Editorial de la Universidad Tecnológica Nacional

Guía de Estudio

INGENIERÍA CIVIL
Inglés I

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con la colaboración de

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AL ESTUDIANTE

El presente material ha sido diseñado por el equipo de cátedra para acompañar tanto el proceso de adquisición de la lengua inglesa como el desarrollo de estrategias de lectura para que puedas comprender material de referencia conectado con tu especialidad. El mismo fue realizado en el año 2010 y se ha ido actualizando año a año de acuerdo con los comentarios y sugerencias de los estudiantes, en especial en relación con las explicaciones y actividades que se ofrecen. Entonces, el presente material no se toma como un producto finalizado que no acepta cambios o reformulaciones, sino como un material en constante proceso de desarrollo, y se espera tu participación activa para que el mismo pueda seguir mejorando con cada año que transcurre, construyendo así una herramienta de trabajo colaborativa entre estudiantes y docentes.

En este cuadernillo encontrarás explicaciones teóricas y guías de ejercitaciones para practicar los contenidos que te llevarán a un dominio intermedio de un texto en la lengua inglesa. Las unidades han sido organizadas en dos secciones. En la parte A de cada unidad encontrarás la introducción a un contenido lingüístico-discursivo en particular a través de un texto genuino relativo a un tema conectado con la ingeniería como por ejemplo "fuentes renovables de energía". En la parte B se practica el contenido presentado en la unidad A por medio de actividades que buscan desarrollar tu nivel de inglés y destreza en la lectura de manera gradual y cíclica. Estas actividades se centran en un texto que se conecta con el texto leído en la unidad A pero que se vuelve más específico a tu carrera.

Si bien las unidades han sido redactadas de manera que puedas trabajar con el cuadernillo independientemente en el hogar de ser necesario, es importante tu asistencia a clase, procurando continuidad y así favorecer el proceso de lectura y de internalización de la lengua. Al escuchar las explicaciones de la docente, participar de las actividades orales que no se encuentran explicitadas en el material, corregir las ejercitaciones, utilizar de manera productiva el diccionario, hacer preguntas, escuchar las preguntas de los compañeros y participar de las discusiones que surgen a partir de los temas planteados, la situación de aprendizaje se convierte en un momento de interacción en el que se van incorporando los contenidos naturalmente, sin mucho esfuerzo.

Este año se continuará trabajando en más material relacionado con las unidades B, el que se encuentra en el espacio para Inglés I en el Campus Virtual. Cada vez que encuentres el logo del campus virtual de la UTN, podrás buscar allí más ejercitación acerca del tema estudiado. Esta incorporación agrega esfuerzos al trabajo realizado por las docentes y los estudiantes SAE que han participado, y siguen haciéndolo, del proyecto "*Desarrollo Colaborativo Docente-Alumno del Campus Virtual de la Cátedra Inglés I e Inglés II de las Carreras Ingeniería Civil, Electrónica y Electromecánica*".

Trabajando colaborativamente, ¡comencemos a leer en inglés!

Mg. Graciela E. Yugdar Tófalo
Prof. Titular Cátedra Inglés
Marzo 2013

TABLA DE CONTENIDOS

Explorando el Material

Para que este cuadernillo pueda resultarte una herramienta de estudio, es importante que conozcas cómo está estructurado y qué tipo de información te brinda. Sigue las instrucciones debajo para poder comenzar a utilizarlo efectivamente.

1- Encuentra la Tabla de Contenidos en el cuadernillo.
2- ¿Cuántas unidades hay?
3- ¿Cómo están divididas las unidades? ¿Cómo se identifican? ¿Qué propósito cumple esta división?
4- Identifica las unidades de revisión y su frecuencia. ¿Cómo están marcadas?
5- Ubica los encabezados y pie de página, ¿qué información encuentras?
6- ¿Contiene cada unidad un tema distinto? ¿Qué relación hay entre los temas de las unidades A y B?
7- Concéntrate en cualquier unidad A, ¿cómo se dispone la información? ¿Qué elemento icónico señala el principio y final de algo? ¿Qué es esto?
8- ¿Qué caracteriza a las unidades B?
9- ¿Qué representan los números en el texto de las páginas 10-12 y los de los textos de las páginas 20-23?
10- ¿Qué encuentras a partir de la página 201? ¿Cómo se usan?

1A Explorando lo conocido: Los tipos de textos. El texto y su paratexto.

Observa los textos y luego responde las preguntas debajo.

a. ¿De dónde han sido extraído estos textos? ¿Cómo lo sabes?
b. Acerca del texto 1, ¿cuál sería tu especialidad si quisieras estudiar en el *Massachusetts Institute of Technology* (MIT)?
c. ¿Qué otras Ingenierías se ofrecen en el MIT?
d. ¿Quiénes están a cargo de las distintas especialidades de ingeniería?
e. Acerca del texto 2: ¿qué tipo de texto es? ¿qué elementos te indican esto?
f. ¿Dónde puedes encontrar una idea general del texto?
g. Acerca del texto 3: ¿Qué tipo de texto es? ¿Cómo se organiza el libro?
h. Acerca del texto 4: ¿Cómo se presenta este texto? ¿Cómo es diferente de los demás? ¿Tienes noción del contenido del mismo?
i. ¿Cuándo fueron extraídos los textos que son de Internet?

Texto 1

Graduate

- Aeronautics and Astronautics
- Biological Engineering
- Chemical Engineering
- Civil and Environmental Engineering
- Computation for Design and Optimization
- Computational and Systems Biology
- Electrical Engineering and Computer Science
- Engineering Systems
- Harvard-MIT Health Sciences and Technology
- Leaders for Global Operations

Civil and Environmental Engineering

Solutions to the major societal problems tackled by civil and environmental engineers often require teams of people with diverse backgrounds to design appropriate solutions. Graduate students and faculty in the Department of Civil and Environmental Engineering have experience in areas as diverse as civil engineering, environmental science, economics, architecture, urban and regional planning, management, electrical engineering, physics, biology, microbiology, chemistry, computer science, geology and oceanography.

Graduate students in the department collaborate with professors and researchers to engage in research projects involving the environment as an integral part of engineering design. We seek to understand natural systems, foster the intelligent use of resources, and design sustainable solutions for energy, transportation, manufacturing, housing, agriculture, water and public health. Students conduct their research in one of the department's many labs or in the field, in areas ranging from geotechnical engineering to hydrology to the mechanics of natural materials at the nano level.

Civil and Environmental Engineering

Department Head: Andrew Whittle
77 Massachusetts Avenue,
Room 1-290
Cambridge, MA 02139
(617) 253-7101

Graduate

- Aeronautics and Astronautics
- Biological Engineering
- Chemical Engineering
- Civil and Environmental Engineering
- Computation for Design and Optimization
- Computational and Systems Biology
- **Electrical Engineering and Computer Science**
- Engineering Systems
- Harvard-MIT Health Sciences and Technology
- Leaders for Global Operations
- Materials Science and Engineering
- Mechanical Engineering
- Nuclear Science and Engineering
- Polymer Science and Technology
- System Design and Management

Electrical Engineering and Computer Science

Graduates of MIT's electrical engineering and computer science department work in diverse industries and conduct research in a broad range of areas. They improve the stability and security of computers and communications networks, and they increase the efficiency of solar panels. They create unique algorithms to analyze financial markets and design robots capable of thinking like human beings. Our community members continually make breakthroughs that enable people to communicate more easily, manage their environments more effectively, and lead more comfortable lives than ever before.

MIT has awarded electrical engineering degrees for nearly 130 years, and our educational programs have been at the cutting edge since their inception. We provide an in-depth education in engineering principles built on mathematics, computation, and the physical and life sciences, and encourage our students to apply what they learn through projects, internships, and research. We succeed in our mission to produce graduates capable of taking leadership positions in the fields of electrical engineering and computer science and beyond.

Nearly 25 percent of MIT's undergraduates are enrolled in the Department of Electrical Engineering and Computer Science, and our graduate programs are world-renowned. Our faculty comprises more than 40 members of the National Academy of Engineering, more than 10 members of the National Academy of Sciences, several members of the Institute of Medicine, several National Medal of Technology winners, as well as many fellows of professional societies, such as the IEEE, ACM, APS, AAAI and others.

Electrical Engineering and Computer Science

Department Head: W. Eric L. Grimson
77 Massachusetts Avenue, Room 38-401
Cambridge, MA 02139
(617) 253-4600

Email | Website

Read the latest EECS newsletter

Recent News

- Reflections on a decade of open sharing: Opening up OpenCourseWare

  MIT will mark the 10-year anniversary of the announcement of OpenCourseWare in April 2011.

Graduate

- Aeronautics and Astronautics
- Biological Engineering
- Chemical Engineering
- Civil and Environmental Engineering
- Computation for Design and Optimization
- Computational and Systems Biology
- Electrical Engineering and Computer Science
- Engineering Systems
- Harvard-MIT Health Sciences and Technology
- Leaders for Global Operations
- Materials Science and Engineering
- **Mechanical Engineering**
- Nuclear Science and Engineering
- Polymer Science and Technology
- System Design and Management

Mechanical Engineering

Mechanical engineering is one of the broadest and most versatile of the engineering professions. This is reflected in the portfolio of current activities in the department, one that has widened rapidly in the past decade. Today, our faculty are involved in projects ranging from the use of nanoengineering to develop thermoelectric energy converters to the use of active control of for efficient combustion; from the design of miniature robots for extraterrestrial exploration to the creation of needle-free drug injectors; from the design of low-cost radio-frequency identification chips to the development of advance numerical simulation techniques; from the development of unmanned underwater vehicles to the invention of cost-effective photovoltaic cells; from the desalination of seawater to the fabrication of 3-D nanostructures out of 2-D substrates.

Graduate Education

MIT's graduate programs in mechanical engineering attract students with a variety of backgrounds, interests, and talents. We provide extensive opportunities for graduate students to engage in advanced research and collaborate with faculty and colleagues. Together, our community members push the boundaries of their professions, and grow profoundly as engineers, researchers, and innovators.

The mechanical engineering department provides opportunities for graduate work leading to the following degrees:

Master of Science in Mechanical Engineering

The SM in mechanical engineering is awarded based on the completion

Mechanical Engineering

Department Head: Mary Boyce
77 Massachusetts Avenue, Room 3-173
Cambridge, MA 02139
(617) 253-2201

Email | Website

Recent News

- Predicting ocean motions and underwater sounds

  MIT research could help ocean science, naval operations and the control and location of underwater vehicles.

- The surprising physics of cats' drinking

Retrieved December 5, 2010 from
http://engineering.mit.edu/education/graduate/cee.php; http://engineering.mit.edu/education/graduate/eecs.php; http://engineering.mit.edu/education/graduate/meche.php

Texto 2

ScienceDaily
Your source for the latest research news

Web address:
http://www.sciencedaily.com/releases/2009/12/091222105441.htm

Bringing Sunlight Inside

Mechanical Engineers Create High-tech Solar Panels

May 1, 2007 — Photovoltaic panels have a new design: concentric circles that focus the sun's rays on miniaturized modules. Having the panels automatically sense sunlight and turn towards it also makes these high-tech solar cells more efficient. Solar energy technology is advancing daily. Now, a new, high-tech system is working to efficiently harness the power of the sun and drastically reduce harmful carbon dioxide emissions.

Today, there are more than 76 million residential buildings and nearly 5 million commercial buildings in the United States. Combined, they use two-thirds of all electricity consumed in the United States and produce 35 percent of all carbon dioxide emissions.

Anna Dyson, an architectural scientist from Rensselaer Polytechnic Institute in Troy, New York, is leading the way to make solar energy a real alternative to pollution-emitting fossil fuels. Her system contains rows of thin lenses that track the sun's movement. Sunlight floods each lens and is focused onto a postage-stamp sized, high-tech solar cell. Dyson says, "Really, what we want to do is be capturing and transferring that energy for usable means."

Conventional solar systems are about 14 percent efficient. This system has a combined heat and power efficiency of nearly 80 percent. "What they're doing is very efficiently capturing and transferring that light into electricity and the solar heat into hot water," Dyson explains. "We basically have a system that can sense where the sun is at any time, and then the modules will basically be facing directly perpendicular to the incoming sun rays," she says. The lenses will be nestled between window panes and all of the pieces will be made of glass.

Michael Jensen, Ph.D., a mechanical engineer from Rensselaer Polytechnic Institute says reducing dependency on fossil fuels is critical. Dr. Jensen explains, "We use fewer fossil fuels, then we are going to put less CO_2 into the atmosphere. We are going to decrease the effects on global warming."

This system will also lower the lighting needs of buildings, as it will provide usable light inside. It could supply as much as 50 percent of the energy needed for a building to operate. The system is set to be installed in the Center for Excellence and Environmental Energy Systems in Syracuse, New York, in 2008, and in the Fashion Institute of Technology in New York City by 2009. Retrieved and adapted January 2, 2010 from http://www.sciencedaily.com/videos/2007/0507-bringing_sunlight_inside.htm

Texto 3

From: Glencoe Program.(2005). *Physics. Principles and Problems*.US: Glencoe/McGraw Hill.

Texto 4

MIT Admissions (video) Retrieved February 9, 2012 from http://mitadmissions.org/index.php/

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

Los textos y los elementos paratextuales

Los textos pueden ser descriptos de distintas maneras, ya sea por la temática que abordan (un texto acerca de microprocesadores, puentes levadizos, los verbos y sus conjugaciones, etc.) por la audiencia a la que están dirigidos (un texto para niños, estudiantes de medicina, abogados, etc.), por su propósito (informar, argumentar, describir, etc.), por la modalidad en la que son transmitidos, es decir, textos orales o escritos y también por su aspecto físico (con títulos, sin gráficos, con letras en cursiva, etc.). Es este último aspecto que se considera de vital importancia para los estudiantes de lenguas extranjeras puesto que el formato de un texto y todos los elementos que lo acompañan (ya sea en una hoja o en un video) actúan como un primer acercamiento al contenido del texto en sí. En el ejemplo del texto 1 de arriba, el hecho de conocer cómo se dispone usualmente la información en una página de Internet de una universidad nos permite saber, en una primera instancia, que se trata de una página de Internet y luego qué tipo de información vamos a encontrar y dónde. Los títulos *Civil and Environmental Engineering, Electrical Engineering and Computer Science y Mechanical Engineering* nos indican que vamos a leer una descripción de cada carrera. Asimismo, nuestro contacto previo con libros nos dice que el texto 3 es una tabla de contenidos. En el caso del video, a pesar de no tener el soporte escrito del texto en sí, las distintas imágenes nos dan un indicio del contenido del mismo.

Este aspecto físico del texto se puede describir en términos de elementos paratextuales (es decir, que acompañan al texto) que se clasifican en verbales e icónicos. Cada texto va a tener elementos particulares, pero en general se pueden mencionar los siguientes:

Paratexto verbal

a- Título
b- Subtítulo
c- Resumen
d- Tabla de contenidos
e- Índice
f- Nombre del autor
g- Sello editorial
h- Año de publicación
i- Encabezado
j- Pie de página
k- Bibliografía
l- Referencias
m- Número de página
n- Enlace

Paratexto icónico

a- Ilustraciones
   1. Gráficos
   2. Cuadros/esquemas
   3. Fotos
   4. Dibujos
b- Tipografía
c- Convenciones de puntuación
d- Subrayado
e- Distribución del Texto

Los elementos detallados arriba junto con el contexto de publicación nos orientan hacia el tipo de texto que estamos leyendo. Es decir, el aspecto general del texto nos dice si estamos frente a un artículo de investigación o de noticias, una propaganda, una entrada de diccionario, un índice de un manual o una tabla de contenidos de un libro de física, por ejemplo.


La primera oración en un párrafo es la que usualmente controla el contenido del mismo.

Una noción básica de cómo se mueve la información en un texto- en especial en los que hay desarrollo temático y no en una tabla de contenidos, por ejemplo- le permite al lector tener un posicionamiento firme frente al texto. Los textos comienzan con una introducción al tema para luego pasar a su desarrollo un poco más detallado y culminar en una conclusión que resume o reflexiona acerca de lo expresado anteriormente. Esta noción simple- que resulta obvia por nuestra experiencia con la lectura en la lengua materna- de cómo se revela progresivamente la información en un texto, parece ser dejada de lado por los estudiantes cuando el texto está en la lengua extranjera. Asimismo, muy pocas veces los estudiantes tienen en cuenta que, por lo general, la primera oración en un párrafo es la que contiene la idea principal en el mismo, la idea que lo controla.

¿En qué ayuda al lector saber cómo se presenta la información en un texto o que los párrafos tienen una idea que funciona como eje regulador del tema discutido en el mismo? Este tipo de conocimiento debe darle al lector, en especial al lector novato en la lengua extranjera, un cierto sentido de tranquilidad al saber que lo que tiene frente a él no es una suma de oraciones en un código que parece cerrado sino una unidad de sentido que tiene como propósito transmitir un significado de manera organizada y coherente, al igual que en la lengua materna. Entonces, saber que un texto tiene una estructura que lo subyace ya nos dice algo del mismo, aunque todavía no sepamos los detalles.

Como se dijo en el párrafo anterior los textos tienen una estructura determinada de acuerdo a la tipología textual a la que pertenecen y tener este tipo de conocimiento nos puede dar pistas de dónde encontrar la información que buscamos. Por ejemplo, en un artículo informativo acerca de los últimos avances en la ciencia, como el texto 2, sabemos que en el primer párrafo encontramos un resumen del tema tratado en el artículo. A partir de allí, los demás párrafos se encargan de expandir el contenido dando detalles que son relevantes para desarrollar la noticia. En un artículo de investigación, cuya extensión puede resultar un aspecto que provoca cierta aprehensión al verlo por primera vez, los contenidos están organizados siguiendo las convenciones del campo disciplinar al que pertenece la investigación que hace que la lectura del mismo sea una tarea mucho más sencilla de lo que parece a simple vista si se tiene conocimiento de esas convenciones. Para ejemplificar, en estos textos, el resumen del trabajo se encuentra en lo que se llama el *abstract* y con leer el mismo el lector puede obtener una idea rápida de su contenido. Las otras partes de un artículo de investigación pueden ser la introducción, el estado del arte, metodología utilizada, instrumentos, resultados, discusión, conclusión y referencias. Entonces, si el lector tiene conocimiento de cómo se estructura una investigación, y sólo tiene interés en saber qué tipo de instrumentos se utilizaron para llevar a cabo el trabajo, el lector sólo leerá el *abstract*, para una idea global del texto, y la sección en la que se describen los instrumentos utilizados. El propósito de lectura y sus conocimientos de la estructura del texto llevarán al lector a encontrar la parte que necesita en el texto sin tener necesidad de leerlo por completo.

En breve, el texto nos proporciona mucha información desde lo físico antes de comenzar a leerlo. Una vista rápida de la disposición de los elementos, el tipo de letra, las fotos y demás paratexto nos permite anticipar el contenido del mismo, activando todo conocimiento previo almacenado en nuestras redes conceptuales. En este cuadernillo, el primer encuentro con el texto siempre va acompañado de actividades que exploran el paratexto como paso preliminar a la lectura en sí puesto que se considera que este momento es clave en el proceso de lectura ya que, a través de las mismas, el lector lo inicia preparado y con herramientas listas para ser utilizadas en la comprensión del texto.

1B Over to your Career Path

Activity 1: Scan the texts. Circle the correct option below.

Text 1

a- This text is a table of contents from a **manual/journal/magazine**.
b- There are **8/10/12** technical papers listed.
c- This journal is published in **Virginia/North Carolina/Texas**.
d- This issue was published in **2008/2009/2010**.
e- This text was downloaded in **2008/2009/2010**.

Text 2

a- This text is a **book review/table of contents/handbook**.
b- This text was extracted from a **magazine/webpage/book**.
c- The book was published in **2008/2009/2010**.
d- The text was downloaded in **2008/2009/2010**.

Text 3

a- This text is an article from a **manual/journal/magazine**.
b- The name of the publication is **Canadian Civil Engineer/Developing Global Engineers.../Engineers without Borders (Canada), Toronto, Ontario**.
c- The iconic paratextual element on page 11 is a(n) **advertisement/a picture illustrating the article/ graph.**
d- The iconic paratextual element on page 12 is a(n) **advertisement/a picture illustrating the article/ graph.**

Activity 2: Complete with information from the texts.

Text 1

a- The acronym ASCE stands for ……
b- The technical paper "Corrosion Rates of Fasteners in Treated Wood Exposed to 100% Relative Humidity" is on page…..
c- The paper "Utilizing Waste Recycled Glass as Sand/Cement Replacement in Concrete" was written by …..
d- The article ……. is on page 805.
e- The journal e-mail address is …..
f- Information about "thermal expansion of aggregates" can be found in the article on page…
g- Information about "recycled glass in concrete" can be found in the article on page…

Text 2

a- The name of the book is …..
b- The authors of this book are …..
c- 978-0-7506-8622-8 is the book's …..
d- The book's publishing house is …..
e- The book includes information about …..

Text 3

a- The acronym EWB stands for….
b- The acronym UBC stands for…
c- The three qualities of engineers without borders are …

d- The three most important elements in the engineering curriculum of engineers without borders are …
e- This project is developed at …… and at……
f- The names of the two classes developed are …….
g- Some examples of projects developed by students at Université Laval are…
h- The class at UBC focuses on…..

Activity 3: True or false?

Text 1

a- "Alternative Apparatus to Evaluate Cavitation Damage" is a technical paper.
b- "Multiscale Prediction of Viscoelastic Properties of Asphalt Concrete" was written by Aigner, Lackner and Pichler.
c- The "2009 Annual Index" was written by Tang, Yen and Chen.

Text 2

a- This webpage has information about different products.
b- The book has a Google Preview link.
c- The book is for students and professionals.
d- The book has information about fire protection to elements of construction.
e- This book is a new edition.

Text 3

a- The project Engineers Without Borders is developed in Canada.
b- The class "COM-21573 Ingénierie, Design et Communication" was redesigned in 2005.
c- The class "APSC 263 Technology and Development" started in 2005.
d- This article was written by Mike Klassen, Justin Wheler, Anna Akkerman, Dr. Annette Brendt, and Nicholas Clermont.

Text 1

ASCE
American Society of Civil Engineers

Publishing Office
Journals Department
ASCE
1801 Alexander Bell Drive
Reston, VA 20191-4400
Telephone: (703) 295-6290
E-mail: journal-services@asce.org

Journal of Materials in Civil Engineering

VOLUME 21 / NUMBER 12 DECEMBER 2009

Technical Papers

Technical Notes

Retrieved January 3, 2010 from
http://ascelibrary.aip.org/getpdf/servlet/GetPDFServlet?filetype=pdf&id=JMCEE7000021000012@webtc.pdf&idtype=tocpdf

Text 2

ELSEVIER

- Home
- Products
- Alerts
- User Resources
- About Us
- Support & Contact
- Elsevier Websites

Search Advanced Product Search

- Products
- Building Construction Handbook
  - Book information
  - Product description
  - Audience
  - Author information and services
  - Ordering information
  - Bibliographic and ordering information
  - Conditions of sale
  - Book-related information
  - Submit your book proposal
  - Other books in same subject area
- Support & contact
- About Elsevier
- User Resources

BUILDING CONSTRUCTION HANDBOOK

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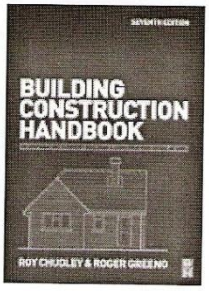
Seventh Edition



By
Roy Chudley, Former Senior Lecturer in Building Technology at the Guildford College of Technology, Surrey, and author of many highly respected construction books.
Roger Greeno, BA(Hons.), FCIOB, FIPHE, FRSA, Formerly Portsmouth University and Guildford College, UK

Description
Building Construction Handbook is an authoritative reference for all students and professionals. It is full of detailed drawings that clearly illustrate the construction of building elements. The principles and processes of construction are explained with the concepts of design included where appropriate. Extensive coverage of building construction practice and techniques, representing both traditional procedures and modern developments, are also included to provide the most comprehensive and easy to understand guide to building construction. The new edition has been reviewed and updated and includes additional material on energy conservation, sustainable construction, environmental and green building issues. Further details of fire protection to elements of construction are provided. Building Construction Handbook is an essential text for undergraduate and vocational students on a wide range of courses including NVQ and BTEC National, through Higher National Certificate and Diploma to Foundation and three-year Degree level. It is also a useful practice reference for building designers, contractors and others engaged in the construction industry.

Audience
Students on vocational courses on Building Services Engineering, Construction and Civil Engineering courses. Built Environment, Construction Management and Civil Engineering undergraduates (and related areas). Professional reference.

Contents
General; Site Works; Builders Plant; Substructure; Superstructure; Internal Construction and Finishes; Domestic Services; Index

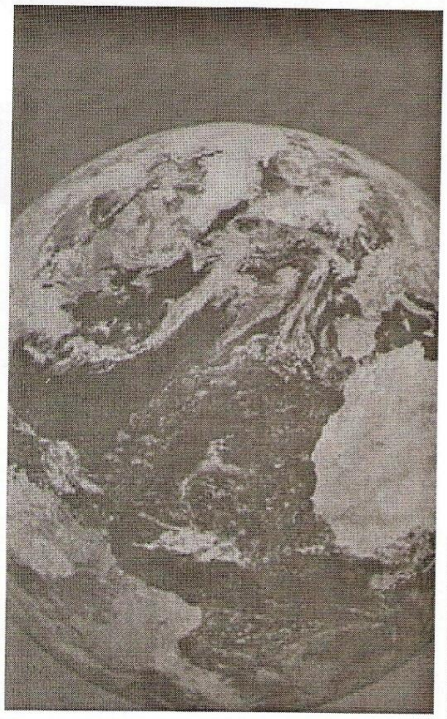
Bibliographic details
Paperback, 776 pages, publication date: MAR-2008 ISBN-13: 978-0-7506-8622-8 Imprint: BUTTERWORTH HEINEMANN

Book contents
- Table of contents

Reviews
- Submit your review

Bookmark this page
Recommend this publication
Overview of all books

Text 3



Developing *Global Engineers*: Incorporating International Development into the Engineering Curriculum

Jonathan M. Fishbein
Engineers Without Borders (Canada), Toronto, Ontario

INTRODUCTION

How can we help to equip young engineers to handle complex global problems? At Engineers Without Borders (EWB), we believe that we can help create more global engineers by incorporating our experiences in international development into the engineering curriculum. We have done this successfully in two different classes, one at the Université de Laval, and the other at UBC. We know that engineers can bring extraordinary change to the world; this is why many of us decided to become engineers in the first place.

The paper first presents our vision for the development of *Global Engineers* at Canadian universities. It then describes two successful courses, giving attention to how we have incorporated our overseas experience in international development with the standard engineering curriculum, and how we have been evaluating these projects.

DEFINING THE *GLOBAL ENGINEER*

The *Global Engineer* is the next generation of engineer that the EWB would like to see graduate from universities across Canada and across the world. These *global engineers* will need to be able to approach global challenges with thoughtfulness, ability and open minds.

We have classified the required qualities into three categories: **knowledge**, **skills** and **attitudes**. Over the past year, EWB has been leading focus group consultations with corporate representatives, engineering students and engineering educators nationally and internationally in helping identify the qualities of *global engineers*. We have grouped and assigned descriptive labels to the emerging themes from each category.

The conference paper provides more detail on each of these, but the overall purpose of the list is to clarify some of the most important characteristics identified by stakeholders in the engineering education community. We found that the different stakeholders share a vision of what it means to be a *global engineer*. More importantly, each of these groups saw a very strong demand for this new type of engineer, given the current state of the world.

INFLUENCING THE CREATION OF *GLOBAL ENGINEERS*

Some of the barriers to developing more global engineers exist prior to engineers' university experiences, such as their stereotypes about other cultures. Some of these pre-existing characteristics can be challenged through the university experience, while others will only be affected by changing the subset of the population that is attracted to the engineering profession in the first place.

EWB has various programs to help shape these pre-existing beliefs, but ultimately believes that the university has a key influence on the way Canadian engineers interact with the world. The profession has had success in tackling complicated technical problems, but non-technical subjects have not received the same degree of formal attention in the engineering curriculum.

Adding a mandatory global issues course to an already over-loaded curriculum is not a solution to promoting the qualities we'd like to see. Also, a *global engineer* must be able to see the links between the non-technical implications within technical problems and solutions. Although specialized curriculum can be created for a separate

engineering discipline that merges technical and non-technical knowledge, this would further emphasize that there are two types of engineers: global and non-global.

Rather than have technical knowledge be the star of the engineering curriculum, we make the key principles of

- poverty reduction,
- sustainability in design, and
- the changing nature of globalization

take centre stage and reinforce them with technical knowledge and examples.

INCORPORATING INTERNATIONAL DEVELOPMENT INTO THE ENGINEERING CURRICULUM

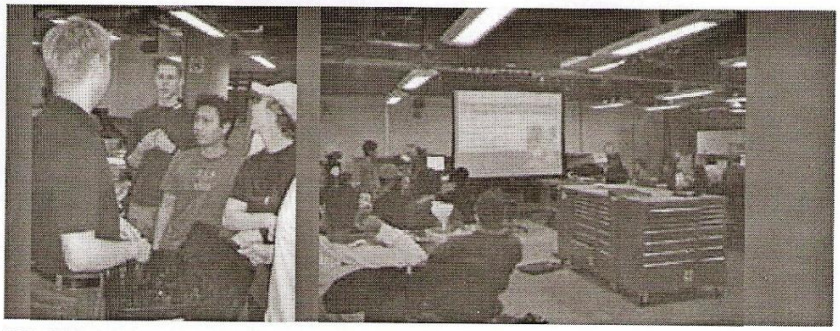
Because there are a lot of unknowns around implementation, EWB has begun testing various curriculum enhancement initiatives throughout the country. We will only learn by doing, and two successful engineering prototype courses are presented here. One of these courses incorporated the curriculum elements through a design project, while the other incorporated the curriculum elements through a more traditional seminar style of teaching.

UNIVERSITÉ LAVAL: COM-21573 INGÉNIERIE, DESIGN ET COMMUNICATION

In 2004, EWB entered into a partnership with the faculty of engineering at Université Laval to help the university redesign one of its first year introductory engineering classes: COM-21573 Ingénierie, Design et Communication. The partnership was a collaboration among EWB's student volunteers at the university, EWB's overseas staff and the faculty. The course was first run in January 2005 and is continuing to be run indefinitely, with an increasing role for EWB each year due to the course's success with students.

The goals of the pre-existing course were to provide a practical experience for students in the class to learn team work, project management, engineering design and communication skills. EWB saw this as an opportunity to incorporate many of the complex international development challenges that we face. In consultation with faculty, EWB redesigned the course project to give students a taste of the role of engineers in international development. Students explore real-world or slightly modified challenges faced by EWB's overseas staff on the ground in developing countries. Examples of some of the project themes examined by student groups are

- **Rain Water Capture**—converting rain water into a useful water source with locally available materials and knowledge for a developing community in India that experiences heavy, seasonal monsoons,
- **Water Filtration System**—cleaning a potentially hazardous water source using locally available materials and knowledge for a developing community in Mali, and
- **Locally Appropriate Shelter**—creating appropriate shelter using locally available materials and knowledge for a developing community in Zambia.



LEFT Students are becoming increasingly more excited at the potential positive global impact they can have by taking a more global approach to engineering.
RIGHT Future Global Engineers must learn about the complex effects that different cultures and economic situations have on their role.

The project groups begin by learning about the country's history, political situation, economy, and culture. They then write a project proposal for the community incorporating the background information of the community. The course staff (EWB volunteers or trained by EWB) challenge the student groups to identify the root causes of the issues presented in the project and to explore the potential implications of their solutions on the complex systems within the community.

The evaluation places a heavy weighting on the process that the student groups take to learning and identifying the impacts of the potential solution for their assigned community. Do the solutions

- use locally available materials?
- use locally available knowledge ?
- take into account social systems in the community?
- follow an appropriate engineering design process?

The resulting projects are of a very high quality, both in terms of the technical requirements of the engineering faculty and in the *global engineer* requirements. This success has allowed the further development of this partnership, with EWB becoming increasingly more involved in this course and other courses at Laval. Before the inclusion of the EWB project component in the course, student satisfaction with the course remained static. However, with the inclusion of the EWB project, student satisfaction has increased, and as EWB's involvement has increased, so has student satisfaction.

UNIVERSITY OF BRITISH COLUMBIA: APSC 263 TECHNOLOGY AND DEVELOPMENT

At UBC, EWB and the faculty of engineering established a new engineering class, *Technology and Development*. The partnership was a collaboration among EWB's student volunteers at the university, EWB's staff and the faculty. The course was first run in January 2005 and is continuing indefinitely.

The course was originally initiated as a student directed seminar. In these types of seminars, students, with a faculty member, develop a course and offer it to other students. In this case, the student who initiated the process brought in EWB staff to help develop the course.

The goals of the course were to expose engineering students to the complex and subtle issues surrounding international development. Although the focus of the course is placed on technological solutions, the course stresses that inappropriate

implementation will often undermine a project before technological failure occurs.

The course has consistently been met with an overwhelming response. The class usually fills up in less than 24 hours from the time the course is opened for registration. There has traditionally been 4 times the demand than the capacity of the course can allow. This year, the course was opened up to a small number of arts students. They provided other viewpoints, allowing for a deeper investigation into the topics of the course.

The course focuses on:

1) Water,
2) Food,
3) Energy,
4) Information and Communication Technology, and
5) Health.

For the first three weeks trained EWB members cover topics such as the World Bank, the United Nations, and general information on international development. The students lead the remainder of the course, with material based on the topics listed above. Some students create participatory games, while others use power point or video. A group project presented at the end of term explores the implementation approaches and challenges of specific technologies in the context of developing communities. From time to time, guest lecturers are invited to come and present to the class. These guest speakers tend to show the students the practical implications of the course material.

From a pedagogical standpoint, the success of the class is measured by the change in students' approach and attitudes towards international development and appropriate technology. At the start of the course, students are asked to complete a basic case study on the needs of a developing community and to suggest possible interventions in the community.

This same case study is revisited at the end of the course in order to gauge how students' attitudes and approaches have shifted through the course. The contrast in answers is always striking, with the same students giving completely different answers, reflecting how the course material has changed their views about development. For example, one student went from suggesting building a western-style power plant in a rural village needing electricity, to suggesting a far more modest run of the river mechanical hydro turbine, or a bicycle powered generator. Overall, APSC 263 is a remarkable success and the students in the class have flourished.

CONCLUSIONS

EWB's experience working to implement specific courses at universities across the country has shown us that it is possible to successfully integrate international development content within existing engineering classes. Most importantly, these curriculum initiatives led by EWB meet the demands of both the engineering faculty and the interest of today's engineering students.

EWB is currently in the process of uniting a community of interested faculty as a national community of practice to help explore many of the issues associated with EWB's vision for engineering education and to advise EWB on how to achieve this vision for engineering education. EWB hopes that we can continue to engage in a dialogue with universities moving forward on how to share our experiences and lessons learned in our curriculum work to have Canada become the leader in developing *global engineers*.

ACKNOWLEDGEMENTS

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2A Explorando lo conocido: Leer, traducir y comprender. Conocimientos previos. Estrategias para la comprensión lectora. Los cognados.

Lee el siguiente texto y contesta las preguntas de tu profesora.

Para la correcta utilización de este producto, siga las instrucciones cuidadosamente.
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Leer, comprender y traducir

Leer y comprender son dos palabras que hacen referencia al acto de lectura pero que no significan exactamente lo mismo. Como el ejemplo del texto de arriba lo demuestra, la lectura –en nuestra lengua materna- no nos llevó inmediatamente a la comprensión de su contenido. En otras palabras, se puede leer sin entender lo que nos dice el texto. Esto puede ocurrir por diversas razones: falta de comprensión de la terminología utilizada, falta de conocimientos previos acerca del tema desarrollado o falta de estrategias de lectura utilizadas por los buenos lectores, como ser la activación de conocimientos previos antes de comenzar con la lectura, entre otros. En el caso de arriba, si bien se trata de la elaboración de hielo en una cubetera, al no contar con la presencia de dibujos, fotos o un título más específico que nos establezca el tema del texto – elementos para-textuales que ayudan a activar conocimientos previos y ubicar el tema en nuestras redes conceptuales mentales- la *comprensión* de la explicación de un hecho de la vida cotidiana se dificulta a pesar de *leerlo* de manera fluida. Como es de esperar, el objetivo último de la clase de Inglés I es la comprensión de un texto y no sólo su lectura.

Otra distinción a tener en cuenta es que la comprensión de un texto en lengua extranjera no equivale a la traducción del mismo. Si bien habrá momentos en el que la traducción palabra por palabra es de suma relevancia, éste no es el fin último de la clase. La traducción se utiliza como una herramienta más para el acercamiento del lector con pocos conocimientos en inglés al texto. La lectura guiada, a través de actividades que orientan al lector novato en lengua extranjera y le proveen una metodología de abordaje del texto que puede ser aplicada sistemáticamente hasta ser internalizada, busca propiciar una interacción entre el texto y el estudiante para que este último pueda apropiarse de los contenidos del mismo sin sentir la necesidad de tener que hacer una traducción del texto para poder responder una pregunta.

Estrategias para facilitar la comprensión de un texto en idioma extranjero

Cuando leemos es importante hacer uso de estrategias que nos ayuden a darle significado al texto, en especial cuando se trata en una lengua extranjera. Entre estas estrategias, la activación de conocimientos previos se presenta como un primer paso hacia la comprensión del contenido del texto ya que a través de la misma se puede traer al acto de lectura un bagaje de elementos lingüísticos y no lingüísticos que han sido adquiridos y almacenados con anterioridad. Esta estrategia nos permite elaborar hipótesis acerca del texto, que son confirmadas o rechazadas a medida que la lectura avanza. Del mismo modo, estos conocimientos previos guiarán nuestra lectura hacia un propósito o meta de lectura en particular. Por ejemplo, si leemos un texto acerca de seguridad en superestructuras de altura, seguro se nos viene a la mente el incidente de las Torres Gemelas de Nueva York. Este hecho nos hace preguntar, ¿hay novedades en cuanto a la resistencia de estructuras metálicas?¿se podría haber evitado la catástrofe?¿fue realmente un caso de una estructura que falló? y seguramente buscaremos las respuestas en el texto, las cuales pueden estar presentes o no. Por lo general, esta estrategia se pone en práctica mediante la atención a los elementos paratextuales estudiados en la sección anterior.

La activación de conocimientos previos es una estrategia que se desarrolla antes de la lectura del texto a ser abordado. Otras estrategias utilizadas en este momento del proceso son:

- Identificación de información específica (*scanning*)
- Sobrevolado del texto (*skimming*)

Asimismo, hay estrategias que se utilizan durante la lectura y otras al terminar la misma. Estos dos grupos de estrategias se detallan a continuación:

Estrategias utilizadas por el lector durante la lectura para facilitar la comprensión:

- Identificación de cognados
- Omisión de palabra desconocida
- Identificación de palabras claves
- Determinación del significado de palabras claves desconocidas (por el contexto de la misma o por su morfología)
- Búsqueda de ideas principales (habiendo identificado el tipo de texto, el lector recurre a las partes en donde usualmente aparece la información deseada. Por ejemplo, en un artículo de investigación un resumen del trabajo aparece en el *abstract*, como dijimos en la unidad 1A)
- Supervisión de la comprensión (el lector identifica las causas de su falta de comprensión y utiliza estrategias de reparación)
- Formulación de preguntas
- Confirmación o rechazo de hipótesis
- Anotaciones al margen

Estrategias post-lectura:

- Elaboración de resúmenes
- Elaboración de cuadros sinópticos y mapas conceptuales
- Integración de información previa + conceptos nuevos

Si bien las estrategias han sido agrupadas de acuerdo con el momento en el proceso de lectura, el lector hace utilización de las mismas en distintos puntos para agilizar la comprensión. Es decir, el lector puede recurrir a la técnica de *scanning* ya sea al comienzo para buscar palabras que le indique de qué se trata la lectura; durante la lectura, para buscar datos que lo ayuden a corroborar si está haciendo una interpretación correcta; y después de la lectura, para buscar información que necesita para la elaboración de un cuadro sinóptico.

Responde las siguientes preguntas acerca de los textos a continuación.

a- ¿De dónde proviene el texto?
b- ¿Qué sabes acerca de "Research Eu"?¿Qué se puede deducir del texto?
c- ¿En qué parte de la revista estamos? ¿Qué ofrece esta sección?
d- Ubica los siguientes subtítulos en la sección de la revista que corresponde de acuerdo con la temática de los artículos:
    1. Events
    2. Energy and Transport
    3. Environment
    4. Industrial Technologies
    5. Biology and Medicine
    6. IT and Telecommunications
e- Imagina que estás haciendo un trabajo sobre proyectos de investigación para una materia de tu carrera, a qué parte recurrirías? Es decir, ¿cuáles son los artículos relacionados con tu carrera?
f- ¿Cómo has buscado la información que se pedía en a-e? ¿Realizaste una lectura lenta, palabra por palabra o sobrevolaste el texto? ¿Cuáles de las estrategias listadas arriba utilizaste?

La revista *Research Eu* se encuentra disponible en la biblioteca de la UTN FRP.

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RESULTS SUPPLEMENT

Special feature

Education, training, 'edutainment': access for the new model society
Interview with Georg Thallinger of Salero

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Frequent acronyms

ERA	European research area	ICT	information and communication technologies
FP5/6/7	Fifth/Sixth/Seventh Framework Programme of the European Community for research, technological development and demonstration activities	IST	information society technologies
		R & D	research and development
		SMEs	small and medium-sized enterprises

Los cognados

Los *cognados* o *palabras transparentes* son palabras que se escriben de manera similar y que tienen significado igual o muy parecido en dos idiomas. Para el lector de lengua extranjera, los cognados son las pistas más directas hacia el contenido del texto que le permiten dar cuenta de lo que se está discutiendo aún cuando el estudiante posee pocos conocimientos de la lengua. Dada la naturaleza del corpus lingüístico del inglés, que posee muchos elementos del latín, hay un sinnúmero de palabras que resultan conocidas en especial en el campo científico-académico. Si bien la mayoría de las palabras que identificamos como palabras transparentes tienen un significado igual o parecido a la palabra en castellano, puede ocurrir que estemos ante un *falso cognado* o *falso amigo* (Ver APÉNDICE 1). Si esto sucede, el lector de lengua extranjera al darse cuenta que no puede darle sentido a lo leído volverá a asignarle significado a la palabra a través de la búsqueda de la misma en el diccionario. Entonces, los cognados son palabras que resultan de gran ayuda para la comprensión de un texto siempre que tengamos en cuenta que existe la posibilidad de que su significado no sea compartido en las dos lenguas que tenemos como referencia.

Para repasar:

Lee rápidamente el artículo que está más relacionado con tu carrera y, mientras lo haces, marca las palabras que te resultan familiares por su similitud con las del castellano. ¿Encuentras falsos cognados? Resuélvelo con la ayuda de tu profesora.

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

a transponder that aircraft use for anti-collision systems which may not always be fully operational.

For larger airports, an improvement in technology would boost efficiency. The new detector can be combined with other data like flight and radar in sophisticated systems such as the 'Advanced surface movement guidance and control systems' (A-SMGCS).

The EU-funded project Ismael ([1]) investigated whether improvements in magnetic sensor technology would fit the bill to provide better surface movement surveillance at airports. The aim was to not only provide appropriate hardware for laboratory and field trials but also to develop software to trace the exact direction, identity and velocity of objects on the runway.

The ingenious detector operates by sensing the ferromagnetic parts of cars and aircraft, motors, engines or gears and can therefore distinguish between them. As the information is based on interaction between the Earth's magnetic field, a single or an array of detectors can be put into action.

The system's technological superiority is in no doubt. As magnetic sensors are used, they are not influenced by weather, temperature or light. It is cost-effective with low power consumption, no radiation output and importantly, has no effect on airport communication.

To test the real-life effectiveness, the system was tested at a provincial airport in Thessaloniki, Greece and the major international airport Frankfurt. In Germany, the A-SMGCS was tested for how it coped with runway incursions and gate management, notoriously complex issues.

Ismael has made a significant contribution to overcome operational limits at small airports by improving safety and therefore capacity. Passengers flying out of major airports will not have a stressful start and finish to their holiday or business trip.

(1) 'Intelligent surveillance and management functions for airfield applications based on low cost magnetic field detectors'.

Funded under the FP6 programme IST (Information society technologies).

Collaboration sought: further research or development support.

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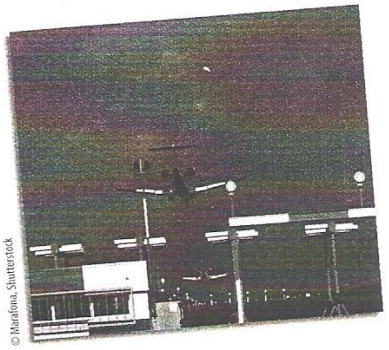

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New multifunctional layer for aircraft structures

New composite structures that are stronger, safer, and more cost-effective are being developed by European researchers for the aircraft industry.

Over the past 35 years the use of composite materials in aeronautics has increased, reflecting their versatility and strength. However, the organic basis of the matrix means that composite materials are poor conductors of electricity and heat, and can emit toxic fumes when burnt.

Researchers from the 'Multifunctional layers for safer aircraft composites structures' (LAYSA) project are investigating the scientific and technological basis of a new multifunctional layer for improved aircraft composite structures. The multifunctional layer needs to include an ice/fire protection and health monitoring capacity integrated into the structure. Project partners are working on new layer types based on commercial nano-materials.

A nano-composite that can conduct heat and electricity, resist fire and possess a sensing capability are now being developed. These three functions were initially studied separately to focus on pre-treatment and the dispersion of the nano-material into the resin in order to achieve the desired function. The developed nano-composite can now be integrated into the traditional composite manufacturing process.

Improvements resulting from the LAYSA project include simplification of manufacturing processes and maintenance operations resulting in time and cost savings. Temperature sensors are not needed because of the self-sensing ability of the layer. The elimination of heavy heating elements results in important weight reduction and therefore fuel savings. A reduction in fuel use will result in fewer emissions from aircraft, thereby reducing their impact on the environment.

The LAYSA project will help to produce cheaper multifunctional layers for safer aircraft composite structures, thereby helping to make the European aircraft industry more competitive. Furthermore, a reduction in fuel use will result in fewer emissions from aircraft, reducing their impact on the environment and helping the air travel industry to become more sustainable.

These barriers are exacerbated by legal hindrances, such as outdated intergovernmental agreements on management of international rail traffic. In addition, market barriers are produced by inconsistent infrastructure changes or the lack of willingness to invest in its upgrading.

There are however clear signs of progress. Effective competition has emerged on the international freight corridors stretching from Scandinavia to Greece. Competition in this railway pipeline has encouraged innovation of undertakings and operational efficiency to reach business objectives.

It appears likely that the efficiency and quality of service of rail freight will improve over the coming years under the impact of greater competition. More importantly, it is possible that the scene has been set for very major changes over the next few years.

Funded under the FP7 specific programme Cooperation under the theme Transport.

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of results. At the theoretical level, the team was able to put actual numbers on the capacity that can be expected from short broadband copper loops, for both single-line and vectored transmission. This is the first time that the capacity of very short-twisted copper channels has been assessed based on measured data. Furthermore, the team was able to prove that downstream rates of 200 Mbps per pair are achievable on a coordinated binder up to a distance of 250 metres.

At the practical level, the prototype transceiver they developed is capable of up to 100 Mbps at a distance of up to one kilometre. Novel noise cancellation and vectoring techniques for single carrier modulation were established and tested, along with advanced coding — including space-time codes over copper. Advanced spectrum management techniques for dynamic bandwidth allocation to the different users supporting high throughput and quality of service constraints were also developed.

The U-broad project represents a significant step forward in enabling existing lines of communication to deliver the internet services of the future.

(1) 'Ultra high bit rate over copper technologies for broadband multi-service access'.

Funded under the FP6 programme IST (Information society technologies).

Collaboration sought: further research or development support.

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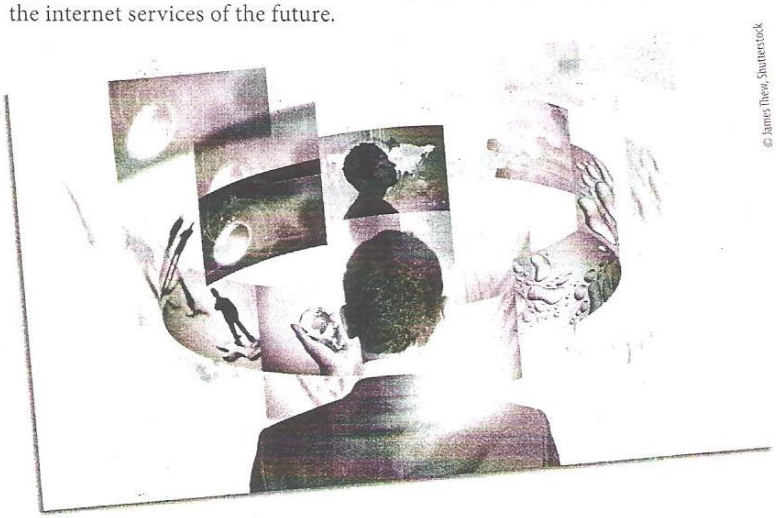

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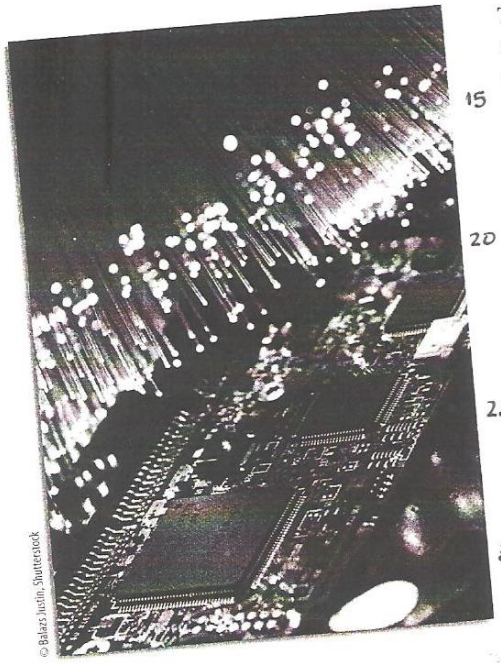
All-optical computing on its way?

Cutting-edge optical computers may one day replace the electronic computer technology of today. As a first stage, optical technology may blend with today's systems.

Computers have come a long way in the past decade, and the way digital computations are performed may also be changing as technology progresses.

Optical computer systems, for example, use photons of visual light or infrared beams instead of traditional electrons used in most computers today.



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There have already been solid efforts to develop optical components that can replace traditional components in creating a hybrid optical/electronic system. Ideally, a completely optical system, known as all-optical computing, would be a much more efficient solution and the epitome of advancement in this field.

The EU-funded 'Multi-functional integrated arrays of interferometric switched' (Mufins) project combined eight European research groups to create optical switching systems — or all-optical gates — for this purpose.

The project involved a variety of tests to develop optical technology matching different applications. Indeed, Mufins ensured that the developed multi-gate elements will have an adequate market to support high-tech applications in products upon completion of the project. This was made possible thanks to the several different types of devices and chips that were developed.

These advances have made the dream of all-optical processing much more tangible than before. They have also offered improvements to existing specialised applications in high data-rate telecommunications and networking, particularly those that can benefit from high-speed, low-complexity all-optical circuits.

In short, Mufins is a robust demonstration of how Europe is rethinking computers and how digital technology can become much more efficient. One day, all our computers may feature this novel technology.

Funded under the FP6 programme IST (Information society technologies).

Collaboration sought: further research or development support.

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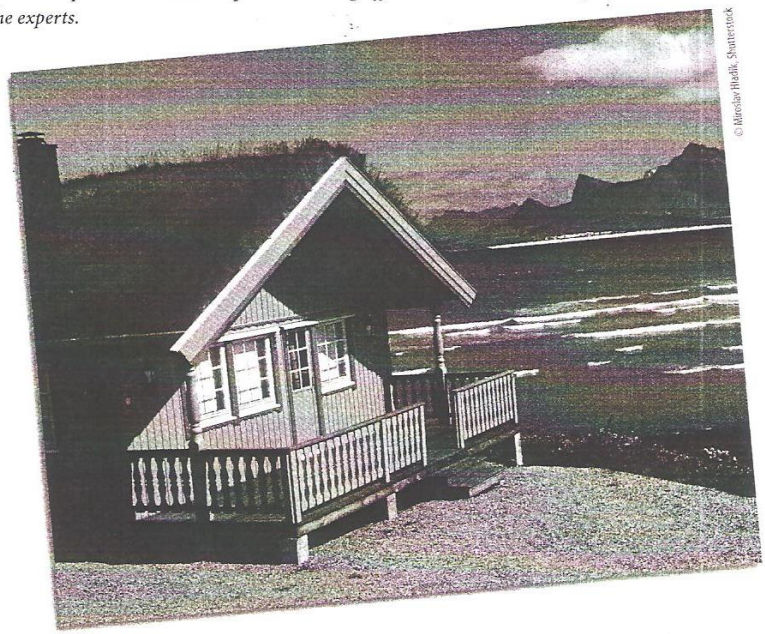
Comfortable homes with near-zero energy costs

The cold air that enters through cracks in walls or underneath doors drives up utility costs. Coupled with the lack of high-quality insulation and energy-efficient windows, people's homes can become expensive to heat. But 'passive housing' offers a much-needed solution, say the experts.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For the past decade, architects, designers, and engineers have been working on how to best minimise energy use in the home and drive down costs. The European Commission is also promoting energy performance of buildings by encouraging Member States to endorse national plans and targets of very low and close to zero energy buildings by 2020. This includes heating water, air conditioning, as well as the everyday consumption of electricity.

But the implications of new sustainable technologies in passive housing are not entirely understood. Are people aware of passive housing and how can they benefit from existing technologies? The EU-funded 'Create acceptance' (1) project, for instance, attempted to answer those questions. They developed a tool that measures, promotes and improves the social acceptance of these technologies. Another EU-funded project, 'Changing behavoir' (2), also created a toolkit that looks at how people use energy. Results will help determine how Europe can best suit the energy needs of its citizens.

Typically, an averaged-sized one-family house will spend almost EUR 240 000 over a 40-year period to heat their home, provided that heating costs do not exceed 5 %. Only around 12 000 homes in Europe — mostly located in Germany, Austria and Scandinavia — were reported in 2009 as 'passive'. But the number of passive houses and buildings throughout the EU has since more than doubled.

Passive housing is sometimes described as obtaining the minimum performance requirements of all types of energy in a house or an apartment. Thermal comfort in one's home without the use of a conventional heating system can be achieved by using novel passive housing technologies and deceptively simple strategies. For instance, a house can have passive credentials just by designing and building it to maximise how much sunlight enters through windows, keeping homes warmer in winter and cooler in summer.

Numerous other EU-funded projects are also working on driving down energy-associated costs in homes and buildings. These projects are working towards making future energy more decentralised, renewable, efficient, technologically varied and intelligent. Researchers at the 'Green solar cities' (3) project, for instance, are developing solar thermal collectors on rooftops. They are also experimenting with using biomass to help offset conventional heating methods. And the EU-backed FENIX (4) project worked out a method to boost distributed energy resources by maximising their contribution to the electric power system. These initiatives not only help reduce energy consumption — some actually make houses and buildings net contributors to the energy grid.

Passive housing continues to excite and is gaining a foothold among small- and medium-sized enterprises and large industry alike. In Germany, trade fairs like the Clean Energy and Passive House (CEP) in Stuttgart have been bringing together interested parties for the past four years. The next CEP is scheduled to run from 10 to 12 February 2011 and includes exhibitions, presentations by industry, and guided tours.

For more information on the CEP event, please visit:
www.cep-expo.de/messe+M52087573ab0.html

(1) 'Cultural influences on renewable energy acceptance and tools for the development of communication strategies to promote acceptance among key actor groups'.
Funded under the FP6 programme Sustdev (Sustainable development, global change and ecosystems).

(2) 'Contextualising behavioural change in energy programmes involving intermediaries and policymaking organizations working towards changing behaviour'.
Funded under the FP7 specific programme Cooperation under the theme Energy.

(3) 'Global renewable energy and environmental neighbourhoods as solar cities'.
Funded under the FP6 programme Sustdev (Sustainable development, global change and ecosystems).

(4) 'Flexible electricity networks to integrate the expected "energy evolution"'.
Funded under the FP6 programme Sustdev (Sustainable development, global change and ecosystems).

2B Over to your Career Path

Activity 1: Scan the text and complete with information from it.

a- This text gives information about……
b- This text describes …… areas of civil engineering.
c- This text was written by……
d- Civil engineers …… a variety of structures from bridges to energy-efficient buildings.
e- Civil engineers solve problems connected with…….

Activity 2: Match the headings to the paragraphs. Underline *cognates* in the paragraphs.

a- Environmental Engineering
b- Water Resources Engineering
c- Structural Engineering
d- Transportation Engineering
e- Geotechnical Engineering
f- Urban & Community Planning
g- Construction Engineering

Activity 3: Circle the word that is NOT a cognate in the context.

a.
1. quality (line 1)
2. facilities (line 2)
3. efficient (line 4)

b.
1. major (line 11)
2. areas (line 11)
3. civil (line 11)

c.
1. community (line 40)
2. materials (line 41)
3. mass (line 43)

Activity 4: Find in the text:

a- Types of projects conducted by Structural Engineers: …….
b- Problems solved by Environmental Engineers: ……
c- Activities conducted by Geotechnical Engineers: ……
d- Problems solved by Water-Resources Engineers: ……
e- Transportation projects conducted by Transportation Engineers: ……
f- Skills used by Construction Engineers: …….
g- Types of projects conducted by Urban & Community Planning Engineers: ……

Civil Engineering
Building the Future

Civil engineers have one of the world's most important jobs: they build our quality of life. With creativity and technical skill, civil engineers plan, design, construct and operate the facilities essential to modern life, ranging from bridges and highway systems to water treatment plants and energy-efficient buildings. Civil engineers are problem solvers, meeting the challenges of pollution, traffic congestion, drinking water and energy needs, urban redevelopment and community planning.

As the technological revolution expands, as the world's population increases, and as environmental concerns mount, civil engineering skills will be needed throughout the world. Whatever area you choose, be it design, construction, research, planning, teaching or management, civil engineering offers you a wide range of career choices. And there is no limit to the personal satisfaction you will feel from helping to make our world a better place to live.

There are seven major, interrelated areas of civil engineering:

1_____

These engineers face the challenge of designing structures that support their own weight and the loads they carry, and that resist extreme forces from wind, earthquakes, bombings, temperature and others. Bridges, buildings, amusement park rides and many other kinds of projects are included within this speciality. Structural engineers develop appropriate combinations of steel, concrete, timber, plastic and new exotic materials. They also plan and design, and visit project sites to make sure work is done properly.

2_____

The skills of these engineers have become increasingly important as we protect our fragile resources. Environmental engineers translate physical, chemical and biological processes into systems to destroy toxic substances, remove pollutants from water, reduce nonhazardous solid waste volumes, eliminate contaminants from the air and develop groundwater supplies. Environmental engineers are called upon to resolve the problems of providing safe drinking water, cleaning up contaminated sites with hazardous materials, disposing of wastewater and managing solid wastes.

3_____

This area of engineering is required in all aspects of civil engineering because most projects are supported by the ground. Engineers in this speciality may develop projects below the ground, such as tunnels, foundations and offshore platforms. They analyze the properties of soil and rock that support and affect the behavior of these structures. They evaluate potential settlements of buildings, the stability of slopes and fills, the seepage of ground water and the effects of earthquakes. They investigate rocks and soils at a project site and determine the best way to support a structure in the ground. They also take part in the design and construction of dams, embankments and retaining walls.

4_____

Water is essential to our lives, and water resources engineers deal with the physical control of water. They work with others to prevent floods, supply water for cities, industry and agriculture, to protect beaches or to manage and redirect rivers. They design, construct and maintain hydroelectric power facilities, canals, dams, pipelines, pumping stations, locks, seaport facilities or even waterslides.

5_____

The quality of a community is directly related to the quality of its transportation system. Transportation engineers work to move people, goods and materials safely and efficiently. They find ways to meet our ever-increasing travel needs on land, air and sea. They design, construct and maintain all types of transportation facilities, including airports, highways, railroads, mass transit systems and ports. An important part of transportation engineering is upgrading our transportation capability by improving traffic control and mass transit systems, and by introducing highspeed trains, people movers and other intermodal transportation methods.

6_____

The construction phase of a project represents the first tangible result of a design. Using technical and management skills, construction engineers turn designs into reality on time and within budget. They apply their knowledge of construction methods and equipment, along with the principles of financing, planning and managing, to turn the designs of other engineers into successful facilities.

7_____

Planners are concerned with the full development of a community. They analyze a variety of information to co-ordinate projects, such as projecting street patterns, identifying park and recreation areas, and determining areas for industrial and residential growth. They employ their technical and people skills to co-ordinate with other authorities to integrate freeways, airports and other related facilities.

Resources for Students

The American Society of Civil Engineers (ASCE), headquartered in Reston, Virginia, is a professional society for 123,000 civil engineers worldwide, with several programs to encourage and support civil engineering students. The Society publishes a booklet on civil engineering careers, and has active student chapters at more than 225 colleges and universities throughout the U.S. For more information on civil engineering careers or college engineering programs, contact the Educational Activities Division of ASCE at 703/295-6000.

James E. Davis
Executive Director and CEO
American Society of Civil Engineers

Retrieved and adapted January 11, 2010 from http://www.studyoverseas.com/engineering/articles/enciv.htm#topmerican Society of Civil Engineers

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

3A Identificando segmentos significativos en el texto: La frase nominal simple

Lee rápidamente el texto a continuación y realiza las siguientes consignas:

a- Identifica el tema del texto.
b- Ubica los títulos *Composites, Polymers, Ceramics y Metals* en el cuadro de la primera página del texto.
c- Une la foto con el título de cada sección.
d- Subraya la definición de cada material y ubícala en el cuadro debajo.
e- Marca con un círculo en el texto las propiedades de los materiales y transcríbelas en el cuadro.

Type of material	Definition	Properties
Metals		
Ceramics		
Polymers		
Composites		

f- Clasifica las siguientes frases en los grupos debajo de acuerdo con el material que describen:

Two industrially important polymeric materials
Thermosetting polymers
Many types of plastics
A number of specialized engineering plastics

High electrical and thermal conductivity
The highest temperature applications
High melting points
Toughness

A mixture of Portland cement and aggregate
Dispersion strengthened composites
A combination of two or more distinct materials
Many metal-matrix composites

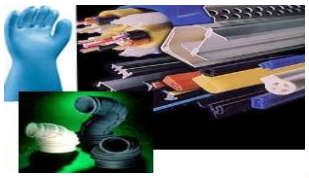
An inorganic, nonmetallic solid
Electrically conductive materials
Advanced ceramics
Low electrical conductivity

General Material Classifications

There are thousands of materials available for use in engineering applications. Most materials fall into one of three classes that are based on the atomic bonding forces of a particular material. These three classifications are metallic, ceramic and polymeric. Additionally, different materials can be combined to create a composite material. Within each of these classifications, materials are often further organized into groups based on their chemical composition or certain physical or mechanical properties. Composite materials are often grouped by the types of materials combined or the way the materials are arranged together. Below is a list of some of the common classification of materials within these four general groups of materials.

• Ferrous metals and alloys (irons, carbon steels, alloy steels, stainless steels, tool and die steels) • Nonferrous metals and alloys (aluminum, copper, magnesium, nickel, titanium, precious metals, refractory metals, superalloys)	• Thermoplastics plastics • Thermoset plastics • Elastomers
• Glasses • Glass ceramics • Graphite • Diamond	• Reinforced plastics • Metal-matrix composites • Ceramic-matrix composites • Sandwich structures • Concrete

Composites
Polymers
Ceramics
Metals



Metals: A metal is a substance with high electrical conductivity and malleability. Metals account for about two thirds of all the elements and for the 24% of the Earth's mass. Metals have useful properties including strength, ductility, high melting points, thermal and electrical conductivity, and toughness. Examples of common metallic materials:

- Iron/Steel - Steel alloys are used for critical strength applications
- Aluminum - Aluminum and its alloys are used because they are easy to form, readily available, inexpensive, and recyclable.
- Copper - Copper and copper alloys have a number of properties that make them useful, including high electrical and thermal conductivity, high ductility, and good corrosion resistance.
- Titanium - Titanium alloys are used for strength in higher temperature (~1000° F) applications, when component weight is a concern, or when good corrosion resistance is required
- Nickel - Nickel alloys are used for still higher temperatures (~1500-2000° F) applications or when good corrosion resistance is required.
- Refractory materials are used for the highest temperature (> 2000° F) applications.

Ceramics: A ceramic is defined as "an inorganic, nonmetallic solid that is prepared from powdered materials, is fabricated into products through the application of heat, and displays such characteristic properties as hardness, strength, low electrical conductivity, and brittleness." They are typically crystalline in nature and are compounds formed between metallic and nonmetallic elements such as aluminum and oxygen (alumina-Al_2O_3), calcium and oxygen (calcia - CaO), and silicon and nitrogen (silicon nitride-Si_3N_4).

Depending on their method of formation, ceramics can be dense or lightweight. Typically, they demonstrate excellent strength and hardness properties; however, they are often brittle in nature. Ceramics can also be formed to serve as electrically conductive materials or insulators. Some ceramics, like superconductors, also display magnetic properties. They are also more resistant to high temperatures and harsh environments than metals and polymers.

The broad categories that make up the ceramic industry can be classified as:

- Structural clay products (brick, sewer pipe, roofing and wall tile, flue linings, etc.)
- Whitewares (dinnerware, floor and wall tile, electrical porcelain, etc.)
- Refractories (brick and monolithic products used in metal, glass, cements, ceramics, energy conversion, petroleum, and chemicals industries)
- Glasses (flat glass (windows), container glass (bottles), pressed and blown glass (dinnerware), glass fibers (home insulation), and advanced/specialty glass (optical fibers)
- Abrasives (natural (garnet, diamond, etc.) and synthetic (silicon carbide, diamond, fused alumina, etc.) abrasives are used for grinding, cutting, polishing, lapping, or pressure blasting of materials)
- Cements (for roads, bridges, buildings, dams, and etc.)
- Advanced ceramics
    - Structural (wear parts, bioceramics, cutting tools, and engine components)
    - Electrical (capacitors, insulators, substrates, integrated circuit packages, piezoelectrics, magnets and superconductors)
    - Coatings (engine components, cutting tools, and industrial wear parts)
    - Chemical and environmental (filters, membranes, catalysts, and catalyst supports)

Polymers: A polymeric solid is a material that contains many chemically bonded parts or units which themselves are bonded together to form a solid. The word polymer means "many parts." Two industrially important polymeric materials are plastics and elastomers. Plastics are a large and varied group of synthetic materials which are processed by forming or molding into shape. There are many types of plastics, such as polyethylene and nylon. Elastomers or rubbers can be elastically deformed a large amount when a force is applied to them and can return to their original shape (or almost) when the force is released.

Polymers have many properties that make them attractive to use in certain conditions. Many polymers:

- are less dense than metals or ceramics,
- resist atmospheric and other forms of corrosion,
- offer good compatibility with human tissue, or
- exhibit excellent resistance to the conduction of electrical current.

The polymer plastics can be divided into two classes, thermoplastics and thermosetting plastics, depending on how they are structurally and chemically bonded. Thermoplastic polymers comprise polyethylene, polypropylene, polystyrene and polyvinyl chloride. There are also a number of specialized engineering polymers. The term ‘thermoplastic’ indicates that these materials melt on heating and may be processed by a variety of molding and extrusion techniques. Alternately, ‘thermosetting’ polymers cannot be melted or remelted. Thermosetting polymers include alkyds, amino and phenolic resins, epoxies, polyurethanes, and unsaturated polyesters.

Polymers are primarily produced from petroleum or natural gas raw products but the use of organic substances is growing. The super-material known as Kevlar is a man-made polymer. Kevlar is used in policemen’s bullet-proof vests, strong/lightweight frames, and underwater cables that are 20 times stronger than steel.

Composites: A composite is a combination of two or more distinct materials, each of which retains its own distinctive properties, to create a new material with properties that cannot be achieved by any of the components acting alone. A wide range of engineering materials fall into this category. For example, concrete is a composite because it is a mixture of Portland cement and aggregate. Fiberglass sheet is a composite since it is made of glass fibers imbedded in a polymer.

Composite materials are said to have two phases. The reinforcing phase is the fibers, sheets, or particles that are embedded in the matrix phase. The reinforcing material and the matrix material can be metal, ceramic, or polymer. Typically, reinforcing materials are strong with low densities while the matrix is usually a ductile, or tough, material.

Some of the common classifications of composites are:

- Reinforced plastics
- Metal-matrix composites
- Ceramic-matrix composites
- Sandwich structures
- Concrete

Composite materials can be separated into three categories based on the strengthening mechanism. These categories are dispersion strengthened, particle reinforced and fiber reinforced. Dispersion strengthened composites have a fine distribution of secondary particles in the matrix of the material. These particles impede the mechanisms that allow a material to deform. Many metal-matrix composites are in the dispersion strengthened composite category. Particle reinforced composites have a large volume fraction of particle dispersed in the matrix and the load is shared by the particles and the matrix. Most commercial ceramics and many filled polymers are particle-reinforced composites. In fiber-reinforced composites, the fiber is the primary load-bearing component. Fiberglass and carbon fiber composites are examples of fiber-reinforced composites.

Retrieved and adapted January 5, 2010 from
http://www.ndted.org/EducationResources/CommunityCollege/Materials/Introduction/classifications.htm

La frase nominal

La frase nominal (o también llamada grupo nominal o frase sustantiva) es la frase dentro de la oración que hace referencia a lo que se está hablando, describiendo o argumentando, es decir, la frase nominal hace referencia, en general, al tema en cuestión y la podemos reemplazar por *esto* (o *éstos, ésta,* o *éstas*). Entonces, en la oración: *The word polymer means "many parts"* (La palabra polímero significa “muchas partes”) podemos decir The word polymer (esto) means “many parts” (esto). Cuando la frase o parte de la oración – como veremos más adelante- a la que se hace referencia puede ser reemplazada de esta manera, decimos que estamos ante la presencia de una frase nominal o sustantiva.

Los sustantivos pueden ser reemplazados por ***esto*** (éstos, ésta, éstas).

Una característica saliente de la frase nominal es la posición que tiene el núcleo- el sustantivo central en la frase- cuando la comparamos con el castellano. Por ejemplo, en inglés decimos *different materials* y en castellano *materiales diferentes*- aunque también podemos decir *diferentes materiales*. En ambos casos decimos que la palabra subrayada es el núcleo de la frase nominal. La diferencia se vuelve más notoria cuando la frase nominal es larga. Por ejemplo: *good corrosion resistance* tiene a *resistance* como núcleo y a *good corrosion* como palabras que le pre-modifican, que especifican el tipo de *resistencia* de la que estamos hablando. La misma frase en castellano sería *buena resistencia a la corrosión.* Como se puede apreciar, la frase ha quedado presentada de una manera muy diferente al inglés precisamente por la posición que tienen los sustantivos núcleos de la frase en cada idioma.

La frase nominal puede ser un núcleo solo (*materials*), un núcleo con otras palabras que lo premodifican (*many materials, many types of materials, these materials, high-melting materials, a material, the materials*) o con otras estructuras que lo pueden post-modificar (*a material for insulation, a material that is highly malleable, a material found in the water).* En

esta sección nos concentraremos en la premodificación del núcleo y en la postmodificación por frases preposicionales.OY6W3

¿Cómo reconocemos el núcleo? ¿Cómo sabemos de qué estamos hablando?

Si bien no es una tarea fácil para el estudiante de lengua extranjera, hay ciertos indicios que nos indican que estamos frente al núcleo de una frase sustantiva. La misma puede ser reconocida desde distintos aspectos:

- *Reconocimiento de sustantivo núcleo 1: La morfología del sustantivo*

Usualmente los sustantivos están formados con los siguientes sufijos:

Sufijo	**Ejemplos**
-er	research**er** (investigador)
-ee	train**ee** (aprendiz)
-ness	tough**ness** (resistencia) brittle**ness** (fragilidad)
-ation	approxim**ation** (aproximación) explan**ation** (explicación)
-ity	malleabil**ity** (maleabilidad), conductiv**ity** (conductividad)
-age	short**age** (escasez) drain**age** (drenaje, avenamiento)
-or	insulat**or** (aislante) conduct**or** (conductor)
-ure	press**ure** (presión) fail**ure** (falla, insuficiencia)
-ence	pres**ence** (presencia)
-ance	import**ance** (importancia)
-ion	corros**ion** (corrosión, herrumbre)

(Para estudiar otros procesos de formación de palabras ver APÉNDICE 2. Asimismo, puede comenzar a leer APÉNDICE 7.)

En cuanto a la apariencia física, vamos a encontrar muchas palabras terminadas en **–ing** (llamados gerundios) que derivan de un verbo y que funcionan como sustantivos. Usualmente estos sustantivos se refieren a una acción, proceso, disciplina, etc. Por ejemplo:

Civil Engineer**ing**, Electromechanical Engineer**ing**, Electronic Engineer**ing**.
The coat**ing** of the material is the first phase.

Una ocurrencia a tener en cuenta es que estas palabras terminadas en -ing también pueden actuar como modificadores del sustantivo como es el caso en:

1. engineer**ing** applications
2. the atomic bond**ing** forces
3. specialized engineer**ing** polymers
4. thermosett**ing** polymers

Las palabras en ***–ing*** pueden ser sustantivos o adjetivos (entre otras funciones que veremos en unidades 4A, 5A, 6A y 9A y APÉNDICE 14.

En los cuatro ejemplos de arriba, el núcleo de la frase nominal es la última palabra y las palabras en –ing funcionan como pre-modificadores. Entonces, hasta el momento podemos decir que las palabras terminadas en –ing pueden funcionar como sustantivos o como adjetivos/modificadores del sustantivo (ver unidad 5A en la que estas palabras funcionan como verbos conjugados y en la unidad 6A se las presenta con la función QUE).

El sustantivo también puede ser identificado por el sufijo que indica la forma plural (para la regla de formación de plurales ver APÉNDICE 5):

material → material**s**
type of material → type**s** of material**s**
variety of polymers → variet**ies** of polymer**s**
glass → glass**es**
alloy → alloy**s**


Una palabra terminada en ***–s, -es, -ies*** puede ser un sustantivo en plural (o un verbo en tiempo presente).

➢ *Reconocimiento del sustantivo núcleo 2: Las palabras que lo acompañan*

Los núcleos pueden ser pre-modificados por distintos tipos de palabras/estructuras (Ver clasificación de palabras en APÉNDICES 4):

a- *Determinantes*

Determinante	**Núcleo**	**Equivalente en castellano**
a	material	
the		
this/that		
any		
its/their		
every/each		
another		
little		
not much		
such		
more		

Si el núcleo es plural podemos decir:

Determinante	**Núcleo**	**Equivalente**
the	materials	
these/those		
many/several/various		
some		
few		
such		
most		
more		
two, three, four		

Asimismo, se pueden encontrar combinaciones:

Determinante	Núcleo	Equivalente
several of those	materials	
these three		
most of the		
some of the		
five of the		
half of the		
thousands of		

Podemos encontrar otras frases que indican número, cantidad, tipo, clase, etc. que son frases nominales en sí mismas:

Determinante	Núcleo	Equivalente
a sort of	material	
a kind of		
a piece of		

Para más información acerca de estos modificadores ver APÉNDICE 4.

b- *Frases adjetivas*

- El núcleo puede estar acompañado por una frase adjetiva como:

a ceramic is defined as an *inorganic, nonmetallic* **solid**

En este caso el núcleo **solid** está acompañado de un determinante (*an*) y dos adjetivos (*inorganic y nonmetallic*) que componen lo que se llama la frase adjetiva.

- El adjetivo puede estar acompañado de un adverbio:

Two industrially important polymeric **materials** are plastics and elastomers.

En este caso la frase nominal completa es *two industrially important polymeric materials*, con *materials* como núcleo, *two* como determinante, con una frase adjetiva compuesta de dos adjetivos que modifican al núcleo *important* y *polymeric* y con el adverbio *industrially* que modifica al adjetivo *important.* Entonces lo podemos decir así:

Dos materiales poliméricos industrialmente importantes son los plásticos y los elastómeros.

- Los adjetivos pueden estar en la forma comparativa (para comparar una cosa con otra) o superlativa (para comparar una cosa con otras en un grupo). Estos adjetivos se pueden reconocer por los sufijos *–er* (comparativo) y *–est* (superlativo) cuando el adjetivo es corto. Cuando el adjetivo es largo, el grado de comparativo y superlativo se expresa a través de *more* y de *most* respectivamente. Entonces decimos:

Titanium - Titanium alloys are used for strength in high*er* temperature (~1000° F) **applications**.
(Las aleaciones de Titanio – Titanio son usadas para resistencia en aplicaciones de más temperatura.)

Plastics are *more* malleable **materials** when they are hot. (Los plásticos son materiales más maleables cuando están calientes.)
Metals are the materials that show the high*est* electrical **conductivity**. (Los metales son los materiales que muestran la mayor conductividad eléctrica.)
Glass is the *most* fragile **material**.(El vidrio es el material más frágil.)

Para más información acerca de los comparativos y superlativos ver APÉNDICE 6.

- En la categoría de adjetivos también se incluyen las palabras terminadas en –ing mencionadas en el punto **a** como cuando decimos:

There are many electronic *engineering* **materials** (Hay muchos materiales para la ingeniería electrónica).

En este caso tomamos a *material*s como el núcleo y a *electronic engineering* como la frase que nos especifica a qué tipo de materiales estamos haciendo referencia.

- Asimismo, podemos encontrar adjetivos que tienen la forma –ed.

powdered **materials** (línea 22- materiales en polvo)

reinforced **plastics** (línea 79 – plásticos reforzados)

Como veremos más adelante, la forma –*ed* puede cumplir otras funciones.

c- *Otros sustantivos*
El núcleo también puede estar modificado por otros sustantivos:

1. A *sandwich* **structure** is a type of composite material.
2. Ceramics are dense or lightweight depending on the *formation* **method**.
3. *Fiberglass* **sheet** is a composite material.
4. Titanium - Titanium alloys are used for strength in higher *temperature* (~1000° F) **applications.**

Asimismo, el sustantivo núcleo puede estar modificado por un sustantivo en el caso genitivo (para expresar pertenencia, parte de)

Metals account for the 24% of the *Earth's* **mass**.
Kevlar is used in *policemen's* bullet-proof **vests**.

El **caso genitivo** es un caso que indica la posesión o pertenencia de algo por parte de un nombre propio o un sustantivo. En la lengua inglesa, esta estructura se realiza mediante **el apóstrofo:**

X 's Y = el que posee + 's + el objeto/la entidad que se posee

(el Y de X)

El **apóstrofo** se escribe a continuación del nombre propio o el sustantivo (poseedor) - siempre que se encuentre en singular o en plural no terminado en -s. El sustantivo núcleo se encuentra luego del apóstrofo, al final de la frase nominal.

Plasma's ***advantages***

Si el sustantivo singular en un caso posesivo termina en ***s*** se agrega solamente el apóstrofo.

See our page on Computer Component and Peripheral Manufacturers' Support **Information**

Nota: cuando hablamos de un sustantivo premodificado por otra palabra, podemos estar ante el caso de una palabra compuesta (ver APÉNDICE 2), la cual puede figurar con sus dos partes (o más) en el diccionario.

d- *La frase preposicional como postmodificación*

- El núcleo de la frase nominal es muchas veces postmodificado por una frase que comienza con una preposición y que es seguida por otra frase nominal. Se la llama frase preposicional porque se dice que el núcleo de esa frase es la preposición. Por ejemplo:

the common **classification** of materials

Toda esta frase es una frase nominal. El núcleo de la frase es *classification*. Tiene una premodificación con un determinante (t*he*) y un adjetivo (*common*). Está postmodificado por una frase preposicional conformada por la preposición *of* y el sustantivo *materials*. Otros ejemplos:

A metal is a **substance** with electrical conductivity and malleability.
Iron and Titanium are **examples** of common metallic materials.
Plastics are a large and varied **group** of synthetic materials.

- Es muy característico que luego de una preposición encontremos la forma *–ing*. A esta función de la *–ing* le vamos a llamar la función preposición + *–ar,-er, -ir* puesto que es muy común que su interpretación en castellano sea con un verbo en estas formas. Asimismo, estas palabras pueden ser transformadas en sustantivos ya que en realidad es la función que cumplen. Por ejemplo:


Hasta ahora, las palabras en ***–ing*** pueden cumplir la función *sustantivo, adjetivo, o preposición + –ar,-er,-ir*.

There are many **advantages** to research*ing* new materials. Hay muchas ventajas (conectadas) con *investigar* nuevos materiales. O también se podría decir: Hay muchas ventajas (conectadas) con la *investigación* de nuevos materiales.

There is increased **interest** in research*ing* new materials for space engineering. Hay creciente interés por *investigar / la investigación de* nuevos materiales para la ingeniería espacial.

Vamos a encontrar casos en que una preposición es seguida de una forma –ing y la traducción corresponde a *–ando –endo*. Tal es el caso de la preposición *by + -ing*. Por ejemplo:

by + -ing toma el valor de –ando, -endo e indica cómo se logra u obtiene algo, es decir, la manera en que se hace algo.

The researchers find new materials by combin*ing* traditional materiales in different ways. Los investigadores encuentran nuevos materials combinando materials tradicionales de diferentes maneras.

Cabe aclarar que aquí la frase *by + -ing* no funciona como postmodificación del sustantivo, sino como un agregado que nos indica cómo se hace o se obtiene algo expresado por el verbo.

Para un listado de preposiciones ver APÉNDICE 3.

- *Reconocimiento del sustantivo núcleo 3: Su posición en la oración*

Veamos la estructura básica de una oración en inglés:

A metal **is** a substance with high electrical conductivity.
Metals **have** useful properties.
Ceramics **demonstrate** excellent strength and hardness properties.

En los ejemplos de arriba se puede observar que tenemos una frase nominal + un verbo + otra frase nominal. Si bien ésta es una simplificación de la estructura de una oración en inglés, este primer acercamiento le permite al lector de lengua extranjera comenzar a incorporar los elementos básicos con los que se puede encontrar. Cada verbo requerirá distintos tipos de complementos y la frase nominal es altamente frecuente entre ellos.

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

3B Over to your Career Path

Activity 1: Scan the text and state TRUE or FALSE below.

Concrete Basics

In its simplest form, concrete is a mixture of paste and aggregates. The paste, composed of portland cement and water, coats the surface of the fine and coarse aggregates. Through a chemical reaction called hydration, the paste hardens and gains strength to form the rock-like mass known as concrete. Within this process lies the key to a remarkable trait of concrete: it is plastic and malleable when newly mixed, strong and durable when hardened. These qualities explain why one material, concrete, can build skyscrapers, bridges, sidewalks and superhighways, houses and dams.

Proportioning

The key to achieving a strong, durable concrete rests in the careful proportioning and mixing of the ingredients. A concrete mixture that does not have enough paste to fill all the voids between the aggregates is difficult to place and produces rough, honeycombed surfaces and porous concrete. A mixture with an excess of cement paste will be easy to place and will produce a smooth surface; however, the resulting concrete is likely to shrink more and be uneconomical.

A properly designed concrete mixture possesses the desired workability for the fresh concrete and the required durability and strength for the hardened concrete. Typically, a mix is about 10 to 15 percent cement, 60 to 75 percent aggregate and 15 to 20 percent water. Entrained air in many concrete mixes may also take up another 5 to 8 percent.

Portland cement's chemistry comes to life in the presence of water. Cement and water form a paste that coats each particle of stone and sand. Through a chemical reaction called hydration, the cement paste hardens and gains strength. The character of the concrete is determined by quality of the paste. The strength of the paste, in turn, depends on the ratio of water to cement. The water-cement ratio is the weight of the mixing water divided by the weight of the cement. High-quality concrete is produced by lowering the water-cement ratio as much as possible without sacrificing the workability of fresh concrete. Generally, using less water produces a higher quality concrete provided the concrete is properly placed, consolidated, and cured.

Other Ingredients

Although most drinking water is suitable for use in concrete, aggregates are chosen carefully. Aggregates comprise 60 to 75 percent of the total volume of concrete. The type and size of the aggregate mixture depends on the thickness and purpose of the final concrete product. Almost any natural water that is drinkable and has no pronounced taste or odor may be used as mixing water for concrete. However, some waters that are not used for drinking are appropriate for concrete.

Excessive impurities in mixing water affects setting time and concrete strength, and causes efflorescence, staining, corrosion of reinforcement, volume instability, and reduced durability. Specifications usually set limits on chlorides, sulfates, alkalis, and solids in mixing water unless tests can be performed to determine the effect the impurity has on various properties. Relatively thin building sections require small coarse aggregate, although aggregates up to six inches (150 mm) in diameter have been used in large dams. A continuous gradation of particle sizes is desirable for efficient use of the paste. In addition, aggregates should be clean and free from any matter that might affect the quality of the concrete.

Hydration Begins

Soon after the aggregates, water, and the cement are combined, the mixture starts to harden. All portland cements are hydraulic cements that set and harden through a chemical reaction with water. During this reaction, called hydration, a node forms on the surface of each cement particle. The node grows and expands until it links up with nodes from other cement particles or adheres to adjacent aggregates. The building-up process results in progressive stiffening, hardening, and strength development. Once the concrete is thoroughly mixed and workable it should be placed in forms before the mixture becomes too stiff.

During placement, the concrete is consolidated to compact it within the forms and to eliminate potential flaws, such as honeycombs and air pockets. For slabs, concrete is left to stand until the surface moisture film disappears. After the film disappears from the surface, a wood or metal handfloat is used to smooth off the concrete. Floating produces a relatively even, but slightly rough, texture that has good slip resistance and is frequently used as a final finish for exterior slabs. If a smooth, hard, dense surface is required, floating is followed by steel troweling.

Curing begins after the exposed surfaces of the concrete have hardened sufficiently to resist marring. Curing ensures the continued hydration of the cement and the strength gain of the concrete. Concrete surfaces are cured by sprinkling with water fog, or by using moisture-retaining fabrics such as burlap or cotton mats. Other curing methods prevent evaporation of the water by sealing the surface with plastic or special sprays (curing compounds).
Special techniques are used for curing concrete during extremely cold or hot weather to protect the concrete. The longer the concrete is kept moist, the stronger and more durable it will become.

The rate of hardening depends upon the composition and fineness of the cement, the mix proportions, and the moisture and temperature conditions. Most of the hydration and strength gain take place within the first month of concrete's life cycle, but hydration continues at a slower rate for many years. Concrete continues to get stronger as it gets older.

The Forms of Concrete

Concrete is produced in four basic forms, each with unique applications and properties. Ready-mixed concrete, by far the most common form, accounts for nearly three-fourths of all concrete. It's batched at local plants for delivery in the familiar trucks with revolving drums. Precast concrete products are cast in a factory setting. These products benefit from tight quality control achievable at a production plant. Precast products range from concrete bricks and paving stones to bridge girders, structural components, and panels for cladding.

Concrete masonry, another type of manufactured concrete, may be best known for its conventional 8 x 8 x 16-inch block. Today's masonry units can be molded into a wealth of shapes, configurations, colors, and textures to serve an infinite spectrum of building applications and architectural needs. Cement-based materials represent products that defy the label of "concrete," yet share many of its qualities. Conventional materials in this category include mortar, grout, and terrazzo. Soil-cement and roller-compacted concrete—"cousins" of concrete-are used for pavements and dams. Other products in this category include flowable fill and cement-treated bases.

Retrieved and adapted January 6, 2010 from
http://www.cement.org/basics/concretebasics_concretebasics.asp

f- This text was taken from a book.
g- This text gives information about different materials used in civil engineering.
h- This text was published by the Civil Engineering Association.
i- There are 5 sections in this text.
j- This first picture illustrates the *Concrete Basics* section.
k- The second picture illustrates the *Hydration Begins* section.

Activity 2: Describe the first picture.

Activity 3: Read the introduction and state:

a- Definition of concrete:
b- Properties of concrete:
c- Applications of concrete:

Activity 4: Read *Proportioning*. Underline the following noun phrases in the text.

a- un concreto durable y fuerte
b- un cuidadoso dosaje y mezcla de los ingredientes
c- los vacíos entre los agregados
d- una mezcla con un exceso de pasta de cemento
e- una mezcla de concreto diseñada apropiadamente
f- cada partícula de piedra y arena
g- la calidad de la pasta
h- la resistencia de la pasta
i- la proporción de agua y cemento

Activity 5: Turn to section *Other Ingredients*. Give the value of the underlined phrases. Then, comment orally on this section.

a- …most drinking water is suitable for use in concrete…
b- …60 to 75 percent of the total volume of concrete.
c- Excessive impurities in mixing water…
d- Relatively thin building sections require small coarse aggregate…
e- A continuous gradation of particle sizes is desirable for efficient use of the paste.

Activity 6: Turn to section *Hydration Begins.* Match the headings below to the paragraphs.

a- The process of cement consolidation
b- The process of cement chemical formation
c- The process of cement curing
d- The process of cement strengthening

Activity 7: Complete the following sentences taken from the text.

a- (line 52) Para las losas, se deja reposar el hormigón hasta que ..... desaparece.
b- (line 58) Las superficies de concreto son curadas.....niebla de agua o usando ..... tales como la arpillera o alfombras de algodón. Otros ..... previenen la evaporación del agua ..... la superficie con plástico o pulverizadores especiales (.....).
c- (line 64) El grado.....depende de la ....., las proporciones de mezcla, y las ..... .
d- (line 66) El hormigón continúa volviéndose ..... a medida que se vuelve ..... .

Activity 8: Turn to section *The Forms of Concrete.* Complete the table below.

The forms of Concrete	**Examples**
1-	
2-	Concrete bricks, paving stones, bridge girders, structural components, panels for cladding
3- Concrete masonry	
4- Cement-based materials	

Activity 9: Study the phrases below. State whether the *–ing* word is a modifier (adjective function) or a head in a noun phrase.

a- The building-up process results in progressive stiffening, hardening and strength development.
b- Curing begins after the exposed surfaces have hardened.
c- paving stones

Activity 10: State the value of the following phrases.

Portland cement's chemistry - concrete's life cycle – today´s masonry units

Activity 11: Match the expression in English to its Spanish equivalent.

Expression	Spanish equivalent
a- coarse aggregate (sus. picture)	**endurecer**
b- fine aggregate (sus. picture)	**resistencia**
c- surface (sus. line 3)	**agregado fino**
d- hydration (sus. line 5)	**dosaje cuidadoso**
e- to harden (v. line 5)	**agregado grueso**
f- strength (sus. l. 5)	**superficie**
g- skyscraper (sus. l. 11)	**puente**
h- bridge (sus. l. 11)	**rascacielos**
i- careful proportioning (frase sustantiva l. 13)	**humidificación, hidratación**
j- mixing of the ingredients (f.s. l. 13)	**una mezcla con un exceso de pasta/ mezcla de cemento**
k- rough, honeycombed surfaces (f.s. l. 15)	**mezcla de los ingredientes**
l- a mixture with an excess of cement paste (f.s. l. 15)	**camiones con tambores giratorios**
m- the required durability and strength (l. 18 f.s.)	**la resistencia y durabilidad requerida**
n- entrained air (l. 20)	**aire insuflado**
o- air pockets (f.s. l. 52)	**burbujas de aire**
p- slab (s. l. 20)	**alisado con llana**
q- handfloat (s l. 53)	**superficies rugosas y porosas**
r- steel trowelling (f.s. l. 56)	**fratacho**
s- trucks with revolving drums (f.s. l. 71)	**losa**

Homework – To turn in

1- Mencionar los componentes básicos del hormigón.
2- Mencionar las propiedades del hormigón.
3- Describir los cuidados claves para obtener un hormigón que sea duradero y resistente.
4- Características del agua a utilizar en la mezcla para el hormigón.
5- Describir la reacción química que se produce con el agua.

Cuidar la manera en que expresamos los conceptos e ideas. Una respuesta bien redactada, tiene un impacto mayor en nuestros lectores.

Nota importante: Los textos utilizados en esta unidad tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

Review Section 1

Activity 1: Scan the pieces of news below and classify them into the following categories: Civil Engineering, Electromechanical Engineering, and Electronic Engineering.

a- Environmental Impact Of Building Construction Can Now Be Predicted
ScienceDaily (Feb. 18, 2009) — A team of researchers from the Polytechnic University of Catalonia (UPC) has developed a method that makes it possible to evaluate the environmental impacts caused during the construction of buildings in advance.
Before beginning the works, with just the project data, the new method makes it possible to predict up to 37 environmental impacts. This information, according to the creators, could help improve environmental management in the construction processes.

b-'Self-Healing' Polymer May Facilitate Recycling Of Hard-to-Dispose Plastic
ScienceDaily (May 1, 2009) — Researchers in The Netherlands are reporting development of a new plastic with potential for use in the first easy-to-recycle computer circuit boards, electrical insulation, and other electronics products that now wind up on society's growing heaps of electronic waste.

c-Hemp Could Be Key To Zero-Carbon Houses
ScienceDaily (Apr. 13, 2009) — Hemp, a plant from the cannabis family, could be used to build carbon-neutral homes of the future to help combat climate change and improve the rural economy, say researchers at the University of Bath.

d-Engineer Designs More Efficient, Quieter Bus
July 1, 2007 — An engineer has designed an electric bus that runs on battery power. Putting motors in each wheel makes a transmission and driveshaft unnecessary, and allows the bus to ride closer to the ground for ease of entry. Using stainless steel also reduces weight. The prototype increases fuel efficiency by four times over a more traditional city bus.

e-New Building Design Withstands Earthquake Simulation
ScienceDaily (Mar. 9, 2009) — Researchers at the University of Michigan simulated a fierce earthquake in a laboratory to test their new technique for protecting high-rise concrete buildings. Their technique passed the test, withstanding more movement than an earthquake would typically demand.

f-A Greener Way to Get Electricity from Natural Gas
ScienceDaily (Dec. 8, 2009) — A new type of natural-gas electric power plant proposed by MIT researchers could provide electricity with zero carbon dioxide emissions to the atmosphere, at costs comparable to or less than conventional natural-gas plants, and even to coal-burning plants.

g-Better Way To Manufacture Fast Computer Chips Developed
ScienceDaily (Apr. 8, 2009) — Engineers at Ohio State University are developing a technique for mass producing computer chips made from the same material found in pencils. Experts believe that graphene -- the sheet-like form of carbon found in graphite pencils -- holds the key to smaller, faster electronics.

h-Light Electric Motor To Increase Efficiency Of Electric Vehicles

ScienceDaily (Sep. 16, 2009) — A new Oxford University spin-out company, Oxford Yasa Motors, has been organized to commercialize lightweight electric motors developed at the Department of Engineering Science. The new technology promises to help companies build more efficient electric vehicles.

i-New Way To Produce Electronic Components Can Lead To Cheap And Flexible Electronics

ScienceDaily (Apr. 1, 2009) — Flexible display screens and cheap solar cells can become a reality through research and development in organic electronics. Physicists at Umeå University in Sweden have now developed a new and simple method for producing cheap electronic components.

Retrieved and adapted January 19, 2010 from http://www.sciencedaily.com/releases/2010/01/100104092458.htm

Activity 2: These statements are FALSE. Justify. Identify the distractor words.

a- The new method evaluates the impact of construction materials on the environment.
b- This piece of news is about a new recycling method.
c- Carbon-neutral homes are constructed in rural areas.
d- The bus described is used in many cities of the world.
e- The simulation tested a new material that withstands earthquakes.
f- The new type of power plant reduces some carbon dioxide emissions.
g- Engineers are developing a new type of pencil.
h- The new car technology is used for faster cars.
i- British physicists have developed cheaper electronic components.

Activity 3: Comment on:

a- Text b: the relationship between the new plastic and electronic waste.
b- Text c: the relationship between hemp and rural economy.
c- Text d: the new bus' efficiency
d- Text f: a natural-gas electric power plant v. natural-gas plants and coal-burning plants

Activity 4: Match the following noun phrases to one of the pieces of news above.

a- the building's drift
b- an attractive alternative to conventional power plants
c- 55 new residential construction sites
d- electrical characteristics of graphene
e- an easier, cheaper, stronger way to brace buildings in earthquake-prone areas
f- a relatively plentiful fuel source
g- a smaller and cheaper motor
h- faster speeds ….higher temperatures
i- the use of hemp-lime construction materials
j- 50 per cent of the world's electricity
k- global reserves of natural gas
l- high-rise concrete buildings
m- the construction of single family homes or apartment buildings
n- other existing or proposed power generating systems
o- the Centre for Innovative Construction Materials' project

Activity 5: Underline the head in the noun phrases in 4.

For example: a- a building's drift – *esta frase nominal tiene como núcleo a* ***drift*** *y este concepto es el foco de la información que estoy dando: el movimiento del edificio*

Activity 6: Choose the best option according to the meaning in the text.

a. researcher (sustantivo - línea 2) = investigador/investigar/investigadores
b. develop (verbo - línea 3) = desactivar/desarmar/desarrollar
c. improve (verbo - l. 6) = manejar/ampliar/mejorar
d. environmental (adjetivo - l. 6) = medioambiente/ambientalistas/medioambiental
e. insulation (sustantivo - l. 10) = aislación / aislar / aislador
f. waste (sustantivo - l. 11) = gastar / basura / basurero
g. improve (verbo - l. 14) = mejorar /solucionar / proveer
h. allow (verbo - l. 18) = facilitar / familiarizar / facturar
i. increase (verbo - l.19) = analizar / aumentar / ameritar
j. fuel (sustantivo - l.20) = combustión / combustible / gas
k. withstand (verbo - l. 21) = pararse / soportar / controlar
l. lightweight (adjetivo - l.37) = liviano /levadizo / luminoso
m. cheap (adjetivo – l. 44) = bajo / barato /beneficioso

Activity 7: Now focus on the complete article below. Scan the text and choose the correct option below.

ScienceDaily
Your source for the latest research news

Web address:
http://www.sciencedaily.com/releases/2009/04/090408074401.htm

Hemp Could Be Key To Zero-Carbon Houses

ScienceDaily (Apr. 13, 2009) — Hemp, a plant from the cannabis family, could be used to build carbon-neutral homes of the future to help combat climate change and boost the rural economy, say researchers at the University of Bath.

A consortium, led by the BRE Centre for Innovative Construction Materials based at the University, has
5 embarked on a unique housing project to develop the use of hemp-lime construction materials in the UK.

Hemp-lime is a lightweight composite building material made of fibers from the fast-growing plant, bound together using a lime-based adhesive. The hemp plant stores carbon during its growth and this, combined with the low carbon footprint of lime and its very efficient insulating properties, gives the material a 'better than zero carbon' footprint.

Professor Pete Walker, Director of the BRE Centre for Innovative Construction Materials, explained: "We are looking at the feasibility of using hemp-lime in place of traditional materials, so that they can be used widely in the building industry. We are measuring the properties of lime-hemp materials, such as their strength and durability, as well as the energy efficiency of buildings made of these materials. Using renewable crops to make building materials makes real sense - it only takes an area the size of a rugby pitch four months to grow enough hemp to build a typical three-bedroom house. Growing crops such as hemp can also provide economic and social benefits to rural economies through new agricultural markets for farmers and associated industries."

The three-year project, worth almost £750,000, will collect vital scientific and engineering data about this new material so that it can be more widely used in the UK for building homes.

The project brings together a team of nine partners, comprising BRE Ltd, Feilden Clegg Bradley Studio architects, Hanson Cement, Hemcore, Lhoist UK, Lime Technology, National Non-Food Crops Centre, University of Bath and Wates Living Space. As part of the project the University of Bath received a research grant of £391,000 from the Renewable Materials LINK programme run by the Department for Environment, Food & Rural Affairs (DEFRA).

Retrieved and adapted from http://www.sciencedaily.com/releases/2009/04/090408074401.htm

a- This text is a **research paper / piece of news / book review**.
b- It was published in **2008 / 2009 / 2010**.
c- This text is about a(n) **new material / traditional material / intelligent material** used for construction of homes.
d- The project is a **two-year / three-year / four-year** project.
e- The project is developed in the **UK/USA/Netherlands**.
f- This project is developed by **two/four/several** partners.

Activity 8: Underline the following information in the text.

a- The description of hemp.
b- The uses of hemp.
c- The description of hemp-lime.
d- The properties of hemp-lime materials studied in the project.
e- The benefits of hemp-lime materials to rural economies.
f- The money used for the development of this project.
g- The name of the university in charge of the project.

Activity 9: Comment on the following information.

a- a plant from the cannabis family	line 1
b- carbon-neutral homes of the future	lines 1-2
c- a unique housing project	line 5
d- a lightweight composite building material	line 6

e-	fibers from the fast-growing plant	line 6
f-	a lime-based adhesive	line 7
g-	the low-carbon footprint of lime	line 8
h-	its very efficient insulating properties	line 8
i-	the feasibility of using hemp-lime in place of traditional materials	line 11
j-	an area the size of a rugby pitch	line 14

Activity 10: Complete the following paragraph.

Homework – To turn in

El uso de cáñamo para la construcción sería beneficioso por varias razones. En un primer lugar, ……..

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

4A El uso del diccionario

1- Lee **rápidamente** el texto a continuación y completa las siguientes consignas:

a- Identifica el tema del texto.
b- ¿De qué se trata el listado que va del 1 al 12?
c- ¿Cuál es la fuente del texto?
d- Este texto fue extraído en el 2010, ¿hay cambios en el texto de Wikipedia?
e- ¿Qué sabes acerca del contenido de esta página en general?
f- ¿Cuál es la idea general del primer párrafo? ¿y del segundo?
g- ¿Sabemos qué significa el acrónimo ASTM a partir de la información brindada por el texto?
h- Ubica los subtítulos del 1 al 12 en los listados debajo.

Properties of Materials

From *Wikipedia*, the free encyclopedia

A material's property is an intensive, often quantitative property of a material, usually with a unit that is used as a metric of value to compare the benefits of one material versus another to aid in materials selection. A material's property may be a constant or may be a function of one or more independent variables, such as temperature. The properties of materials often vary to some degree according to the direction in the material in which they are measured; a condition referred to as anisotropy. The properties of materials that relate two different physical phenomena often behave linearly in a given operating range and may then be modeled as a constant for that range. This linearization can significantly simplify the differential constitutive equations that the property describes.

Some properties are used in relevant equations to determine the attributes of a system a priori. For example, if a material of a known specific heat gains or loses a known amount of heat, the temperature change of that material can be determined. The properties of materials may be determined by standardized test methods. Many such test methods have been documented by their respective user communities and published through ASTM International.

1 Thermal properties
2 Optical properties
3 Mechanical properties
4 Chemical properties
5 Biological properties
6 Electrical properties
7 Radiological properties
8 Acoustical properties
9 Magnetic properties
10 Environmental properties
11 Manufacturing properties
12 Atomic properties

A-_____
Young's modulus
Specific modulus
Tensile strength
Compressive strength
Shear strength
Yield strength
Ductility
Poisson's ratio
Specific weight

B-_____
Electrical conductivity
Permittivity
Dielectric constant
Dielectric strength
Piezoelectric constants
Seebeck coefficient

C-_____
Thermal conductivity
Thermal diffusivity
Thermal expansion
Seebeck coefficient
Emissivity
Coefficient of thermal expansion
Specific heat
Heat of vaporization
Heat of fusion
Pyrophoricity
Flammability
Vapor Pressure
Phase diagram
Binary phase diagram
Autoignition temperature
Inversion temperature
Critical temperature
Glass transition temperature
Eutectic point
Melting point
Vicat softening point
Boiling point
Triple point
Flash point
Curie point

D-_____
pH
Hygroscopy
Surface energy
Surface tension
Specific internal surface area
Reactivity
Corrosion resistance

E-_____
Permeability
Hysteresis
Curie Point

F_____
Absorptivity
Reflectivity
Refractive index
Color
Photosensitivity
Transmittance
Luminosity

G-_____
Acoustical absorption
Speed of sound

H-_____
Neutron cross-section
Specific activity

I_____
Toxicity

J-_____
Embodied energy
Embodied water
RoHS compliance

K-_____
Atomic number - applies to pure elements only
Atomic weight - applies to individual isotopes or specific mixtures of isotopes of a given element.

L-_____
Machining speeds and feeds
Machinability rating
Hardness
Extruding temperature and pressure

Retrieved and adapted January 14, 2010 from http://en.wikipedia.org/wiki/List_of_materials_properties

i - Subraya en el texto la siguiente información y especifica número de línea:

1. definición de propiedad de materiales
2. descripción de lo que significa *anisotropy*
3. propósito de la descripción de propiedades
4. métodos para determinar las propiedades de los materiales

j - Todas las propiedades listadas arriba están expresadas en distintos tipos de frases nominales. Transcribe sustantivos que contengan los siguientes sufijos y establece el equivalente en castellano de toda la frase:

k -

Sufijo	Ejemplos	Significado de la frase completa
-ness		
-ation		
-ity		
-ure		
-ance		
-ion		

El uso del diccionario

El diccionario bilingüe es una herramienta más a ser utilizada en la clase de idioma extranjero cuando todos los demás recursos han sido agotados. Es decir, una vez que se ha tratado de descubrir el significado de las palabras a través del análisis del contexto en el que se encuentran, los cognados que las rodean, su morfología, su posición en la oración, el lector de lengua extranjera puede recurrir a esta herramienta para facilitar la comprensión de una palabra en particular.

El uso del diccionario puede resultar ser una estrategia de acercamiento al texto de gran valor como así también un obstáculo que no permite el avance en la lectura. Para que el uso del diccionario tenga un lugar positivo en el acto de lectura, el estudiante debe conocer cómo está estructurado y cómo se presenta la información en cada entrada del mismo. Cada diccionario posee particularidades que sólo pueden ser descubiertas con una exploración inicial de la organización de los contenidos y un uso frecuente en el que el estudiante se va familiarizando con la terminología y abreviaciones utilizadas. Asimismo, el diccionario debe ser utilizado con moderación, siempre teniendo en cuenta que debe ser un recurso más para el estudiante y no el único elemento disponible para asignarle valor a lo leído. La lectura que es interrumpida constantemente por la búsqueda de palabras, se torna en una traducción *verbatim* que no necesariamente lleva a la compresión de un texto.

En una exploración inicial es importante identificar los elementos disponibles en un diccionario. Los mismos pueden ser:

a- Guía para la utilización del diccionario
b- Tabla con los símbolos fonéticos
c- Tabla con las abreviaciones utilizadas
d- Lista de verbos y sus conjugaciones
e- Nociones básicas de gramática
f- Otros

Conocer lo que significan las distintas abreviaturas en cada entrada es de suma relevancia para así poder encontrar el significado que estamos buscando. Si tomamos las frases nominales *surface energy* y *surface tension* de la sección *Chemical Properties* del texto de arriba podemos ver que la búsqueda de la palabra *surface* se torna relevante puesto que no es una palabra transparente y aparece repetidamente. El primer paso es buscar la frase completa en la que aparece la palabra puesto que puede llegar a ser un término muy utilizado en el campo y ya se lo conoce así. En este caso, el Diccionario Internacional Simon and Schuster no tiene entrada para las combinaciones presentadas.

surface [ˈsɜrfəs, ʙ ˈsɜfəs] *s.* 1. superficie, sobrefaz, cara. 2. aspecto superficial, ej., *he looks only at the s. of things*, él mira solo el aspecto superficial de las cosas. 3. (geom., aer.) superficie. *--a.* superficial, de la superficie, externo, exterior. *–v.t.* 1. allanar, alisar. 2. cepillar, pulir (madera). 3. emplastecer (pared, etc.). 4. (f.c.) emparejar, nivelar. 5. hacer volver a la superficie (submarine). *–v.i.* 1. trabajar en la superficie. 2. Salir o volver a la superficie, emerger (submarine, pez, etc)

Al buscar la palabra *surface* vemos que la misma puede representar distintas clases de palabras- puede ser un sustantivo, un adjetivo, un verbo transitivo y un verbo intransitivo. Dentro de cada clase de palabra podemos encontrar distintos significados como es el caso de *surface* como verbo transitivo “1. allanar, alisar. 2. cepillar, pulir (madera). 3. emplastecer (pared, etc.). 4. (f.c.) emparejar, nivelar. 5. hacer volver a la superficie (submarine)”. Entonces,

son muchas las opciones que hay que tener en cuenta en una entrada y en este caso debemos decidir si *surface* es un adjetivo o un sustantivo premodificando a *energy* y a *tension*. Si es un adjetivo, la lectura de la frase será *energía superficial* y *tensión superficial*. Si es un sustantivo, la interpretación será *energía de la superficie* y *tensión de la superficie*. Si bien las dos interpretaciones llevarían a la comprensión de la frase (siempre y cuando se conozca acerca del tema), los términos utilizados en los textos en castellano son los que toman a *surface* como adjetivo, resultando ser, entonces, la mejor elección.

Aparte de las abreviaturas utilizadas para designar la clase de palabras, hay otros elementos que hay que conocer dentro de una entrada. Por ejemplo, al leer la entrada de *surface*, ¿qué sigue a continuación de la palabra en negrita? ¿qué significa la B?¿cómo aparecen los ejemplos? ¿cómo aparece el equivalente en castellano? ¿cómo está escrita la palabra en cuestión en el ejemplo? ¿qué información se incluye en los paréntesis?

Ahora hagamos el intento de buscar la palabra *pyrophoricity* en la sección *Thermal Properties*. ¿Encontramos la palabra *pyrophoricity*? ¿Por qué está cortada la pronunciación de *pyrophoric*? ¿La entrada de *pyrophoric* nos da indicios de cómo formar la forma comparativa o superlativa del adjetivo? ¿Qué aprendemos acerca del sustantivo *pyrophorus*?

pyrophobia [ˌpaɪrə'foubɪə] *s.* (med.) pirofobia.

pyrophoric [−'fɔrɪk, −'fɑr−, B −'fɔr−] *a.* (quím.) pirofórico.

pyrophorus [paɪ'rɑfərəs, B −'rɔf−] *s.* (*pl.* PYROPHORI [-raɪ]) (quím.) piróforo.

Como se puede ver, la palabra *pyrophoricity* no aparece en una entrada, sólo palabras relacionadas. En este caso, debemos analizar la palabra y utilizar lo que sabemos acerca de sufijos y combinarlo con lo que encontramos en el diccionario. Entonces podemos tomar la palabra *pyrophoric* (adjetivo) + -ity (sufijo utilizado para formar sustantivos) y obtenemos la palabra *piroforicidad*.

Los afijos y el uso del diccionario: los sufijos

Hasta el momento, sólo se han presentado los sufijos conectados con los sustantivos (unidad 3A). Sin embargo, hay sufijos que caracterizan a los adjetivos, adverbios y verbos, los cuales al ser reconocidos pueden facilitar tanto el reconocimiento del tipo de palabra como su búsqueda en el diccionario. A continuación se presentan los sufijos más comunes que caracterizan las distintas clases de palabras (ver APÉNDICE 3 para una descripción de las distintas clases de palabras y APÉNDICE 7 para un listado de sufijos según la función de la palabra):

a. Formación de Verbos

(adj) legal, modern + **-ize/ise** = legalize, modernize

(adj) simple, pure + **-ify** = simplify, purify

(sus) example + **-ify** = exemplify

(adj) dark, loose + -**en** = darken, loosen

b. Formación de Adjetivos

(sus) ease + **-y** = easy

(sus) atom + **-ic** = atomic

(sus) biology, grammar + **-ical** = biological, grammatical

(sus) colour, care + **-ful** = colourful, careful

(sus) colour, strap + **-less** = colourless

(adj) red, brown + **-ish** = reddish, brownish

(sus) danger, space + **-ous** = dangerous, spacious

(sus) difference + -**ial** = differential

(sus) inclusion + **-ive** = inclusive


Recordar la terminación *–er* y *–est* que pueden tener los adjetivos en comparativo y superlativo (Unidad 3A, sección *b. frases adjetivas y APÉNDICE 6*).

c. Formación de Adverbios

(adj) independent + **-ly** = independently

(adj/sus) south + **-ward** = southward

(sust) clock + **-wise** = clockwise

Nota: Los adverbios también pueden agregar la terminación *–er* y *–est* estudiada para los adjetivos (Ver APÉNDICE 6).

d. El sufijo/La forma –ing

Como vimos en la unidad 3A, el sufijo **–ing,** comúnmente asociado con verbos, puede presentar dificultades para los estudiantes de lecto-comprensión. Repasemos aquí las funciones que hemos visto hasta ahora que pueden cumplir las palabras terminadas en **–ing**, aunque sus usos se irán esclareciendo y detallando en unidades siguientes.

Palabra en –ing puede cumplir:

a. La función sustantivo (unidad 3A) the materials used in Engineer**ing**
b. La función adjetivo (unidad 3A) determin**ing** properties
c. La función preposición + –ar, -er, -ir (Unidad 3A) There is increased interest in research**ing** new materials for space engineering.

e. El sufijo/La forma –ed

El sufijo –ed también puede tener funciones varias dependiendo del lugar en la oración. Hasta ahora sólo hemos visto una, palabra en –ed funcionando como:

1. *adjetivo* cement-bas**ed** materials (la palabra en –ed agrega información acerca del sustantivo. Sabemos que estamos hablando de materiales pero son materiales a base de cemento)

Los afijos y el uso del diccionario: los prefijos

Los prefijos son afijos que se agregan al comienzo de una palabra. El uso de los mismos no implica el paso de un tipo de palabra a otra – como es el caso de los sufijos derivativos estudiados arriba en *a,b,c*- sino que hacen que su significado cambie ya sea para expresar el sentido opuesto u otro significado, como se expone debajo.

a. Prefijos negativos

a- + (adj) typical = atypical
anti- + (sus) technology = antitechnology
counter- + (sus) argument = counterargument
de- + (v) centralize = decentralize
dis- + (v) charge = discharge
il- + (adj) legal = illegal
im- + (adj) possible = impossible

in- + (adj) adequate = inadequate
ir- + (adj) rational = irrational
non- + (adj) available = non-available

b. *Otros prefijos*
pre- + (adj) established = preestablished
auto- + (sus) ignition = autoignition
bi- + (adj) annual = biannual
micro- + (sus) processor = microprocessor
re- + (v) structure = restructure
over- + (v) simplify = oversimplify
inter- + adj) connected= interconnected


Las palabras pueden no aparecer en el diccionario como las vemos en el texto. Es importante conocer los posibles afijos para saber cómo buscarlas.

Dada la diferencia entre un diccionario y otro y la gran variedad de afijos que pueden aparecer en una palabra, la búsqueda en el diccionario no es una tarea pasiva en la que la información aparece siempre lista para usar. Al disponerse a buscar un término, los alumnos deberán analizar si la palabra puede ser encontrada de la misma manera que aparece en el texto o si deberán tratar de encontrar una palabra similar y asignarle el valor que corresponda de acuerdo con el sufijo presente. Una vez localizada la posible entrada, es el usuario el que le va a dar sentido a lo que está buscando ya sea utilizando conocimiento previo, conocimiento acerca de la lengua y conocimiento del diccionario que posee. Para poder abordar dicha tarea, el uso del diccionario debe ser realizado procurando utilizar el mismo diccionario en cada acto de lectura- a menos que se consulten distintas fuentes- para así asegurar no sumar un obstáculo más a la tarea de asignar significados a través de esta herramienta.

Para más información acerca de prefijos y sufijos ver APÉNDICE 7.

Para repasar:

Encuentra en el texto una palabra relacionada con la palabra en la primera columna. Luego intenta esclarecer el significado de la frase en la que la palabra se encuentra.

Palabra	**Valor**	**Palabra en el texto**	**Valor**	**Line number**
quantity (sus)	*cantidad*	*quantitative (adj)*	*cuantitativa*	*line 1*
meter (sus)	metro			
beneficial (adj)	beneficioso			
function (v)	funcionar			
depend (v)	depender			
vary (v)	variar			
line (sus)	línea			
operate (v)	operar, funcionar			
signify (v)	tener importancia/relevancia			
constitute (v)	constituir/componer			
standard (sus)	estándar			

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

4B Over to your Career Path

Activity 1: Scan the text and complete.

Source: .....
Date of publication: .....
Place of publication: .....
Date of retrieval: .....
Number of technical papers: ......

Activity 2: Find an article that makes reference to:

a- Concreto liviano
b- Agregados finos
c- Fatigas térmicas
d- Concreto auto-consolidante
e- Resistencia a tracción
f- Módulo de elasticidad
g- Pastas de cementos combinados
h- Perfiles de fibra orientada

Activity 3: Match the following definitions to four of the words in activity 2.

a- A type of porous concrete. According to its features and uses it is similar to aerated concrete.
b- Stress introduced by uniform or non-uniform temperature change in a structure or material which is constrained against expansion or contraction.
c- The resistance of a material to a force tending to tear it apart, measured as the maximum tension the material can withstand without tearing.
d- A measurement of elasticity obtained by dividing stress below the proportional limit by its corresponding strain value. A measure of stiffness.

Activity 4: Find the value of the following words in the dictionary.

a- Thickness (article on page 625)
b- Shrinkage (article on page 631)
c- Behavior (article on page 631)
d- Uptake (article on page 657)
e- Sealant (article on page 688)

Activity 5: Match the following ABSTRACTS to four of the technical papers.

a- Article's Name:

_____

To evaluate and optimize new engineered wood products such as oriented strand lumber (OSL), it is necessary to investigate their mechanical properties and the influence of the manufacturing process on these mechanical properties. In a conventional manufacturing process, the vertical density profile (VDP) of OSL is typically non-uniform through its thickness. In this study, the relationships between
5 VDP, tensile strength, and modulus of elasticity (MOE) through the thickness of OSL were investigated. The scope was primarily experimental. OSL specimens were sliced into thin layers, and tension tests performed with these layers. Based on the test results, tensile strength and MOE were determined and related to the respective density of each layer. Equations to predict tensile strength and MOE based on density were also developed.

b- Article's Name:

_____

Adhesives are being increasingly used in civil engineering applications as a means of bonding together similar or dissimilar materials. The prediction of the strength of bonded components is therefore vitally important and different analytical approaches and methods are being used to investigate and predict the durability of adhesive joints. In this work an attempt has been made to predict the durability of butt mild steel adhesive joints subjected to static stresses in the presence of water from data obtained using double-torsion mild steel adhesive joints subjected to similar conditions. In both cases accelerated aging test equipment were built. The first step in developing a test method and model for predicting the environmental fracture data of butt adhesive joints has been proposed that was independent of the detailed butt joint geometry. The model was reasonably successful and accounted for the excessive crack tip blunting that occurred in the adhesives. This is the first time such a model is reported in the literature that may be useful when all variables are included.

c- Article's Name:

_____

In this paper, the effects of carbonation on pore structure of blended pozzolan cement pastes were investigated. Ordinary Portland cement (OPC) was partially replaced with ground palm oil fuel ash (POA), ground rice husk ash (RHA) and classified fine fly ash (FA). The strength, total porosity, specific surface area, and pore size distribution were tested. In general, incorporation of pozzolans increased the total porosity of blended cement pastes in comparison to that of OPC paste. Carbonation of pastes under 5% CO_2 and 50% relative humidity (RH) for 28 days resulted in filling of the pore voids and possible attack on calcium silicate hydrate (CSH) depending on the type of pozzolan used. After carbonation, total porosity decreased and specific surface areas of the blended pozzolan cement pastes reduced indicating the infilling of voids. Pore size distributions of POA and RHA pastes were different to those of FA pastes. Large pores of the POA and RHA pastes were increased indicating coarsening of pores owing to possible attack on CSH. It is possible that POA and RHA were highly reactive and hence their uses resulting in severe carbonation compared to use of FA.

d- Article's Name:

_____

In the absence of coarse aggregate, the relative influence of factors affecting the shrinkage of foam concrete are likely to be different as compared to normal concrete. This paper presents the shrinkage behavior of preformed foam concrete for the influences of basic parameters, viz, density, moisture content, composition like filler-cement ratio, levels of replacement of sand with fly ash, and foam volume. Shrinkage of foam concrete is lower than the corresponding base mix. For a foam concrete with 50% foam volume, the shrinkage was observed to be about 36% lower than that of a base mix. The shrinkage of foam concrete is a function of foam volume and thus indirectly related to the amount and properties of shrinkable paste. Shrinkage increases greatly in the range of low moisture content. Even though removal of water from comparatively bigger artificial air pores will not contribute to shrinkage, artificial air voids may have, to some extent, an effect on volume stability indirectly by allowing some shrinkage; this effect was more at a higher foam volume.

Activity 6: Give the value of the four titles above.

a-

b-

c-

d-

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Technical Papers

Technical Notes

Activity 7: Circle the affixes in the underlined words and state word class. Then, provide the meaning of the technical paper's title.

a- 637 Predicting the Environmental Lifetime of Adhesive Joints under Laboratory Conditions.
b- 648 Application of GEM Equation in Microstructure Characterization of Cement-Based Materials
c- 657 Carbonated Ladle Slag Fines for Carbon Uptake and Sand Substitute
d- 672 Prediction of Fresh and Hardened Properties of Self- Consolidating Concrete

Activity 8: State the value of the following **–ing** and **–ed** words in the phrases below.

Word	**Line**	**In the phrase**	**Value**
engineered	*1*	*engineered wood products*	*productos de madera prensada*
oriented	1	oriented strand lumber	
manufacturing	2	the manufacturing process	
bonding	10	of bonding together similar and dissimilar materials	
bonded	11	bonded components	
blended	28	the blended pozzolan cement pastes	
coarsening	31	coarsening of pores	
preformed	35	preformed foam concrete	

State the function of the –ing words above:
a- Sustantivo
b- Adjetivo
c- Preposición -ar, -er, -ir (o un sustantivo)

Now analyze these:

investigated	5	were investigated	
sliced	6	were sliced	
based	7	based on the test results	

Activity 9: Choose the best option.

1- (abstract 1) It is important to investigate…
   a. …new engineered wood products' mechanical properties.
   b. …new mechanical properties of wood.
   c. …properties of new mechanical wood products.
2- (abstract 2) The phrase "butt mild steel adhesive joints" (line 14) refers to…
   a. …a kind of metal.
   b. …a type of joint.
   c. …a kind of adhesive.

3- The phrase “accelerated aging test equipment” (line 16) refers to…
   a. …a type of test.
   b. …a kind of equipment used.
   c. …a type of acceleration equipment.

Justification: ……

Cuando se pide una justificación, se debe explicar la razón por la que se ha elegido una opción. No es suficiente con poner la línea en la que aparece lo que se interpreta como la respuesta.

4- The experiment was aimed at…
   a. …developing a method for predicting adhesive joint durability.
   b. …testing adhesive joint strength.
   c. …predicting adhesive joint aging.

5- (abstract 3) This paper presents the results of.…
   a. …mixing Ordinary Portland Cement with different pozzolans.
   b. …blending ground rice hush ash with Ordinary Portland Cement.
   c. …combining classified fine fly ash with Ordinary Portland Cement.

Justification: …….

6- (abstract 4) This paper is about…
   a. …preformed foam concrete shrinking behavior.
   b. …foam concrete behavioral formation.
   c. …shrinkage behavior of concrete foam.

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5A Segmentos significativos en el texto: La frase verbal en tiempo presente

1- Scan the texts and underline the information specified below.

Text 1

What are intelligent materials?
Intelligent materials adapt to their environment by altering their properties, such as thermochromic glazing that changes its transparency in response to changing temperatures.

Retrieved and adapted November 25, 2010 from

Text 3

Intelligent Materials

Wood, stone, ceramics— for thousands of years people have made use of all kinds of naturally available materials. But things are changing in a big way. Researchers are now customizing materials for a variety of purposes, and they are even doing it at the atomic level. The future belongs to intelligent materials.

Retrieved and adapted November 25, 2010 from http://www.siemens.com/innovation/en/publikationen/publications_pof/pof_spring_2003/materials_articles/intelligen

Text 2

Are smart materials intelligent?

In recent years, there have been significant developments in the science and applications of intelligent, or 'smart', materials. These can be defined as materials with one or more properties (e.g. mechanical, thermal, optical, or electromagnetic properties) that can be varied in a predictable or controllable way in response to external stimuli, such as, for example, stress, temperature, moisture, pH and electric or magnetic fields. Such materials are now used in a vast number of applications, from photochromic lenses for sunglasses to military and aerospace uses.

What do smart structures incorporate?

Smart structures incorporate smart materials and exhibit one or more of the following features:

- sensors or actuators which are either embedded within a structural material or else bonded to the surface of that material
- control capabilities which permit the behaviour of the material to respond to an external stimulus according to a prescribed functional relationship or control algorithm

A smart structure is thus an integrated system comprising actuators, sensors and a control system.

When do smart materials become intelligent?

At a more sophisticated level, smart materials become intelligent when they have the ability to respond intelligently and autonomously to *dynamically-changing environmental conditions*.

When we say intelligent materials, what technologies are we talking about?

The technologies encompassed by intelligent materials are very diverse and include electrorheological fluids, fibrous materials, ceramics, photonics, microsensors, signal processing, piezoelectrics, dielectric elastomers, biomimetics, shape memory alloys, neural networks, nanotechnology, conducting and chiral polymers, liquid crystals, microactuators, biotechnology and information processing.

How are smart materials used?

Potential applications are similarly widespread and have excited interest in industrial, military, commercial, medical, automotive and aerospace fields. Embedded fibre-optic sensing systems are employed in many engineering disciplines to monitor critical characteristics. Several smart skins programmes have been initiated for both civil and military aircraft. Large space structures are also candidates for the incorporation of smart structural systems because of the variable service conditions in which they operate.

Retrieved and adapted November 25, 2010 from
http://www.theiet.org/publishing/inspec/support/newsletter/subjectspot/smart.cfm

a- Definition of intelligent/smart materials
b- Characterizing features of smart structures
c- Materials and technologies listed as smart materials

2- Scan the texts and choose the correct alternative.

Text 1

1- Intelligent materials adapt to their environment in a way that they…..
   a. …alter their properties.
   b. …are altering their properties.
   c. …have altered their properties.

Text 2

a. According to this text, smart or intelligent materials…
   a. …can have only one property.
   b. …can have many properties.
   c. …can have only one or many properties.
b. A smart structure is an integrated system…
   a. …that includes actuators, sensors, and a control system.
   b. …that is including actuators, sensors and a control system.
   c. …that has included actuators, sensors and a control system.
c. "*dynamically-changing environmental conditions*" means…
   a. …environmental conditions that change dynamically.
   b. …environmental conditions that are changing dynamically.
   c. …environmental conditions that have changed dynamically.

Text 3

1- According to the text, people… …
   a. …have always used materials such as wood, stone, ceramics.
   b. …are using materials such as wood, stone, ceramics differently now.
   c. …have always used and they are using materials such as wood, stone, ceramics differently now.
2- Researchers…..
   a. …are working on materials at the atomic level.
   b. …are not working on materials at the atomic level.
   c. …have always worked on materials at the atomic level.

Introducción a la frase verbal

La frase verbal puede ser descripta de muchas maneras, dependiendo del aspecto del verbo que se toma en consideración. Entonces podemos hablar de:

Clasificación	**Ejemplo**
Frase verbal simple (un solo verbo)	Intelligent materials **adapt** to their environment … (texto 1)
Frase verbal compuesta (más de un verbo)	In recent years, there **have been** significant developments in the science and applications of intelligent, or 'smart' materials. (texto 2). Reaserchers **are** now **customizing** materials for a variety of purposes… (texto 3)

Frase verbal en voz activa	Smart structures incorporate smart materials… (texto 2)
Frase verbal en voz pasiva (Ver Unidad 9A y APÉNDICE 8)	These **can be defined** as materials with one or more properties… (texto 2) (*Éstos **pueden ser definidos** (por alguien) como materiales con una o más propiedades*- La voz pasiva se estudiará más adelante)

Verbos auxiliares (los que acompañan a los verbos lexicales/principales para dar detalles de persona, número, tiempo)	In recent years, there **have** been significant developments in the science and applications of intelligent, or 'smart' materials. (texto 2). Reaserchers **are** now customizing materials for a variety of purposes… (texto 3- el primer verbo de la frase es el verbo auxiliar)
Verbos lexicales o principales (los que llevan la idea de la acción/estado)	In recent years, there have **been** significant developments in the science and applications of intelligent, or 'smart' materials. (texto 2). Reaserchers are now **customizing** materials for a variety of purposes… (texto 3- el primer verbo de la frase es el verbo auxiliar)

Verbos auxiliares primarios (su función es gramatical, es decir, dar idea de persona, número y tiempo)	Internet users **have** grown 300% (linea 67) … It **is** estimated that the Internet grew by 100% per year during the 1990s. (linea 67)
Verbos auxiliares modales (éstos expresan variedad de significados: posibilidad, obligación, deducción, etc)	…these nations **must** adopt economic and policies which promote trade…(line 100)

Verbos conjugados (una frase verbal completa, es decir, al escucharla sabemos a qué persona hace referencia y en qué tiempo)	Smart structures **incorporate** smart materials… (texto 2) Las estructuras inteligentes **incorporan** materiales inteligentes… es decir, *ellas* –las estructuras- *incorpor**an*** – en tiempo presente- *materiales inteligentes*.
Verbos sin conjugar (no hacen diferenciación entre persona, número o tiempo)	Intelligent materials adapt to their environment by **altering** their properties… (texto 1- es un verbo que termina en –ing pero al no estar acompañado del verbo *to be*, se dice que no está conjugado. (Estos verbos serán estudiados más adelante)

Para más información sobre los aspectos detallados arriba, ver APÉNDICE 8.

Los verbos y el tiempo verbal

Otra manera de caracterizar a la frase verbal es por el tiempo al que hace referencia, es decir al presente, pasado o futuro. Cabe aclarar que el verbo en inglés sólo puede hacer diferenciación entre presente y pasado a través de su morfología. Para indicar la idea de futuro se necesita hacer uso de verbos auxiliares; no puede expresarlo en el verbo mismo como hacemos en castellano al decir *estudia**ré***, por ejemplo. En este apartado nos focalizaremos en los verbos en tiempo presente en voz activa.

a- El Presente Simple

El tiempo presente simple se utiliza en general para hablar de:
- Verdades eternas;
- Datos, hechos;
- Acciones cotidianas;
- Descripción de un proceso, mecanismo, etc.

Descriptores de tiempo utilizados con el presente simple son: *usually, generally, always, seldom, every year*, etc.

El verbo en tiempo Presente Simple se reconoce por su forma base (como aparece en la primera columna en los listados de verbos -ver APÉNDICE 11-, a excepción del verbo BE) cuando se conjuga con las personas I, YOU, WE, THEY y por agregar el sufijo **–s**, **-es** o **–ies** cuando es conjugado con HE, SHE, IT. Entonces se lo puede representar así:

I
YOU **use** intelligent materials; **develop** new intelligent systems; **identify** new problems
WE
THEY

HE
SHE **uses** intelligent materials; **develops** new intelligent systems; **identif*ies*** new
IT problems

b- El Presente Perfecto

El Presente Perfecto se utiliza generalmente para:
- Hablar de situaciones, eventos o estados que comenzaron en el pasado pero que se extienden hasta el presente. Es decir, lo utilizamos para hablar de acciones que *hemos hecho* desde algún tiempo atrás hasta ahora. Segmentos indicadores de tiempo que acompañan a este uso del Presente Perfecto son *since* + dato especificando fecha, *for* + expresión especificando duración, in the last few years/decades;
- Destacar un hecho que ocurrió en el pasado, pero que tiene consecuencia en el presente. Palabras que acompañan al Presente Perfecto en este uso son *just*, *recently*, *yet*;
- Hablar de acciones, situaciones, que hemos experimentado a lo largo de la vida sin especificar cuándo y hechos ocurridos en un pasado reciente. Palabras relacionadas con este uso son *ever*, *never*, *in my life*, *already*, *just, recently*, etc.


Aquí encontramos una nueva función para la *forma – ed*: *Función Verbo Conjugado*.

El verbo en voz activa en el tiempo Presente Perfecto Simple se reconoce por la siguiente forma:

HAVE / HAS + Verbo en Pasado Participio (3era columna)

I
YOU **have used** intelligent materials; **have developed** new intelligent systems; **have**

WE **identified** a new problem; **have written** a report recently.
THEY

HE
SHE **has used** intelligent materials; **has developed** new intelligent systems; **has**
IT **identified** a new problem; **has written** a report recently.

c- El Presente Progresivo o Continuo

El Presente Progresivo se utiliza generalmente para:

- Referirse a acciones que ocurren en el momento de estar hablando;
- Hablar sobre situaciones que ocurren en un presente que se extiende un poco más allá del ahora;
- Hablar sobre acciones futuras que ya han sido acordadas con anterioridad. (Un uso especial con idea de futuro).

Los marcadores de tiempo característicos del Presente Progresivo pueden incluir *now*, *at this moment, these days*, etc. Cabe destacar que el Presente Progresivo no es un tiempo verbal muy frecuente en los géneros explorados en las ingenierías, a menos que se trate de una sección dentro de artículo de noticias o de investigación en el que se discuta lo que se está haciendo actualmente con respecto al tema desarrollado en el texto.


Aquí encontramos una nueva función para la forma –*ing*: Función Verbo Conjugado.

El verbo en voz activa en el tiempo Presente Progresivo se reconoce por la siguiente forma:

BE (am, is, are) **+ Verbo en –ing**

I	**am**	
HE/SHE/IT	**is**	**researching** new intelligent materials.
WE/YOU/THEY	**are**	

Para resumir:

Tipo de presente	**Nombre**	**Forma**	**En inglés**	**En español**
Rutina, hechos, verdades eternas	Presente Simple	Verbo base (primera columna) o verbo terminado en -s/-es/-ies	I research / She researches intelligent materials.	Yo investigo/Ella investiga materiales inteligentes.
Ahora, en este momento	Presente continuo o progresivo	Verbo *to be* (is/are/am)+ un verbo en -ing	I am researching… She is researching…	Yo estoy investigando… Ella está investigando…
Unión del pasado con el presente	Presente perfecto	HAVE/HAS + verbo en tercera columna	I have researched/ She has researched	Yo he investigado/Ella ha investigado

			intelligent materials for 4 years now.	materiales inteligentes por cuatro años.

En cuanto a la forma *–ing* que hasta ahora hemos visto podemos resumir (más información en APÉNDICE 14):

d. La función sustantivo (unidad 3A, 4A) the materials used in Engineer**ing**
e. La función adjetivo – antes del sustantivo (unidad 3A, 4A) determin**ing** properties
f. La función preposición + –ar, -er, -ir (unidad 3A) There is increased interest in research**ing** new materials for space engineering. (repasar uso especial de la preposición *by* + -ing con significado –ando, -endo)
g. La función como parte de frase verbal conjugada: They <u>are research**ing**</u> the application of intelligent materials these days.

En cuanto a la forma *–ed* que hasta ahora hemos visto podemos resumir:

a. La función adjetivo: preform**ed** cement
b. La función parte de frase verbal conjugada: Researchers <u>have customiz**ed**</u> many materials in the last decade (veremos más instancias de esta función en las unidades 9 y 10).

Para repasar:

Choose the best option:

1- These days, researchers **are transforming** / **transform** / **have transformed** traditional materials for new purposes.
2- People **are using** / **use** / **have used** traditional materials for many years.
3- Intelligent materials **are having / have / have had** the ability to adapt to the conditions of the environment.
4- To adapt to the environment, intelligent materials **alter / are altering / have altered** their properties.
5- Intelligent materials **are developing / develop / have developed** considerably in the last decade.
6- These materials **are presenting / present / have presented** properties that can change in a predictable or controllable way.
7- A smart structure is an integrated system that **is comprising /comprises /has comprised** actuators, sensors and a control system.
8- Researchers **are considering / consider / have considered** the incorporation of smart structural systems into large space structures at the moment.

Los verbos y las preguntas

En los textos 1 y 2 de arriba encontramos varias preguntas utilizadas para desarrollar los temas. Ellas son:

Texto 1
a. What are intelligent materials?

Texto 2
b. Are smart materials intelligent?
c. What do smart structures incorporate?
d. When do smart materials become intelligent?
e. When we say intelligent materials, what technologies are we talking about?
f. How are smart materials used?

La mayoría de estas preguntas contienen un "interrogante" que se focaliza en la palabra WH. En algunos casos, esta palabra puede estar acompañada por una frase nominal como es el caso de la pregunta *e (what technologies)*. Las palabras que pueden encabezar una pregunta WH son: What? (Qué?, Cuál?); Which? (Cuál?); When? (Cuándo?); Where? (Dónde?); Why? (Por qué?); How? (Cómo?); How much/many? (Cuánto/a, Cuántos/as?); Who? (Quién?); Whose? (De quién?)

Para formular una pregunta es necesario hacer uso de un verbo auxiliar, ya sea el que corresponde al tiempo verbal al que se hace referencia o un verbo modal, que expresan distintos significados (posibilidad, probabilidad, obligación, necesidad, etc.- Ver APÉNDICE 13 para más información). Los verbos auxiliares correspondientes a los tiempos verbales que hemos analizado arriba son:

Presente Simple	do (I, we, you, they)/ does (he, she, it)	What **do** smart structures incorporate?
Presente Perfecto	have (I, we, you, they)/ has (he, she, it)	Why **have** those changes affected our society? What **has** this change meant to our society?
Presente Progresivo	am (I) / is (he, she, it)/ are (you, we, they)	**Am** I explaining this topic in a clear way? What **is** the reasearcher analyzing in this section of the article? What **are** the researchers investigating right now?

Si bien pareciera que las preguntas en a-f son todas distintas, hay una estructura subyacente que se podría expresar de la siguiente manera:

	PALABRA WH (+ frase nominal) +	**AUXILIAR (o verbo BE como verbo principal)+**	**PERSONA +**	**(otro verbo auxiliar +) VERBO LEXICAL +**	**(COMPLEMENTO DEL VERBO)**
a-	What	are	intelligent materials?		
b-		Are	smart materials		intelligent?
c-	What	do	smart structures	incorporate?	
d-	When	do	smart materials	become	intelligent?
e-	What technologies	are	we	talking about?	
f-	How	are	smart materials	used?	

Algunas preguntas son muy fáciles de comprender, en especial las que contienen al verbo BE (ser/estar). Cuando otro tipo de verbo auxiliar aparece, como es el caso de la pregunta c, lo que se debe hacer para comprender la pregunta es poner el verbo auxiliar y el principal

juntos para darle significado. Es decir, en *What do smart structures incorporate*? Lo que hacemos es juntar el verbo *do* y el *incorporate* para decir *incorporan*. ¿Cómo sabemos que esto es así? El verbo do (como auxiliar del tiempo Presente Simple) es el que nos da la clave de que estamos hablando del presente y no del pasado, por ejemplo. Asimismo, por estar en la forma *do* en vez de *does* nos dice que estamos ante las personas *I, we, you o they* –en vez de *he, she, it*- lo que se comprueba al ver la frase *smart structures*, que puede ser reemplazada por *they*, lo que nos hace decir *incorporan* y no *incorpora* o *incorporo*.

Como se puede ver en el cuadro, cuando el verbo BE es utilizado como verbo principal, éste ocupa el lugar del verbo auxiliar, sin necesidad de contar con otro verbo en la pregunta (pregunta *a*). El verbo BE es el único que se comporta de esta manera en inglés. Sin embargo, una situación que se asemeja al comportamiento del verbo BE es cuando la entidad que realiza la acción denotada por el verbo es el foco de la pregunta. Entonces decimos:

Who **invented** the optical fiber?

Which company **introduced** electric cars into the market first?

Estas preguntas requieren información acerca de quién realizó algo y del nombre de una compañía. El verbo principal ocupa el lugar del verbo auxiliar y se lo conjuga de la misma manera que en una oración.

A diferencia de la mayoría de las preguntas presentadas arriba, hay preguntas que sólo buscan la confirmación de la información dada en la misma. Estas preguntas requieren como respuesta un SI o un NO. Cuando éste es el caso, la estructura de la misma se puede describir así, siempre comenzando con un verbo:

AUXILIAR (o verbo BE como verbo principal) +	**PERSONA +**	**(otro verbo auxiliar +) VERBO LEXICAL +**	**(COMPLEMENTO DEL VERBO)**
Do	engineering students	need to have	a new set of engineering skills…?
Has	all this	affected	the world trade?
Are	smart materials		important?

Para repasar:

Place the questions in the table below.

a. How do smart structures behave at low temperatures?
b. How many new materials have researchers customized?
c. Are ceramics smart?
d. Do researchers work at the atomic level?
e. Why does this new technology require attention from researchers?

	PALABRA WH (+ frase nominal)+	**AUXILIAR (o verbo BE como verbo principal)+**	**PERSONA +**	**(otro verbo auxiliar +) VERBO LEXICAL +**	**(COMPLEMENTO DEL VERBO)**
a-					
b-					

c-					
d-					
e-					

Los verbos y la negación

Para negar un verbo en inglés se hace uso de la palabra NOT y del verbo auxiliar correspondiente al tiempo verbal al que se hace referencia a través del verbo lexical. Entonces la negación se podría representar de la siguiente manera:

Presente Simple (hechos, rutina, verdades eternas)	do/does	do not, don't / does not, doesn't	Researchers **do not** find a solution. / The article **does not** discuss that aspect of the problem.
Presente Perfecto Simple (el tiempo que une el pasado con el presente)	have / has	has not, hasn't / have not, haven't	Researchers **have not** found a solution to the problem yet. / The present article **has not** discussed the positive results of the research conducted yet.
Presente Progresivo (en este momento, ahora)	am / is / are	am not, 'm not / is not, isn't / are not, aren't	I **am not** studying the effects of the new transportation system on the environment. / The university **is not** researching the effects of…. / Researchers **are not** studying the effects…..

Para un resumen de los tiempos verbales presentados aquí ver APÉNDICE 8 (concentrarse sólo en el cuadro de la voz activa.

Otros verbos: Verbos auxiliares modales

En la Introducción a la frase verbal se hizo mención a los verbos auxiliares modales, que por su función de auxiliares acompañan a los verbos que controlan una cierta idea en la oración. Estos verbos auxiliares, a diferencia de los verbos auxiliares primarios (be, do, have), tienen significados específicos. Dependiendo del contexto en el que se encuentran su significado puede presentar variaciones. Los verbos modales son (la lista no es exhaustiva – ver más información en el APÉNDICE 13):

	Ejemplo en voz activa	**Significado**
CAN	The system *can solve* the energy problem.	El sistema *puede solucionar* el problema de energía.
COULD	The system *could solve* the energy problem. The researchers *could not solve* the problem.	El sistema *podría solucionar* el problema de energía. Los investigadores *no pudieron solucionar* el problema.
MAY	This *may cause* a problem.	Esto *puede causar* un problema.
MIGHT	This *might cause* a problem.	Esto *podría causar* un problema.

MUST	Researchers *must find* a solution soon.	Los investigadores *deben encontrar* una solución pronto.
SHOULD	Researchers *should find* a solution soon.	Los investigadores *deberían encontrar* una solución pronto.
WILL	Researchers *will find* a solution soon.	Los investigadores *encontrarán* una solución pronto.
WOULD	Researchers *would find* a solution if they had more resources.	Los investigadores *encontrarían* una solución si tuvieran más recursos.

Para repasar:

Choose the correct option:

a. What **can** smart materials **do**? = ¿Qué **pueden** hacer**/deben** hacer**/deberían** hacer los materiales inteligentes?
b. These materials **would be** more readily available if they were made in Argentina. = Estos materiales **deberían estar/podrían estar/estarían** más disponibles si fueran hechos en Argentina.
c. Researchers **could find** a solution soon. = Los investigadores **podrían encontrar /podrán encontrar/encontrarán** una solución pronto.
d. We **should** not **expose** this device to sunlight. = No **deberíamos exponer/debemos exponer/debíamos exponer** este artefacto a la luz solar.
e. **Will** this material **be** available here in Argentina soon? = ¿**Estaría/Estará/Está** este material disponible aquí en Argentina?

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual

5B Over to your Career Path

Activity 1: Scan the text and complete.

ScienceDaily
Your source for the latest research news

Web address:
http://www.sciencedaily.com/releases/2009/10/091029161253.htm

Liquid Granite: Building Material Of The Future Unveiled

Glossary
unveil: (verb) to show or tell people about a new product
breakthrough: (noun)- a new discovery
carbon footprint: (noun)- carbon dioxide produced by a product
withstand: (verb)- to remain stable in the presence of heat, cold, pressure, etc.
lintel: (noun) a piece or wood or stone across the top of a window, forming part of the frame.
Definitions adapted from LDOCE

ScienceDaily (Nov. 4, 2009) — Scientists have developed a new building material that is fire resistant to temperatures in excess of 1100 degrees Celsius, is made largely from recycled material and is as versatile as concrete.

Liquid Granite offers a real breakthrough in reducing fire risk in buildings as, unlike concrete, it doesn't explode at high temperatures. It can also withstand high temperatures for longer periods, offering valuable minutes in the case of a fire.

The material is made up of between 30 and 70 per cent recycled material, mainly base products from industry. It uses less than one third of the cement used in precast concrete, which also reduces its carbon footprint.

The product was developed at Sheffield Hallam University and is available from Liquid Granite Ltd. The new material is being used by a number of organisations in building projects as it has a four hour fire rating, meaning that it provides the top level of protection in the case of a fire.

Professor Pal Mangat is the Director of the Centre of Infrastructure Management at Sheffield Hallam University and developed Liquid Granite. He explains, "Liquid Granite is a very versatile material that can be used in a similar way to concrete. The fact it has a high level of fire resistance means that it can be used in areas where fire safety is crucial, such as around power stations, and in domestic and commercial buildings can offer added time for evacuation in case of an emergency.

"The product replaces most of the cement in standard concrete with a secret formula of products to change the basic properties of the material. I believe it has great potential for the future."

Bob Richards from Liquid Granite said, "There has already been a great deal of interest from the building industry about this product, and it has been supplied onto projects such as the Olympic Village and Stratford Shopping Centre in London in the form of fire rated lintels manufactured by King Stone Products'. It will really make a difference to the safety of our buildings and could potentially save lives."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Sheffield Hallam University**, via AlphaGalileo.

Retrieved January 13, 2011 from http://www.sciencedaily.com/releases/2009/10/091029161253.ht

a- Article's title:
b- Article's topic:
c- Date of publication:
d- Source of publication:
e- Type of publication:
f- Summary of story (line numbers):

Activity 2: Are the following questions answered by the text? If your answer is YES, match the questions to the parts of the text where they are answered.

Question	YES (directly)	Yes (indirectly)	NO	Part of Text
a- What is this new material made of?				
b- Where is this product available from?				
c- Is this product available in South America?				
d- What are the advantages of this material?				
e- Where can this material be very effective?				
f- Is liquid granite used to build football stadiums?				
g- Do environmentalists approve of the use of this material?				
h- How much cement does this material use?				

Activity 3: Choose the *best* option:

1- Researchers…
   a. …are developing a new material.
   b. …have worked on and produced a new material.
   c. …work on a new material every year.

JUSTIFICATION: ……

2- This new material is important because it is good at….
   a. …reducing fire risks.
   b. …reducing building costs.
   c. …building fire structures at a lower cost.

3- Because liquid granite uses less cement, there is ….
   a. …reduction in carbon dioxide intake.
   b. …carbon footprint reduction.
   c. …higher carbon footprint.

JUSTIFICATION: ……

4- A number of organizations…
   a. …are using liquid granite in their building projects.
   b. …have used liquid granite in their building projects.
   c. …use liquid granite in their building projects.

Cuando se pide una justificación, se debe explicar la razón por la que se ha elegido una opción. No es suficiente con poner la línea en la que aparece lo que se interpreta como la respuesta.

5- Liquid granite is…
   a. …as fire resistant as concrete.
   b. …more fire resistant than concrete.
   c. …less fire resistant than concrete.

Activity 4: Are the following statements TRUE or FALSE?

a- Liquid granite is an environmentally friendly building material.
b- Many organizations are using this material at the moment.
c- Researchers have been working with this new material for 50 years now.
d- In case of a fire, this new material has a four hour rating.
e- The reduction of carbon-dioxide emission is an advantage in using this material.

Activity 5: In the statements above, what is the function of the –ing form?

Forma-ing	**sustantivo**	**adjetivo**	**preposición + ar,er,ir**	**Parte de frase verbal conjugada**
a- building				
b- using				
c- working				
d- rating				
e- using				

Homework – To turn in

What have you learned about liquid granite? Write a summary.

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

Review Section 2

Activity 1: Scan the following brochure about liquid granite, retrieved and adapted January 14, 2011 from http://www.liquidgranite.co.uk/Images/Liquid%20Granite%20Brochure.pdf. Write five questions in Spanish, predicting the contents of the brochure.

1- .....
2- .....
3- .....
4- .....
5- .....

Activity 2: Complete the following outline of the brochure.

CHANGING THE WAY PROFESSIONALS THINK
What is LIQUID GRANITE?

THINK ABOUT STRUCTURAL CONCRETE
Sheffield Hallam University
.....

.....
Heat
Strength

SAFETY FOR THE CONSTRUCTION INDUSTRY
.....
.....
.....

LIQUID GRANITE Applications
.....
Structural concrete
.....

Activity 3: Where do you find.... Underline this exact information in the text.

a- ...a definition of Liquid Granite?
b- ...information about the person responsible for the Liquid Granite project at Sheffield Hallam University?
c- ...a description of the work Bodycote Warrington does in connection with Liquid Granite?
d- ...the results of a strength test conducted using a lintel made from this product?
e- ...Liquid Granite's water absorption value?
f- ...the percentage of cement used by Liquid Granite?
g- ...the uses of Liquid Granite.

Activity 4: Choose the correct option based on the information in the text. Justify your answers orally.

1- The technology used to develop Liquid Granite is…
   a. …highly advanced and innovative;
   b. …conventional;
   c. …interesting.
2- In today's construction industry,
   a. …strengthening materials are needed;
   b. …strong and fire resistant materials are needed;
   c. …fireproof and waterproof materials are needed.
3- The word "breakthrough" (noun) on line 15 means…
   a. …discovery.
   b. …equipment.
   c. …method.
4- The best equivalent for "…Liquid Granite comes as a real breakthrough in reducing fire risk in building construction" (lines 15-16) is….
   a. …Liquid Granite is a real breakthrough in the reduction of fire risk in building construction.
   b. …Liquid Granite is a real breakthrough because it reduces fire risk in building construction.
   c. …Liquid Granite is a real breakthrough because it has reduced fire risk in building construction.
5- Bodycote Warrington Fire…
   a. …are conducting the fire testing on Liquid Granite.
   b. …have conducted the fire testing on Liquid Granite.
   c. …are testing Liquid Granite this year.
6- The expression "results above the designed failure load" (line 46) means that the results are…
   a. …better than the predicted weight of the structure.
   b. …better than the failing weight of the structure.
   c. …better than the predicted weight at which the structure would fail.
7- In terms of reinforcement, Liquid Granite…
   a. …is more productive than concrete.
   b. …is as productive as concrete.
   c. …is less productive than concrete.
8- As regards moisture, Liquid Granite is suitable…
   a. …for protecting water-surrounded places.
   b. …for isolating flooding areas.
   c. …for controlling waterproof constructions.
9- Another benefit of Liquid Granite is that it is good…
   a. …at keeping high levels of CO2.
   b. …at reducing CO2 levels.
   c. …at producing more CO2.
10- "without compromising on durability, quality or looks" (line 85) means…
   a. …without considering these aspects.
   b. …without affecting these aspects.
   c. …without controlling these aspects.

Activity 5: Comment on the following aspects in Spanish. Use the phrases provided in your answers.

1- moisture resisting properties (line 61)
2- the highest energy intensive CO2 producing industries (line 71)
3- its specialist mixing and setting characteristics (line 86)
4- durable flooring around furnaces (line103)

Activity 6: True or False? If the statement is FALSE, justify it. Number 1 is given as an example.

1- The building industry has used Liquid Granite for several decades.
Esta respuesta es FALSA puesto que la industria de la construcción no ha usado Liquid Granite por varias décadas, sino que su uso es reciente. La primer línea del texto presenta a Liquid Granite como un material nuevo, describiendo sus características a lo largo del texto.

Notar que en la respuesta aparece el contenido de la pregunta y de esta manera se puede demostrar que se comprende bien a qué hace referencia la misma.

2- Liquid Granite has become an alternative to concrete.
3- Researchers are testing Liquid Granite's resistance to heat at the moment.
4- Liquid Granite does not have a good performance in wet areas.
5- According to the text, Liquid Granite is becoming popular because it is highly cost-effective.

Activity 7: Go back to the questions in 1 and state:

Question	I don't have an answer	I have an answer	The answer is…
1			
2			
3			
4			
5			

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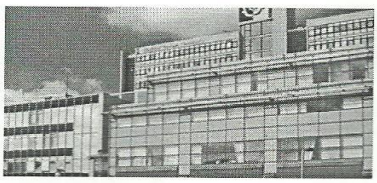
CHANGING THE WAY PROFESSIONALS THINK ABOUT STRUCTURAL CONCRETE

What is LIQUID GRANITE?

Liquid Granite is a new material developed by Sheffield Hallam University. It utilises groundbreaking technology which will change the way professionals think about structural concrete, engineered stone and all the associated fields within these sectors of the construction industry.

In today's construction industry, there is a requirement for technology-based advances that will yield robust building materials coupled with a demand for improved resistance to fire and heat. There is also a need for greater versatility from the materials that make up the fabric of our buildings and surroundings. Liquid Granite meets these requirements and has a reduced environmental impact compared to conventional materials.

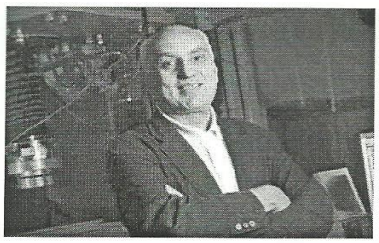
Sheffield Hallam University



Sheffield Hallam University

Following many years of research at Sheffield Hallam University, Liquid Granite comes as a real breakthrough in reducing fire risk in building construction. Using the University's extensive knowledge, coupled with its first class research facilities, Sheffield Hallam University has developed a material to compete with the best in the business.

Pal Mangat - Professor Pal Mangat (picture right) is the Director of the Centre for Infrastructure Management at Sheffield Hallam University (www.shu.ac.uk/cim). He has an extensive track record of research and innovation in the construction materials field which has been funded over many years by the European Commission, UK research councils, Government bodies and industry. Liquid Granite is the culmination of his R&D effort of over ten years.



www.liquidgranite.co.uk

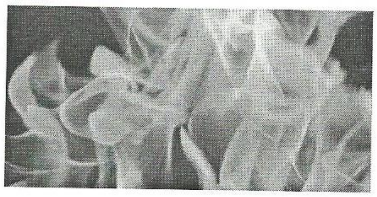
Testing LIQUID GRANITE

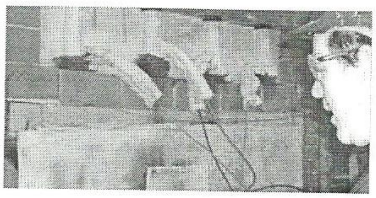
As a revolutionary new construction material, Liquid Granite has been the subject of many testing procedures which have all produced favourable results. So new is the material that tests are ongoing with results being made available on request.

IMPROVED QUALITIES AND VERSATILIT

Heat

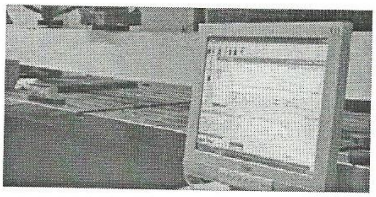
Bodycote Warrington Fire offers a comprehensive range of fire safety services to an International market. They are the largest independent fire testing, consultancy, research and certification organisation in the UK and have a significant presence in Europe, Asia, Australia and the Middle East. Companies from all over the world work with their scientists and engineers to address a wide range of fire safety problems. With their impressive reputation and undoubted skills we have turned to Bodycote Warrington to conduct the fire testing required to ensure Liquid Granite delivers when it matters most.



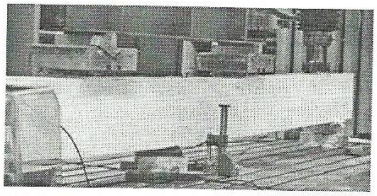


Strength

Liquid Granite can be manufactured to comply with the toughest standards. Compressive strengths of up to 80N/mm^2 have been achieved. A recent cold load test of a 2.7 metre long lintel made from Liquid Granite was conducted at Sheffield Hallam University and gave results above the designed failure load.



The beam was tested under 4-point bending over a span of 2.7m. Load was applied through a hydraulic system at a constant displacement rate of 0.5mm/min. A load deflection plot was recorded.

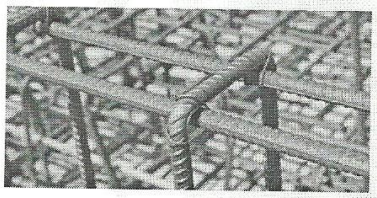


During the test the load deflection plot remains practically linear up to an applied load W of 26.2KN at each of the two load points. The corresponding serviceability load required in the Warrington Fire Research test is approximately 18KN. The beam deflection at this loading was 11.5mm and the crack width was less than 3mm. The ultimate failure load of the lintel was 64.6KN (each point load W being 32.3KN).

Y FOR THE CONSTRUCTION INDUSTRY

Reinforcement

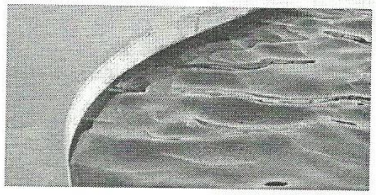
Liquid Granite will accept the same levels, types and procedure for reinforcement as concrete, which can be determined by the structural engineer for the specific project.

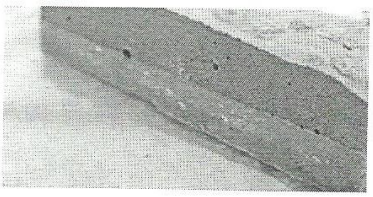


Moisture

Liquid Granite has excellent moisture resisting properties. Absorption values were determined following the drying and soaking procedures given in the standard absorption test methods for concrete, BS 1881:Part 122:1983 and ASTM C642-90. The water absorption value of Liquid Granite was tested and found to be as low as 5.18%. In comparison the absorption value of standard concrete ranged between 9.39% and 12.41%.

This means that with its low capillary action it is an ideal material for use in wet or damp environments such as basements, sea defences, etc.

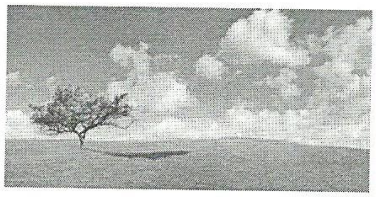




Eco Benefits

Cement production is one of the highest energy intensive CO_2 producing industries in the world. Liquid Granite uses less than 5% cement with the potential to reduce this content even further. This is over 60% less than most traditional concrete products.

It takes the science of cement replacement to a whole new level, meaning the end user can confidently make a significant step forward by reducing the environmental impact of any project using Liquid Granite.

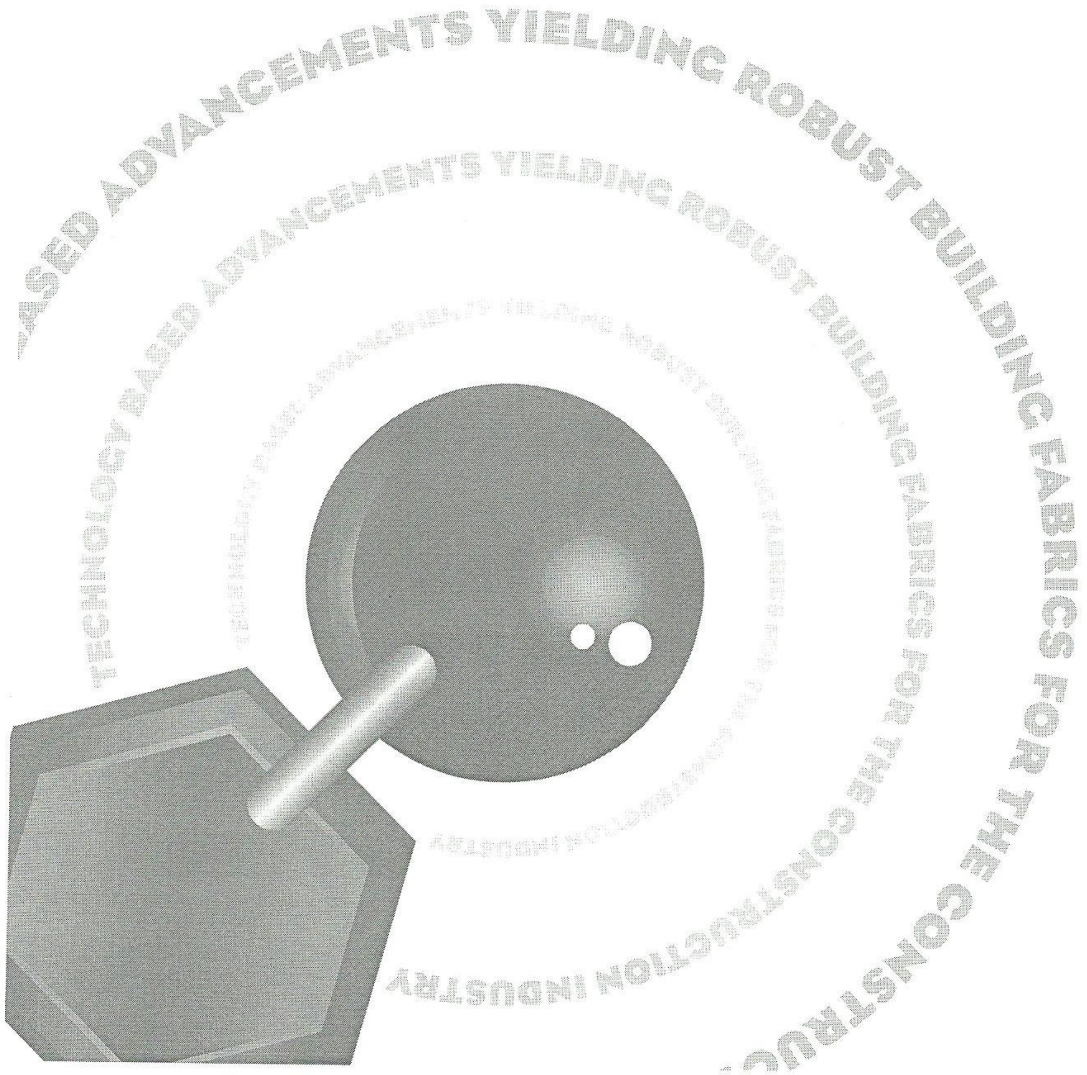


www.liquidgranite.co.uk

LIQUID GRANITE Applications

A number of applications for Liquid granite have been identified and are described on the facing page.

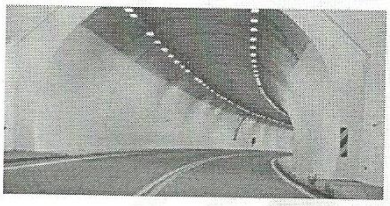
The range of potential applications for this unique material is extensive and we would be happy to discuss the ways in which Liquid Granite can be utilised to add value to your business.

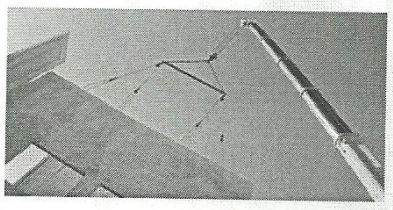


Engineered Stone

Liquid Granite provides a 'green' alternative to natural stone without compromising on durability, quality or looks.

Its specialist mixing and setting characteristics enable even the most complex of shapes to be cast, whilst its durability and finish allow it to be used in areas where even the most demanding of finishes are expected.

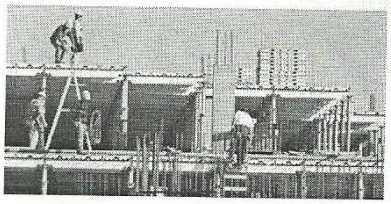


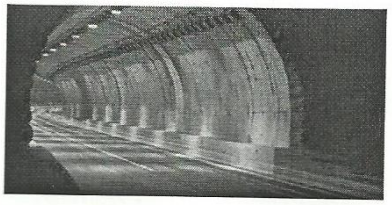


Structural Concrete

Liquid Granite can be used to replace normal structural concrete and provide fire rated sections, as Liquid Granite does not spall in a fire situation like normal concrete it introduces the possibility of reducing the section dimensions.

Tests carried out to BS 476 showing Liquid Granite's reaction to fire and the physical properties testing conducted by Sheffield Hallam University, show the materials advantages over normal structural concrete.

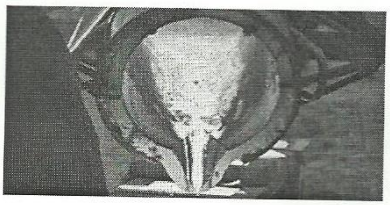




Refractory Environments

Liquid Granite has been tested by CERAM, one of the leading test facilities in its field. They are a UKAS accredited facility and have tested Liquid Granite to BS EN 993-10: 1998.

Combining the robustness of concrete with the thermal resistance of a refractory castable, Liquid Granite can also be used to provide extremely durable flooring around furnaces etc.



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6A Segmentos significativos en el texto: La frase nominal compleja

Lee **rápidamente** el texto a continuación y completa las siguientes oraciones de acuerdo con la información dada:

a- The two categories of forms of energy are…….
b- The forms of potential energy are…..
c- The forms of kinetic energy are ……
d- Examples of chemical energy are….
e- Examples of radiant energy are….
f- The movement of electrons is …….
g- Motion is …….
h- The internal energy in substances is……

Teniendo en cuenta las distintas formas de energía, ¿dónde ubicarías la siguiente información? Es decir, ¿a qué forma de energía se refiere el pronombre ***It*** en las siguientes oraciones?

a- It is the energy created by the interaction of subatomic particles with electromagnetic force.
b- It is the energy that is produced through reactions that occur in chemical compounds.
c- It is the energy which is carried by light.
d- It is the energy coming from the splitting of uranium atoms in a process called fission.
e- It is the energy stored in the movement of objects.
f- It is the energy that is stored in objects by tension.
g- It is the energy which is also called *heat*.
h- It is the energy which is stored in an object's height.
i- It is the energy coming from the movement of energy through substances in longitudinal (compression/refraction) waves.

FORMS OF ENERGY

All forms of energy fall under two categories

POTENTIAL

Potential energy is stored energy and the energy of position (gravitational)

CHEMICAL ENERGY

Chemical energy is the energy stored in the bonds of atoms and molecules. Biomass, petroleum, natural gas, propane and coal are examples of stored chemical energy.

NUCLEAR ENERGY

Nuclear energy is the energy stored in the nucleus of an atom - the energy that holds the nucleus together. The nucleus of a uranium atom is an example of nuclear energy.

STORED MECHANICAL ENERGY

Stored mechanical energy is energy stored in objects by the application of a force. Compressed springs and stretched rubber bands are examples of stored mechanical energy.

GRAVITATIONAL ENERGY

Gravitational energy is the energy of place or position. Water in a reservoir behind a hydropower dam is an example of gravitational potential energy. When the water is released to spin the turbines, it becomes motion energy.

KINETIC

Kinetic energy is motion - the motion of waves, electrons, atoms, molecules and substances

RADIANT ENERGY

Radiant energy is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays and radio waves. Solar energy is an example of radiant energy.

THERMAL ENERGY

Thermal energy (or heat) is the internal energy in substances - the vibration and movement of atoms and molecules within substances. Geothermal energy is an example of thermal energy.

MOTION

The movement of objects or substances from one place to another is motion. Wind and hydropower are examples of motion.

SOUND

Sound is the movement of energy through substances in longitudinal (compression/ rarefaction) waves.

ELECTRICAL ENERGY

Electrical energy is the movement of electrons. Lightning and electricity are examples of electrical energy.

Retrieved February 13, 2010 from http://www.need.org/needpdf/FormsofEnergy.pdf

La frase nominal compleja

La frase nominal compleja se caracteriza por condensar mucha información acerca del sustantivo al cual hacemos referencia. En vez de dar información o describir un concepto utilizando muchas oraciones, se opta por agregarle al sustantivo diferentes tipos de estructuras que pueden acompañarlo. La frase nominal compleja es muy frecuente en textos científicos, en especial en la sección del título y del abstract. ¿Para qué? De esta manera, el lector que se encuentra en la búsqueda de material de lectura acerca de un tema en particular puede obtener la mayor cantidad de información en un número reducido de palabras.

En las oraciones del ejercicio anterior vemos que se han utilizado diferentes estructuras para caracterizar a la energía. Debajo se listan cuatro tipos diferentes, ¿cuál de esos patrones no ha sido utilizado?

1. Sustantivo + oración introducida por *which* o *that* (QUE)
2. Sustantivo + oración introducida por la forma *–ing* (QUE)
3. Sustantivo + oración introducida por la forma *–ed (-ado –ido)*
4. Sustantivo + oración introducida por la forma *to-infinitive (-ar, -er, -ir)*

- Los casos 2 y 3 pueden considerarse como una forma reducida de 1. Veamos el ejemplo siguiente:

It is the **energy** *which* is carried by light.
(Es la energía que es conducida por la luz.)

A esta nueva función de la forma –ed le llamamos ***función QUE o –ado, -ido*** y nos agrega información acerca de la entidad a la que hacemos referencia (el sustantivo núcleo). Es clave no confundir esta forma con un verbo en pasado ya que tienen la misma apariencia física.

Esta idea también se podría expresar de la siguiente manera:

It is the ***energy*** *carried* by light.
(Es la energía conducida por la luz.)

Lo mismo ocurre en el siguiente caso:

It is the **energy** *that* comes from the splitting of uranium atoms in a process called fission.
(Es la energía que proviene de la separación de átomos de uranio en un proceso llamado fisión.)

It is the **energy** *coming* from the splitting of uranium atoms in a process called fission.
(Es la energía que proviene de la separación…)

A esta función de la forma -ing le llamamos función ***QUE*** y, como la forma-ed, agrega información acerca de la entidad a la que hacemos referencia.

- El caso 1 tiene a *which* y a *that* como palabras (las cuales son pronombres llamados pronombres relativos) que introducen la postmodificación del sustantivo (es decir, este segmento de la oración nos agrega más información acerca del sustantivo núcleo). Se utiliza *which* o *that* cuando el sustantivo se refiere a una cosa. Cuando el sustantivo se refiere a una persona, utilizamos los pronombres *who o that* , como en el siguiente ejemplo:

The **researchers** *who/that* participate in the project are from Cambridge University.
(Los investigadores que participan en el proyecto son de la Universidad de Cambridge.)

- Asimismo, podemos encontrar otras palabras que cumplen la misma función:

Cambridge is the **university** *where* the project is developed.
(Cambridge es la Universidad en donde el proyecto es desarrollado.)

The **university** *in which* the project is carried out is Cambridge University.
(La universidad en la que el proyecto es desarrollado es la Universidad de Cambridge)

The **researchers**, *whose* names are not included, developed the project in 2008.
(Los investigadores, cuyos nombres no están/son incluidos, desarrollaron el proyecto en 2008.)

The project was developed at a **time** *when* optical fibers were a new discovery.
(El proyecto fue desarrollado en un tiempo/en una época cuando las fibras ópticas eran un nuevo descubrimiento)

- El patrón de postmodificación presentado en 4 arriba tiene la forma *to-infinitive*.

Researchers have developed a **way** *to eliminate* carbon-dioxide emissions.
(Los investigadores han desarrollado una manera/forma de/para eliminar emisiones de dióxido de carbono)

Estamos hablando de una forma (*a way*) de algo, ¿de qué? de eliminar emisiones de dióxido de carbono. La forma *to-infinitive* nos da información que nos especifica aún más a qué hace referencia el sustantivo)

There are many **efforts** *to reduce* carbon emissions.
(Hay/Existen muchos esfuerzos para reducir las emisiones de carbono.)

It is the **time** *to impose* stricter carbon emission reduction policies.
(Es el momento de/para imponer normativas más estrictas de reducción de emisión de carbono.)

¿*Esfuerzos* para qué? ¿El *momento* para qué? Las dos estructuras que le siguen a los sustantivos aclaran un poco más a qué se refieren. Es decir, no estamos hablando de cualquier tipo de esfuerzo, sino de esfuerzos para reducir emisiones de dióxido de carbono. De la misma manera, hablamos del momento para imponer normativas más estrictas y no el momento para decidir si hay que reducir el dióxido de carbono o no.

En los ejemplos con el *to-infinitive* de arriba hablamos de "una forma para/de hacer algo", "esfuerzos para hacer algo" o del "momento de/para hacer algo", es decir, que interpretamos esta ocurrencia como la forma PARA (u otra preposición como ser DE) + –ar, -er, -ir del castellano. Ahora bien, no siempre que encontremos una forma *to-infinitive* será interpretada como para + -ar, -er,-ir. Tal es el caso en el siguiente ejemplo:

Researchers have decided **to work on a solution to the problem now**. (Los investigadores han decido **trabajar en una solución para el problema**.)

Aquí la interpretación es –ar, -er, -ir directamente sin el PARA (u otra preposición) de los ejemplos anteriores. Esto se debe a que estamos ante una ocurrencia gramatical diferente, y cuya explicación detallada sería proporcionar demasiada información al estudiante de lengua extranjera sin proporcionar mucho conocimiento utilizable. Entonces, ante una forma *to-infinitive* se deberá decidir si es una forma PARA (u otra preposición) + –ar, -er, -ir o si se trata directamente de la interpretación –ar, -er, -ir. Este tema se estudiará nuevamente en la Unidad 8A: La voz pasiva y los verbos especiales en la sección del "to-infinitive".

Volviendo al tema central de discusión – la postmodificación de sustantivos-, como se puede observar en los casos presentados arriba, el sustantivo en cuestión puede estar post-modificado por estructuras que son pequeñas oraciones en sí mismas. Es decir, al momento de tratar de asignarle significado a un segmento de la oración se debe tener en cuenta que el sustantivo puede estar acompañado de estructuras que no son parte de la macro-oración sino que agregan datos que hacen que el mismo se vuelva más específico. Por lo tanto, en la oración:

The efficient use of energy is a key component of current **efforts** *to reduce carbon emissions*.

El segmento *to reduce carbon emissions* especifica el significado o agrega información acerca del sustantivo *efforts*. Asimismo el sustantivo efforts + su postmodificación, *to reduce carbon emissions*, son parte de la postmodificación de *component* que comienza con la preposición *of*. Es decir:

a key **component** of current efforts to reduce carbon emissions
premodificación postmodificación (con frase preposicional)

Entonces podemos decir que el sustantivo *component* está premodificado por un artículo (*a*) y un sustantivo (*key*) y que tiene una postmodificación en la forma de una frase preposicional (*of current efforts to reduce carbon emissions*) que, a su vez, contiene otra frase sustantiva (*current efforts to reduce carbon emissions*).

Si bien las estructuras presentadas arriba son estructuras que aparecen con regularidad, se debe tener en cuenta que son muchas las combinaciones posibles en las que éstas se pueden dar. Si bien esto representa un obstáculo más para el estudiante de lengua extranjera, el reconocimiento sistemático de estos patrones recurrentes representa un gran paso hacia una mayor comprensión del texto.

Para resumir:

- Es muy común que los sustantivos estén postmodificados por pequeñas oraciones dentro de la oración más grande;
- Estas postmodificaciones pueden estar introducidas por pronombres relativos (that, which, who, where, when, etc.);
- Si el pronombre no se encuentra, decimos que estamos ante la presencia de una reducción de esa pequeña oración y es introducida por una forma –ing (interpretada como QUE) o por la forma –ed (interpretada QUE o –ado, -ido);
- Los sustantivos también pueden estar post modificados por una forma *to infinitive*.

Hasta el momento hemos visto la forma *–ing* en:

Función sustantivo	La puedo reemplazar por ***esto*** para saber si es sustantivo	There are many different materials used in *engineering* (Hay muchos materials diferentes utilizados en *esto*…en la *ingeniería*)
Función adjetivo	La encuentro antes del sustantivo	There are different *engineering* materials.
Función QUE	La encuentro después del sustantivo y puede estar acompañada de otras palabras para formar una idea más larga	The researchers *working on the solar car project* are from UTN FRP. (los investigadores QUE están trabajando (o QUE trabajan)
Función Preposición – ar,-er, -ir	La encuentro después de una preposición (a excepción de la preposición *by*) y en vez de interpretar –ar,-er, -ir se puede utilizar un sustantivo si se encuentra un equivalente.	There are advantages in *obtaining* energy from solar panels. (Hay muchas ventajas *en obtener/ la obtención* de energía de los paneles solares.)
Función verbo conjugado	La encuentro cuando describo acciones que ocurren en el momento de estar hablando, ahora.	The researchers <u>are *working*</u> on solar energy to power vehicles. (Los investigadores están trabajando en la energía solar para impulsar vehículos.

Hasta el momento hemos visto la forma *–ed* en:

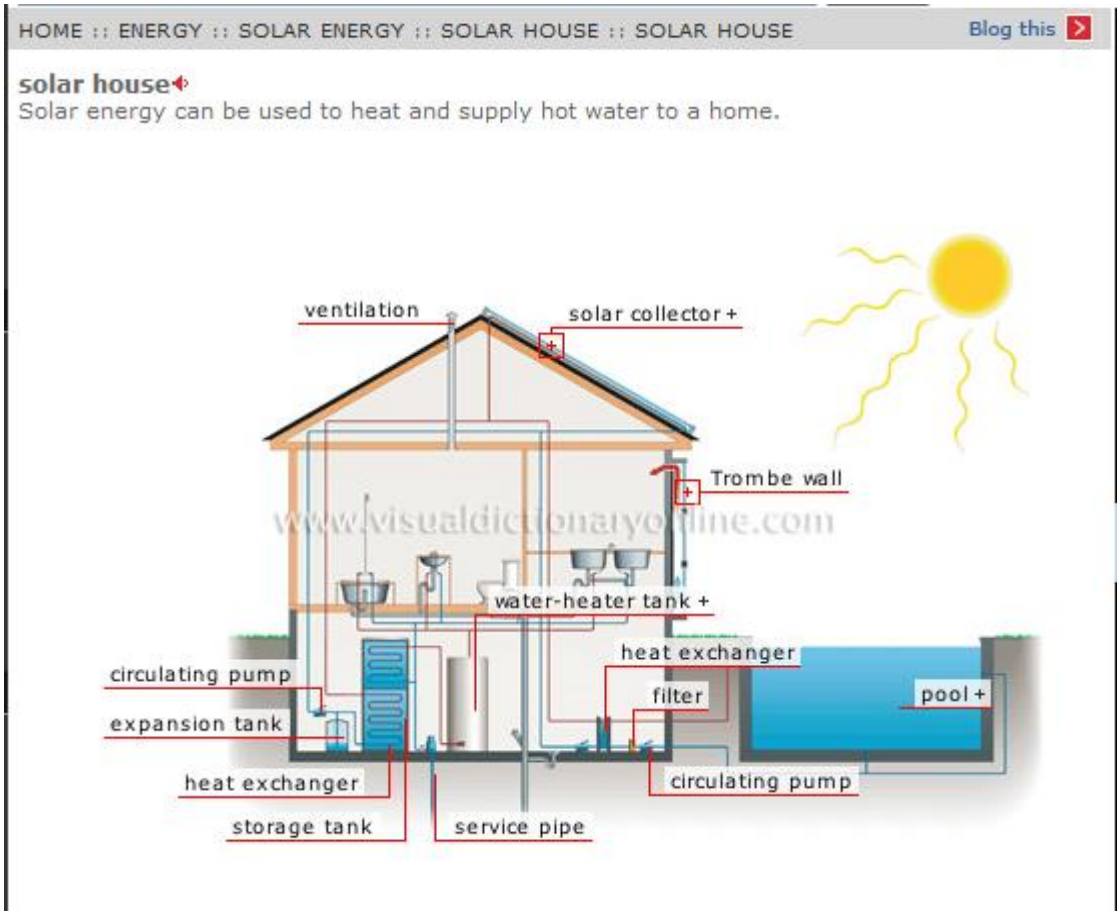
Función adjetivo	La encontramos como parte de la premodificación del sustantivo núcleo	cement-*based* materials (materiales a base de cemento)
Función verbo conjugado	La encontramos formando parte del presente perfecto (el tiempo que hace una conexión entre el pasado y el presente – He realizado algo desde el momento que nací hasta ahora)	Researchers <u>have *investigated*</u> intelligent materials for several years now. (Los investigadores han investigado materiales inteligentes por varios años ya.)
Función QUE o –ado -ido	La encontramos postmodificando a un sustantivo y la consideramos como una reducción de una estructura introducida por *that, which, who*, etc.	The researchers *sponsored* by the government are from UTN. (los investigadores QUE son patrocinados / patrocinados por el gobierno…)

Para una explicación más detallada de cómo abordar la interpretación de la frase nominal ver APÉNDICE 9 y para resumen y ejemplos de la forma –ing ver APÉNDICE 14.

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

6B Over to your Career Path

Activity 1: Look at the following entry from the Merriam Webster VISUAL DICTIONARY ONLINE available at http://visual.merriam-webster.com/index.php. Comment on the picture, identifying the function of each element.



***solar collector**: Device that traps heat from solar radiation and releases it to the coolant fluid.*

filter: Device that holds back impurities contained in the pool water.

pool: *Man-made basin designed for swimming.*

circulating pump: *Apparatus that ensures that the cooled water flows from the pool to the solar collector.*

Trombe wall: *Solar collector with double glazing on a wall that faces south; it is used to distribute heat in a room.*

storage tank: Insulated metal tank that contains clean hot water to be distributed in the home.

service pipe: *Pipe connecting a public water supply to the house.*

water-heater tank: *Apparatus that produces clean hot water by gas or electric heating; this auxiliary system is used when there is insufficient sunlight, mainly in winter.*

heat exchanger: *Apparatus used to release the heat of the coolant liquid generated by the collector to the home's water system.*

expansion tank: *Reservoir for absorbing water expansion; it keeps the water pressure in the system steady.*

circulating pump: *Apparatus that circulates the cooled coolant from the heat exchanger to the solar collector.*

Ventilation: *Piping that ensures that fresh air enters and stale air exits the home.*

heat exchanger : *Device that transfers the heat produced by the collector to the home's hot water system*

Retrieved and adapted January 24, 2011 from http://visual.merriam-webster.com/energy/solar-energy/solar-house/solar-house.php

Activity 2: Scan the text and state TRUE or FALSE.

Pros and Cons of Solar Energy

1 Below is an in depth list of the **pros and cons of solar energy**. These pros and cons will cover areas such as solar energy for the home, and the industrial use of solar power.

Solar Energy Pros:

- Solar panels give off no pollution. The only pollution that is produced as a result of solar panels is the
5 manufacturing of these devices in factories, transportation of the goods, and installation.

- The production of energy which comes from the use of fossil and some renewable fuels (e.g. wind turbines) can be noisy. Solar energy coming from solar panels produces electricity very quietly.

- One of the great advantages of solar energy is the ability to provide electricity in remote locations that are not linked to a national grid. A prime example of this is in space, where satellites are powered by high
10 efficiency solar cells.

- The installation of solar panels in remote locations is usually much more cost effective than laying the

required high voltage wires.

- Solar energy can be very efficient in a large area of the globe, and new technologies allow for a more efficient energy production on overcast/dull days.
- Solar panels can be installed on top of many rooftops, which eliminates the problem of finding the required space for solar panel placement.
- Another great advantage of solar energy is the cost. Although the initial investment of solar cells may be high, once installed, they provide a free source of electricity, which will pay off over the coming years.
- The use of solar energy to produce electricity allows the user to become less dependent on the world's fossil fuel supplies.

Solar Energy Cons:

- The major disadvantage of solar energy is the initial cost of solar cells. Currently, prices of highly efficient solar cells can be above $1000, and some households may need more than one. This makes the initial installation of solar panels very costly.
- Electricity that is produced from solar energy is only generated during daylight hours. This means for around half of each day, solar panels are not producing energy for your home.
- The weather can affect the efficiency of solar cells.
- Pollution can be a drawback of solar energy, as pollution levels can affect solar cells efficiency. This would be a major disadvantage for businesses or industry wishing to install solar panels in heavily polluted areas, such as cities.

Overview

Above is a list of many solar energy pros and cons, and although not definitive, you can see how the number of pros relating to solar energy, greatly outweighs the cons of solar energy.
The main reason we are not seeing a large amount of solar energy technology installations is due to cost, and unfortunately, as the price of fossil fuels remains lower than the initial investment towards the currently available solar panels, we will not see a mass shift towards solar electricity production.

Retrieved and adapted February 24, 2010 from http://www.clean-energy-ideas.com/articles/pros_and_cons_of_solar_energy.html

a- This text is from an Internet source.
b- There is a definition of solar energy in this text.
c- There are 8 advantages connected with solar energy.
d- There are more advantages than disadvantages.

Activity 3: Match the statements below to the advantages. SE stands for Solar Energy.

Statement	**Advantage**
a- The energy coming from the production of SE is not noisy.	
b- The installation of a SE system is more cost effective in areas where there is no electricity.	
c- There is little contamination connected with the generation of SE.	

d- With new technology, energy can be produced on days in which there is no sun.	
e- Energy can be provided to locations where there is no electricity.	
f- The energy which is produced by SE does not depend on fossil fuels.	
g- The panels needed for the reception of light can be installed on a house rooftop.	
h- The money that is invested in solar energy is recovered in full.	

Activity 4: Identify in the sentences in 3 the information that develops the following concepts:

Example: a- energy ….coming from the production of SE
La energía que proviene de la producción de energía solar… (energy es el sustantivo y "coming from the production of SE" es la postmodificación, o la idea que define la palabra "energy" aún más)

g- areas
h- contamination
d- days
e- locations
f- energy
b- panels
c- money

Activity 5: Match the following headings to the disadvantages in the text.

a- Limited production of energy in a day
b- Effect of pollution on solar cells
c- Weather constraints
d- High cost of initial installation of solar cells

Como la actividad requiere la enumeración de argumentos, podemos utilizar conectores de enumeración para organizar los párrafos: en primer lugar, segundo, además, por otra parte, además de proporcionar…también puede…., otra ventaja es.., por último, etc.

Homework - To turn in

Complete the following ideas in well-written paragraphs.

La energía solar se presenta como una buena opción para generar energía por diversas razones. En primer lugar, …..

A pesar de proporcionar muchos beneficios, hay ciertas desventajas conectadas con este tipo de energía que no pueden ser dejadas de lado. Por un lado, ….

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

7A Relaciones de significado entre segmentos del texto: Las referencias contextuales

1- Scan the texts below. Identify the type of renewable energy source described in texts 2-4.

Renewable Energy Sources in the United States **Texto 1**

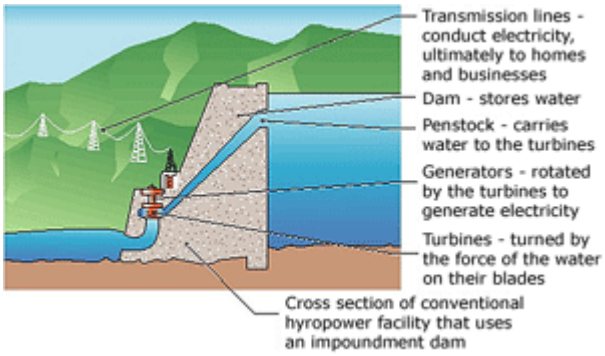
- Hydropower
- Wind Power
- Solar Power
- Geothermal Power
- Biomass
- References
- Related Links

Renewable energy sources are energy sources that are continually replenished. **These** include energy from water, wind, the sun, geothermal sources, and biomass sources such as energy crops. In contrast, fuels such as coal, oil, and natural gas are non-renewable. Once a deposit of **these fuels** is depleted **it** cannot be replenished – a replacement deposit must be found instead. Both renewable and non-renewable energy sources are used to generate electricity, power vehicles, and provide heating, cooling, and light.

Renewable sources of energy vary widely in **their** cost-effectiveness and in **their** availability across the United States. Although water, wind, and other renewables may appear free, **their** cost comes in collecting, harnessing, and transporting the energy so that **it** can do useful work. For example, to utilize energy from water, a dam must be built along with electric generators and transmission lines.

Renewables **themselves** are non-polluting, while the structures built to harness **them** can have positive or negative environmental impacts. For example, dams may affect fish migration but **they** may also create wildlife habitat.

..... Texto 2



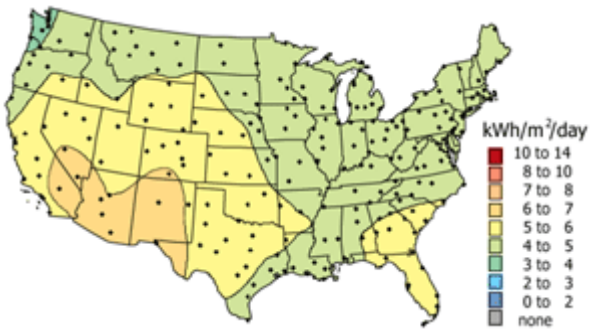
An impoundment hydropower plant dam water in a reservoir

This type of energy refers to using water to generate electricity. Water is the most common renewable source of energy in the United States today.

Many hydroelectric power plants use a dam on a river to store water. Water released from behind the dam flows through a turbine, spinning **it**, which then turns a generator to produce electricity. Electricity generated **this way** is known as hydroelectricity, and **it** accounts for about 7% of the electricity used by the nation. **It** is not necessary to build a large dam to generate hydroelectric power this way – some hydroelectric power plants just use a small canal to channel the river water through a turbine. A small or micro-hydroelectric power system can produce enough electricity for a home, farm, or ranch.

..... Texto 3

This technology uses the sun's energy to provide heat, light, hot water, electricity, and even cooling, for homes, businesses, and industry. Despite sunlight's significant potential for supplying energy, solar power provides less than 1% of U.S. energy needs. **This percentage** is expected to increase with the development of new and more efficient solar technologies.



Annual average daily solar radiation per month, using a flat-plate collector facing south at a fixed tilt equal to the latitude of the site. Capturing the maximum amount of solar radiation throughout the year can be achieved using a tilt angle approximately equal to the site's latitude.

Different types of solar collectors are used to meet different energy needs. Passive solar building designs capture the sun's heat to provide space heating and light. Photovoltaic cells convert sunlight directly to electricity. Concentrating solar power systems focus sunlight with mirrors to create a high-intensity heat source, which then produces steam or mechanical power to run a generator that creates electricity. Flat-plate collectors absorb the sun's heat directly into water or other fluids to provide hot water or space heating. And solar process heating and cooling systems use specialized solar collectors and chemical processes to meet large-scale hot water and heating and cooling needs.

Solar technologies produce few negative environmental impacts during collector operation. However, **there** are environmental concerns associated with the production of collectors and storage devices. In addition, cost is a great drawback to solar power. Although sunlight is free, solar cells and the equipment needed to convert their direct-current output to alternating current for use in a house is expensive. Electricity generated by solar cells is still more than twice as expensive as electricity from fossil fuels. Part of the problem with cost is that solar cells can only operate during daylight hours. In contrast, a coal or natural gas plant can run around the clock, which means the cost for building the plant can be spread over many more hours of use.

..... **Texto 4**

McNeil Generating Station, Burlington, Vermont, the country's only utility-owned and operated wood-fired power plant.

This power is obtained from the energy in plants and plant-derived materials, such as food crops, grassy and woody plants, residues from agriculture or forestry, and the organic component of municipal and industrial wastes **It** provides two valuable services: **it** is the second most important source of renewable energy in the United States and **it** is an important part of our waste management infrastructure. In the future, farms cultivating high-yielding energy crops (such as trees and grasses) will significantly expand our supply of biomass. **These** energy crops, coupled with high-efficiency conversion technologies, can supplement our consumption of fossil fuels and help us respond to global climate change concerns.

Wood has been used for energy longer than any other biomass source and today is still the largest biomass energy resource. The largest

source of energy from wood is pulping liquor or "black liquor," a waste product from processes of the pulp, paper, and paperboard industry. Biomass energy can also be derived from waste and from alcohol fuels. Waste energy is the second-largest source of biomass energy. The main contributors of waste energy are municipal solid waste, manufacturing waste, and landfill gas.

Biomass can be used for direct heating (such as burning wood in a fireplace or wood stove), for generating electricity, or can be converted directly into liquid fuels to meet transportation energy needs.

Retrieved and adapted March 24, 2010 from http://www.nationalatlas.gov/articles/people/a_energy.html

2- True or False? Identify the parts in the text that explain the choice.

Text 1
- a- The use of renewable sources of energy is limited to home applications only.
- b- There are costs involved in the application of renewable sources.
- c- There is pollution involved in the use of renewable sources of energy.

Text 2
- a- The use of water as a renewable source of energy is not rare.
- b- The percentage of electricity produced from hydroelectric power is high.
- c- Micro-hydroelectric systems are used to provide energy to factories and large areas.

Text 3
- a- The percentage of energy produced from solar power is smaller than the one produced from hydroelectric power.
- b- Five types of solar collectors are mentioned.
- c- There is little pollution connected with the production of solar energy.

Text 4
- a- There are many benefits connected with biomass-produced power.
- b- Trees and grasses are energy crops.
- c- Waste-derived biomass energy is the largest source of biomass energy.

3- Study the following sentences. Replace the words in bold with one of the following elements:

biomass energy (x 3) - renewable sources – renewable sources' (x 2) – hydropower – this number

- a- **These** include energy from water, wind, the sun, geothermal sources, and biomass sources such as energy crops. (line 2)
- b- Renewable sources of energy vary widely in **their** cost-effectiveness and in **their** availability across the United States. (line 9)
- c- **This type of energy** refers to using water to generate electricity. (line 19)
- d- **This percentage** is expected to increase with the development of new and more efficient solar technologies. (line 52)

e- **It** provides two valuable services: **it** is the second most important source of renewable energy in the United States and **it** is an important part of our waste management infrastructure. (line 82)

Relaciones de significados entre elementos del texto

Hay palabras dentro de un texto cuya función es establecer relaciones entre elementos mencionados en otras partes del mismo. Esta función sirve a dos propósitos muy claros: (a) estas palabras ayudan a que el texto tenga continuidad, es decir, a que las partes se relacionen unas con otras; (b) estas palabras o frases evitan que un concepto tenga que ser repetido una y otra vez para que el lector sepa de qué se está hablando. Veamos ejemplos:

(a) Renewables (1) **themselves** are non-polluting, while the structures built to harness (2) **them** can have positive or negative environmental impacts. For example, dams may affect fish migration but they may also create wildlife habitat. (Text 1, line 16)

Las palabras que se encuentran en negrita hacen referencia, en este caso, a las fuentes renovables de energía. El primer caso, **themselves**, es un pronombre reflexivo cuyo valor puede ser especificado como *por sí solos* o *en sí mismos.* En el segundo caso **them** es un pronombre en función objeto y se lo podría interpretar de la siguiente manera:

…las estructuras construidas para utilizar**las** pueden tener impactos ambientales positivos o negativos.

Entonces si aislamos estas palabras comenzando con renewables, que es el punto de partida, quedaría una cadena de relaciones como la siguiente:

Renewables **themselves**……**them**…

Hay un tercer uso de pronombre que puede llevar a confusión en la última oración. El pronombre **they** en *they may also create wildlife habitat* ya no hace referencia a las fuentes renovables de energía sino a *dams* (represas). Para evitar esta confusión el lector debe buscar si aparece otra frase nominal entre la frase que se cree que es el referente y el pronombre que se está estudiando.

Para resumir, estas palabras en negrita, que se encuentran en distintas oraciones del párrafo, cumplen la función de unir una parte con otra y de darle cohesión al texto. Cohesión hace referencia a los diferentes elementos que hacen que un texto parezca estar "pegado", unido.

(b) Renewable energy sources are energy sources that are continually replenished. **These** include energy from water, wind, the sun, geothermal sources, and biomass sources such as energy crops. (Text 1, line 1)

La palabra que está en negrita es un pronombre demostrativo. **These** hace referencia a *renewable energy sources*, pero al hacer uso de la misma evitamos la repetición, que si bien, no estaría mal gramaticalmente hablando, no sería la opción estilística más apropiada. Veamos cómo quedaría la oración si reemplazamos *these* por *renewable energy sources*:

Renewable energy sources are energy sources that are continually replenished. **Renewable energy sources** include energy from water, wind, the sun, geothermal sources, and biomass sources such as energy crops.

Al leer las dos oraciones juntas se puede apreciar que hay una repetición innecesaria que hace que el texto no "corra" de manera fluida.

Los pronombres y los adjetivos posesivos y demostrativos cumplen las dos funciones especificadas arriba la de otorgar cohesión – unión entre partes- y de evitar repetición. Ellos son:

Pronombre Sujeto	
I	
You	
She	
He	
It	
We	
You	
They	

Pronombre Objeto	
Me	
You	
Her	
Him	
It	
Us	
You	
Them	

Pronombre Posesivo	
Mine	
Yours	
Hers	
His	
_____	
Ours	
Yours	
Theirs	

Pronombre Reflexivo	
Myself	
Yourself	
Herself	
Himself	
Itself	
Ourselves	
Yourselves	
Themselves	

Pronombre Demostrativo	
This	
That	
These	
Those	

Adjetivo Posesivo	
My	
Your	
Her	
His	
Its	
Our	
Your	
Their	

Adjetivo Demostrativo	
This	
That	
These	
Those	

Ver APÉNDICE 10 para ejemplos en los que se usan estos pronombres y adjetivos posesivos y demostrativos.

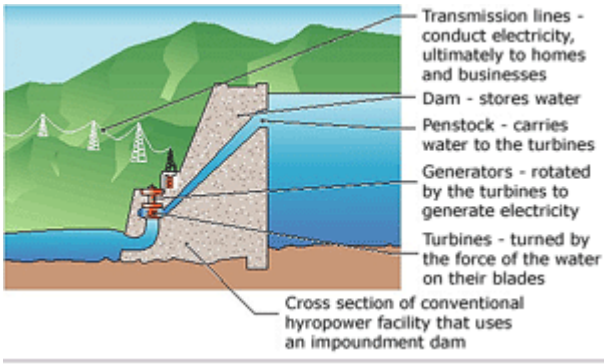
En los casos en los que se hace uso de los adjetivos especificados arriba, muchas veces se usa una palabra que reemplaza al concepto especificado como punto de partida. Por ejemplo:

Hydropower **Texto 2**

This type of energy refers to using water to generate electricity.

Water is the most common renewable source of energy in the United States today.

Many hydroelectric power plants use a dam on a…



An impoundment hydropower plant dam water in a reservoir

En el texto de arriba comenzamos con el concepto de *hydropower* como punto de partida en el subtítulo. Luego tenemos la expresión *this type of energy* que, a través de *this* hace referencia a algo que ha sido mencionado inmediatamente antes (*hydropower)* y *type of energy* reemplaza a *hydropower*, puesto que la fuerza hidroeléctrica es un tipo de energía. Entonces, en este ejemplo vemos cómo se forman relaciones entre una parte del texto (primer párrafo) y otra (el subtítulo).

En el siguiente ejemplo también se puede ver cómo, a través del uso de expresiones sinónimas, se puede mantener el tema tratado sin hacer repetición de las mismas palabras:

In addition, cost is a great drawback to **solar power**. Although **sunlight** is free, solar cells and the equipment needed to convert their direct-current output to alternating current for use in a house is expensive. (Text 3, line 30)

En la primera oración se habla de *solar power*. En la segunda oración en vez de decir nuevamente *solar power* o reemplazarlo por *it*, la elección ha sido usar una frase que está relacionada o muy cercana (aunque no un sinónimo directo), *sunlight.* De esta manera las ideas fluyen y no se pierde el sentido de lo que se está diciendo, formando una cadena de significados que se relacionan de alguna manera (el todo + una parte / parte + el todo, por ejemplo). Asimismo, se puede ver cómo en la segunda oración se nombra a *solar cells* y al volver a hacer referencia a las mismas se usa el adjetivo posesivo *their* para identificar "algo" relacionado con ellas (ese "algo" es *direct-current output*).

A través de los ejemplos presentados arriba se pueden observar las múltiples relaciones que hay entre las partes de un texto que hacen a la cohesión y coherencia del mismo. Entender que un texto se "mueve" de esta manera ayuda al estudiante de lengua extranjera a no perder de vista el hecho de que siempre se van a encontrar claves a lo largo de un texto que ayudan a seguir con la temática desarrollada.

Referencia anafórica y referencia catafórica

Los pronombres y adjetivos posesivos y demostrativos presentados arriba hacen referencia a conceptos presentados con anterioridad en el texto. En otras palabras, cuando se hace uso de estas palabras de referencia, primero se nombra el concepto y luego se las usa. Entonces se dice que estas palabras tienen referencia anafórica. En el texto 4:

Biomass **Texto 4**

This power is obtained from the energy in plants and plant-derived materials, such as food crops, grassy and woody plants, residues from agriculture or forestry, and the organic component of municipal and industrial wastes **It** provides two valuable services: **it** is the second most important source of renewable energy in the United States and **it** is an important part of our waste management infrastructure. In the future, farms cultivating high-yielding energy crops (such as trees and grasses) will significantly expand our supply of biomass.

McNeil Generating Station, Burlington, Vermont, the country's only utility-owned and operated wood-fired power plant.

This junto con *power* hacen referencia a *biomass* (mencionada en el subtítulo). Luego tenemos el uso del pronombre sujeto *it* en tres instancias para referirse, nuevamente a *biomass*. En todos estos ejemplos se puede ver cómo las expresiones hacen referencia a un concepto que se toma como punto de partida. Estos pronombres tienen referencia anafórica.

Puede ocurrir también que alguna expresión haga referencia a un concepto que aparece más adelante. En este caso se dice que la palabra de referencia tiene referencia catafórica. Tal es el caso de **there** en el texto 3, línea 28.

Solar technologies produce few negative environmental impacts during collector operation. However, **there** are environmental concerns associated with the production of collectors and storage devices.

La palabra **there** no tiene ningún tipo de significado en sí misma en este caso. Sólo se utiliza como una forma de cumplir con el requisito de tener un sujeto en la oración. Sin embargo, se dice que hace referencia a la frase nominal que se encuentra adelante, *environmental concerns assocaited with the production of collectors and storage devices*. Entonces, en la estructura:

There + forma del verbo *be* + frase nominal

La palabra **there** tiene referencia catafórica y se proyecta a la frase nominal que le sigue después del verbo. A pesar de que se hace este detalle gramatical, lo que se debe recordar es que ante THERE + el verbo to BE estamos ante la presencia del significado hay, hubo, había, etc. dependiendo de la forma del verbo to BE.

THERE + forma del verbo BE = HAY, HABÍA, HABRÁ, etc.

Otro caso similar al anterior se da con el pronombre *it*, que al cumplir una función parecida se lo denomina el *it vacío* (*empty it*). Tal es el caso de *it* en el siguiente ejemplo en el texto 2, línea 14:

It is not necessary *to build a large dam to generate hydroelectric power this way* – some hydroelectric power plants just use a small canal to channel the river

water through a turbine. A small or micro-hydroelectric power system can produce enough electricity for a home, farm, or ranch.

El pronombre *it*, en este ejemplo hace referencia a lo que sigue después del verbo: *to build a large dam to generate hydroelectric power this way*. La oración podría ser invertida aunque en resultado no es la forma ideal de decirla:

To build a large dam to generate hydroelectric power this way is not necessary.

El pronombre *it* desaparece puesto que su función en la oración original era ocupar el lugar de sujeto. Al invertir el orden de las partes, la oración tiene un sujeto (*to build a large dam to generate hydroelectric power this way*) seguido de su predicado (*is not necessary*). Lo importante aquí es asignarle el valor correcto a IT. Es decir, *el estudiante deberá preguntarse si el IT debe ser interpretado como ESTO o como ES, ERA, SERÁ, dependiendo de la forma del verbo TO BE.*

IT + verbo BE = ES, ERA, SERÁ, etc. o ESTO ES, ERA, SERÁ, etc.

Para repasar:

1- Choose the best option.

1- "it" on line 5 refers to…
   a. …natural gas.
   b. …these sources.
   c. …a deposit.
2- "their cost" on line 11 refers to…
   a. …water and wind's cost.
   b. …other renewables' cost.
   c. …water, wind and other renewables' cost.
3- "they" on line 17 refers to…
   a. …positive or negative environmental impacts.
   b. …dams.
   c. …fish migration.
4- "it" on line 29 refers to…
   a. …water.
   b. …the dam.
   c. …a turbine.
5- "this way" on line 30 refers to…
   a. …water released from behind the dam flows through a turbine.
   b. …water released from behind the dam flows through a turbine, spinning it.
   c. … water released from behind the dam flows through a turbine, spinning it, which then turns a generator to produce electricity.
6- "there" on line 66 refers to…
   a. …solar technologies.
   b. …few negative environmental impacts.
   c. …environmental concerns associated with the production of collectors and storage devices.

2- State the meaning of the pronoun IT in the following sentences.

1- Energy shortage is a real problem nowadays. However, **it** is important to solve **it** soon. are many ways to solve this problem.
2- Energy shortage is a real problem nowadays and **it** is an issue that requires our immediate attention. **It** is not difficult to find a solution if we work together.
3- The recycling of garbage is a solution to the energy problem but **it** is not easy to do **it**.
4- **It** is advisable to start saving energy by reducing energy consumption at home and at work.

7B Over to your Career Path

Activity 1: Scan the text below and complete:

a- This text is not taken from a news source. This text is taken from a …….
b- The publication's name is……
c- The article's name is…….
d- It was written by…..
e- It was published in the year……

Activity 2: Scan the text and complete the outline of the article.

Abstract
1. Introduction
2. ……
3. ……
4. ……
5. ……
6. ……

Acknowledgements
References

Glossary

You may need the following meanings to do the next activities:

coating: (n) a cover, a thin layer of something that covers a surface

cool: (adj) low in temperature but not cold

cool: (v) to make something colder

decrease: (v) to reduce the amount of something

eaves: (n) overhanging of a roof that projects beyond the supporting exterior walls

emulate: (v) to imitate

envelope: (n) a layer that covers something else: *an envelope of gases around the planet*.

face: (n) the outside surface of something: *a cube has six faces*.

gain: (n) accumulation of something / an increase in something ≠ loss

glazing (n) glass used in a window

heat: (n) the quality of being hot

heat: (v) to make something warm or hot

height: (n) how tall someone or something is: *buildings of different heights*.

high: (adj) the opposite of low

overall: (adj) general

resemble: (v) to be like something else

roof: (n) the structure that covers or forms the top of a building, vehicle, etc.

scale: (v) to adjust the size of something

shade: (n) darkness or protection from direct light of the sun made by something blocking it: *the temperature is 90 degrees in the shade*.

shade: (v) to protect something from direct light

storey: (n) a level of a building: *a five-storey building*.

suitable: (adj) appropriate

surface: (n) the top part of an area of water or land

tilt: (n) a movement or position in which one side of something is higher than the other

Activity 3: Scan the abstract and state orally:

a- Kind of energy system used:
b- Example of Chinese building type:
c- Characterization of Chinese building type:
d- Examples of building parameters taken into account:
e- Results of the energy system used in relation to cooling demands:
f- Results of the energy system used in relation to heating demands:

Activity 4: Match the advantages in incorporating solar energy systems into Chinese style buildings in the introduction to the statements below.

a- This is connected with the loss of energy reduction.
b- This is related to eaves as a surface where to place solar panels.
c- This makes reference to eaves and their shading function.

Activity 5: Scan the following paragraphs and identify:

a- The most important function of a solar energy system;
b- The two stages involved in the design process of this type of buildings;
c- The parameters that are taken into account in an existing building and in a new building.

Activity 6: Move to the *Conclusions* section and comment on the following concepts:

a- Materials
b- Installation of solar panels
c- Reflective coatings on glass

Activity 7: State the reference of the following words and phrases.

a- *those parameters* (line 37) refers to:
    1. parameters mentioned;
    2. parameters which are relevant to energy consumption;
    3. parameters connected with cost-effectiveness.
b- *it* (line 38) refers to:
    1. design process;
    2. building;
    3. energy balance.

c- *This* (line 40) refers to:
   1. to minimize the use of non-solar energy;
   2. solar energy;
   3. solar energy system.

d- *Both* (line 41) refers to:
   1. addition of solar panels to existing buildings and construction of new buildings;
   2. solar panels and new buildings;
   3. addition and construction.

e- *the latter* (line 44) refers to:
   1. solar thermal and photovoltaic panels;
   2. solar thermal panels;
   3. photovoltaic panels.

Activity 8: Now, *you* find the reference of the following words and phrases in the text. Comment on the meaning of the text as you discover them.

a- this style (line 47)
b- This (line 51)
c- both (line 56)
d- This (line 57)
e- their (line 58)
f- both (line 65)
g- These (line 70)
h- both (line 71)
i- This (line 75)
j- some of which (line 88)

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

The text was retrieved March 29, 2010 from http://www.sciencedirect.com/science?_ob=MImg&_imagekey=B6V2V-4WW2SJM-9-R&_cdi=5712&_user=10&_pii=S0378778809001480&_orig=browse&_coverDate=01%2F31%2F2010&_sk=999579998&view=c&wchp=dGLbVlW-zSkWz&md5=33ed3e27d7f0a5560cdbf16f3e37d07a&ie=/sdarticle.pdf

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Optimisation of solar-optical and thermal properties of buildings incorporating solar panels, emulating traditional Chinese building style

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ARTICLE INFO

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Chinese

ABSTRACT

A building-integrated solar energy system, based on the traditional Chinese building (e.g., pagoda) – buildings with roofing at intermediate levels (known as eaves) – was investigated, with regard to providing for heating and cooling demands. A number of building parameters, related to energy exchange – solar absorptivity of the exterior wall, level of glazing, etc. – were optimised to minimise demand, and the orientation and tilt of the panels were selected to provide maximum energy at the times of maximum demand. Each parameter was investigated for a range of locations, in order to identify trends, which could then be applied to other locations. In most cases, solar power was sufficient to meet the cooling demands. For a number of locations, solar power provided some, but not all, of the heating loads.

1. Introduction

A previous design study has proposed installation of solar panels on buildings, such that the overall morphology resembles that of a traditional Chinese building (e.g., pagoda)—buildings with roofing at intermediate levels (known as eaves), in addition to that on the top of the building, as shown in Fig. 1 [1,2]. In addition to the general advantages of building-integrated solar panels, the incorporation of solar energy systems into buildings of traditional Chinese style confers the following further advantages:

1. The eaves provide additional surfaces for collection of solar energy. Both the top roof and the eaves can be (or can include) solar panels. These can provide heating, electricity, or a combination of both.
2. The energy collection is distributed throughout the height of the building, which reduces the requirement for internal transfer. This can incur considerable energy losses, particularly for circulating air in space heating systems.
3. The eaves will shade windows and roofing at lower levels, to a degree which varies with solar elevation, i.e., throughout the day and with season, and with latitude. Thus, shading is at a maximum in the middle of the day, when the temperatures tend to be higher. By suitable design, it may be possible to match solar collection to energy demand, and reduce solar gain and hence cooling requirements at the highest ambient temperatures.

(These technical advantages are in addition to the cultural and aesthetic value of combining traditional Chinese styles with modern building methods.)

In this work, the design process was developed further, to optimise those parameters of the building, and the panels mounted on it, which are relevant to energy balance. The end objective of a solar energy system is to minimise the use of non-solar energy. (This is not necessarily identical with maximising use of solar energy.) Both addition of solar panels to existing buildings, and construction of new buildings were considered. The primary energy demands evaluated were space heating and cooling. Solar thermal and photovoltaic panels were included, with the latter providing electrical energy for air conditioning systems (including bi-directional versions, which can act as heat pumps.)

2. General method

The methodology adopted in the design process for this style of building consists of two stages.

1. The envelope of the building (walls, windows, etc.) is optimised to provide a passive energy balance for the building, which is closely matched to demand. This reduces the demand on active systems. Examples include passive solar heating, to minimise active heating requirements, and shading, to reduce air conditioning demands.
2. The design of the active systems is optimised to make maximum use of solar energy, both for solar thermal and photovoltaic panels. This includes not only the scaling of the systems, to achieve the required power, but also their location around the

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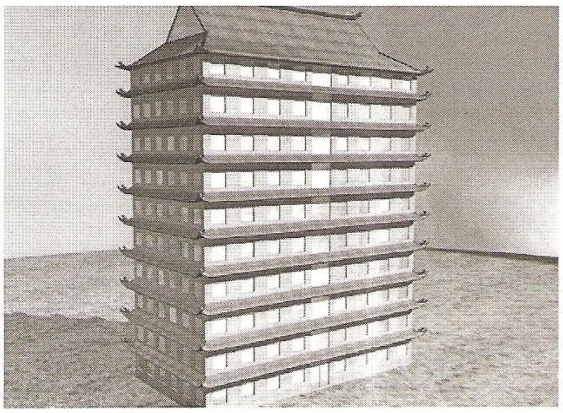

Fig. 1. Medium-rise tower block with wall-mounted and roof-mounted solar panels, emulating traditional Chinese architectural style.

building, to generate power at times of maximum demand. This minimises the use of non-solar energy, with benefits for the occupier and for energy conservation.

(This methodology can be applied to any style of building, where solar energy makes up a significant proportion of the total balance. Where relevant, the effects of modifying certain building parameters will be considered for both the style of building being investigated – solar panels/shading – and for more conventional buildings.)

For existing buildings, a number of parameters relevant to the energy management are fixed, whereas for new buildings, many parameters can be selected (within certain limits). These are listed in Table 1. For both new buildings and upgrading of existing buildings, the limits of certain parameters may be specified by building regulations [3]. The requirements for envelope insulation are given by JGJ 26-95—relevant primarily to Northern China [4]. This may limit the choices available. For instance, the maximum limit for the *U*-values of windows in Haerbin is 2.5 W/m^2 K. This is lower than that for standard double glazing, requiring that triple glazing or enhanced double glazing is used.

Within the limitations specified above, the parameters can be adjusted to optimise energy performance. However, the final design choice may be influenced by additional factors. For instance, double glazing reduces heat loss, compared to single glazing. However, in moderate climates, the energy saving may be marginal, and would not justify the additional cost. Similarly, energy saving would favour large south-facing windows, and small north-facing ones. However, aesthetic considerations would favour windows of equal area on all sides.

The building model had a number of properties, some of which were fixed for all the case studies.

Table 1
Parameters which can be modified in existing and new buildings.

Parameter	Existing	New
Aspect ratio	No	Yes
Orientation	No	Possibly
Wall construction (material/thickness)	No	Yes
Exterior wall absorptivity	Yes	Yes
Window area	Limited	Yes
Glazing (single, double, etc.)	Yes	Yes
Glass reflectivity (solar)	Yes	Yes
Glass reflectivity (thermal infra-red)	Yes	Yes

- A single storey of a residential tower block. (Vertical heat flow between storeys was not considered at this stage.)
- The long axis of the building was oriented north-south, to present the largest area to the morning sun, and maximise setback recovery. (This also allows maximum warming of the building prior to sunset, which partially mitigates the effects of overnight cooling.)
- Four flats (each measuring 10 m × 6 m and 2.8 m high), in a 2 × 2 arrangement formed each single storey.
- The windows each measure 1.2 m × 1.2 m, with 4 on the 10 m wall and 3 on the 6 m wall.
- Standard Chinese values for parameters of building materials, e.g., *U*-values, wall thicknesses, were used in the analysis [4,5].

In addition, further parameters were varied between case studies, with examples for a range of locations. The building parameters, which were varied are shown below.

- Wall construction. Two commonly used structures were used [5].
- 370 mm (triple layer) brick wall—*U*-value = 0.68 W/m^2 K (inc. convective heat transfer).
- 370 mm concrete hollow block—*U*-value = 0.83 W/m^2 K (inc. convective heat transfer).
- Wall colour—quantified as absorptivity over the solar spectrum.
- Window glazing level—single, double, etc., including enhancements such as e-glass (heat reflecting coatings) or inert gas fills.
- Window reflective coatings—50% reflective coatings were compared with uncoated glazing. (This was investigated in conjunction with the shading effects of panels, as both affect direct solar gain.)

The heating/cooling system was a bi-directional heat pump/air conditioner, with a coefficient of performance of 4 (heating) and 3 (cooling). The schedules for thermostat set points were:

- Heating. 15 °C when the building is unoccupied (09:00–17:00) and during overnight setback (22:00–07:00); 20 °C during morning (07:00–09:00) and evening (17:00–22:00) peak periods.
- Air conditioning. 26 °C all day.

The solar panels were 1 m × 1 m, and the array (number of panels) was scaled to provide the power demand, and positioned on the east, south and/or west walls, to best match the daily cycles in demand. A solar–electrical conversion efficiency of 15% was used.

For most of the (varied) parameters – wall construction, window glazing and window reflective coatings – successive trials were performed for each of a relatively small number (2 or 3) of possible options, and the results compared for energy savings. Heat flow calculations were based on a thermal network, derived from the *U*-values and surface areas of each envelope component (modified by first-order predictor–corrector methods). The outdoor air temperature was provided by SWERA climate data for each location [6]. Solar radiation data (also from SWERA) was used to calculate the solar temperature and the direct solar gain. This was also used to calculate solar electricity generation, for each configuration of solar panels. Electrical demands were calculated from the heat transfer demands, based on the specified coefficients of performance.

In the case of the wall colour, the annual heating and cooling days were calculated, based on the solar temperature [7]. By varying the solar absorptivity between trials, this could be optimised for a given location (in terms of outside air temperature and solar radiation). The calculations were performed at hourly intervals, to incorporate the daily solar cycle, and divided by 24 to give the result as degree days.

3. Results (a): wall construction and colour

For locations with a mean outdoor air temperature in the −0.1 to −1.0 °C range, the maximum U-value for walls, specified by JGJ 26-95, is 0.85 W/m^2 K. Including the convective heat transfer coefficient, either brick or concrete walls (as specified above) meet this requirement, without additional insulation. Cities in this zone include Shijiazhuang and Tianshui. For cities in higher temperature zones – 0.9 to 0.0 °C (U = 1.00 W/m^2 K, e.g., Qingdao, Xian) and 2.0–1.0 °C (U = 1.10 W/m^2 K, e.g., Zhengzhou, Luoyang) – and for cities further south, where JGJ 26-95 does not specify limits, either construction material can be used. For a flat (as specified above) located in Shanghai, the heat flow (via the walls) at the time of maximum demand (January, daily mean temp) is:

Brick : $U = 0.68\,\mathrm{W/m^2\,K}$, $\dot{q} = 13.6\,\mathrm{W/m^2}$, $\dot{Q} = 544\,\mathrm{W}$

Concrete : $U = 0.83\,\mathrm{W/m^2\,K}$, $\dot{q} = 18.6\,\mathrm{W/m^2}$, $\dot{Q} = 744\,W$

A brick wall gives an energy saving, compared to a concrete wall. However, the saving is moderate, and if the construction cost of a brick wall is significantly higher than that of a concrete wall, this may more than offset the energy saving.

Beijing lies in the zone with a mean outdoor temperature in the range −1.1 to −2.0 °C (heating period); thus the requirement of JGJ 26-95 is a maximum U-value for walls of 0.82 W/m^2 K. Thus, a brick wall would meet this requirement, whereas a concrete wall would require a little extra insulation. The heat flow at maximum demand is:

Brick : $U = 0.68\,\mathrm{W/m^2\,K}$, $\dot{q} = 17\,\mathrm{W/m^2}$, $\dot{Q} = 680\,\mathrm{W}$

Concrete + insulation : $U = 0.82\,\mathrm{W/m^2\,K}$, $\dot{q} = 20.5\,\mathrm{W/m^2}$, $\dot{Q} = 820\,\mathrm{W}$

As for Shanghai, a brick wall provides energy savings, but this may be offset by higher construction costs.

Haerbin is in the temperature range −9.1 to −10.0 °C, giving a required maximum U-value of 0.4 W/m^2 K. This is lower than that for a brick wall, and thus additional insulation (usually polystyrene foam) is required. The heat flow, both with and without this extra insulation, is shown.

Brick : $U = 0.68\,\mathrm{W/m^2\,K}$, $\dot{q} = 30.6\,\mathrm{W/m^2}$, $\dot{Q} = 1224\,\mathrm{W}$

Brick + insulation : $U = 0.4\,\mathrm{W/m^2\,K}$, $\dot{q} = 18\,\mathrm{W/m^2}$, $\dot{Q} = 720\,\mathrm{W}$

As shown, without the extra insulation, the heat flow, and hence heating demand, is much higher than for other locations. The extra insulation reduces the heat flow to a level similar to that for Beijing.

For a number of cities across China, representing a wide range of climates, the heating degree days and cooling degree days both showed an approximately linear dependence on the solar absorptivity of the external walls. However, the extent of the dependence varied, according to climate.

For Hong Kong, the results are shown in Fig. 2. Cooling (air conditioning) is the main energy demand, and the cooling degree days are lowest for $\alpha = 0$. Thus, energy demand is minimised for lightly coloured walls, as expected for a hot climate. The large dependence of energy demand on absorptivity means that highly reflective surfaces may be cost-effective. White paint has a typical absorptivity of 0.2.

$\alpha = 0$, HDD = 177, CDD = 326

$\alpha = 0.2$, HDD = 137, CDD = 637

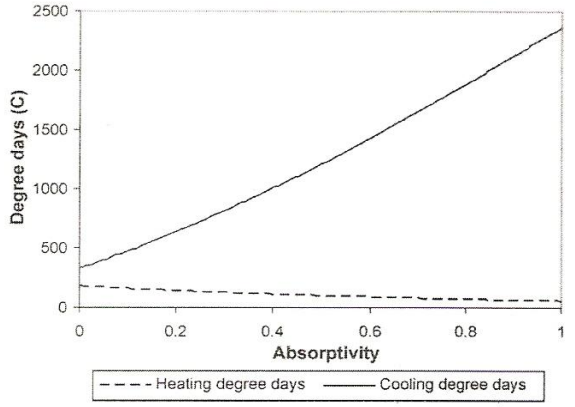

Fig. 2. Annual heating and cooling degree days vs. exterior wall absorptivity for Hong Kong.

A material, such as "cool paint", which is highly reflective in the near infra-red, could give significant energy savings, at little extra cost [9].

For Shanghai, heating is the larger demand, but cooling shows a greater dependence on absorptivity, as shown in Fig. 3. Thus, the minimum energy demand occurs for $\alpha = 0$. However, the demand for a white painted surface ($\alpha \sim 0.2$) is not substantially greater than for a pure white surface. Therefore, the extra cost of more reflective surfaces may not be justified.

$\alpha = 0$, HDD = 1561, CDD = 154

$\alpha = 0.2$, HDD = 1366, CDD = 339

In Haerbin, the heating demand is considerably larger than the cooling demand, as shown in Fig. 4.

$\alpha = 1$, HDD = 3986, CDD = 866

$\alpha = 0.7$, HDD = 4265, CDD = 514

Although the total demand does not vary much with absorptivity, the lower demand in winter, resulting from darker walls, would result in a lower non-solar heating requirement, at a time when solar energy availability is lower. However, highly absorbent surfaces would not reduce demand significantly,

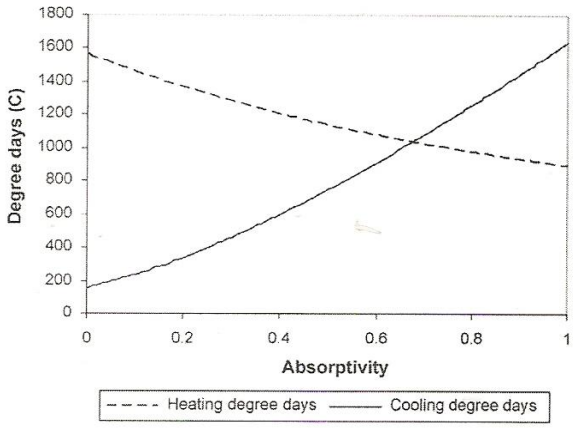

Fig. 3. Annual heating and cooling degree days vs. exterior wall absorptivity for Shanghai.

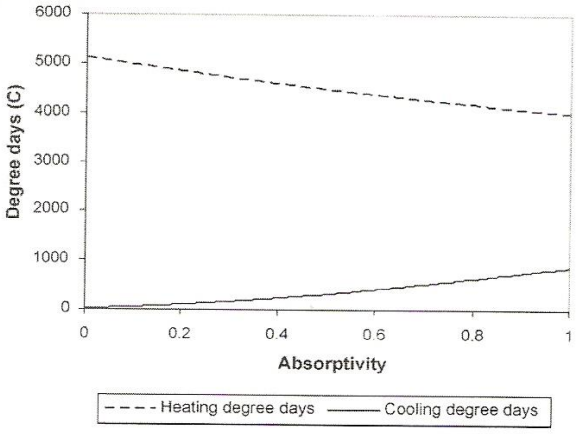

Fig. 4. Annual heating and cooling degree days vs. exterior wall absorptivity for Haerbin.

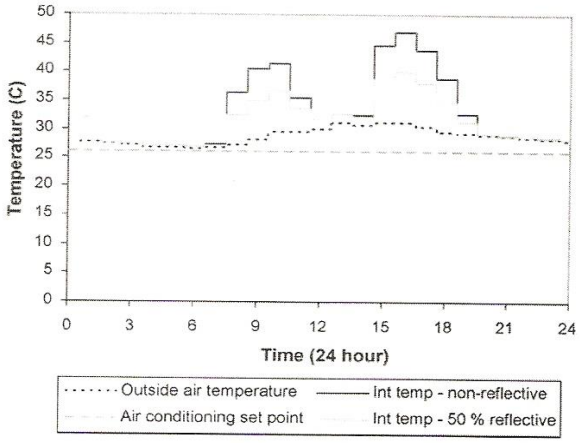

Fig. 5. Free-response interior temperature, and outdoor air temperature, for a standard flat in Hong Kong, with no shading panels.

compared to commonly used dark surfaces, e.g., red brick ($\alpha \sim 0.75$), and would be justified only if the additional cost was marginal.

Considering the examples given above, and similar studies for other cities, some general trends can be identified.

1. In the hottest climates, the cooling demand is strongly dependent on the wall colour (solar absorptivity). This gives a significant performance advantage to highly reflective surfaces, compared to more conventional surfaces (e.g., white paint), which may justify the extra cost of such surfaces.
2. In more moderate hot climates, the performance advantage of highly reflective surfaces is less significant, and would probably not justify the extra cost. In such cases, conventional white paint, etc., would be appropriate.
3. Even in the coldest climates, there is little advantage for highly absorbent surfaces, compared to conventional dark surfaces (e.g., red brick). Thus the extra cost would probably not be justified, and conventional dark surfaces would be appropriate. In more moderate cold climates, the advantages of highly absorbent surfaces would be marginal, thus favouring conventional dark surfaces.

4. Results (b): window glazing

For buildings in Northern China, the maximum limits for *U*-values of windows is specified by regulations – JGJ 26-95 – based on the requirement to reduce heating demand. For each location, this limits the choice of glazing types, which can be selected. The permitted types of glazing, for a number of representative cities, are shown in Table 2 [4,8]. (Single glazing – $U = 6$ W/m^2 – does not meet the requirements for any zone covered by JGJ 26-95.) Glazing can be selected, based on energy savings and cost. For instance, in Haerbin, the minimum requirement is triple glazing. The temperature difference across the windows is approx. 25 °C. This gives a heat loss of approx. 45 W/m^2. The highest performance glazing (e-glass with argon) would have a heat loss of approx. 33 W/m^2, giving a net saving of 11 W/m^2. As high performance glazing is generally more expensive than triple glazing, economic considerations would favour triple glazing.

In Central and Southern China, the hotter climate results in air conditioning being the higher demand. As a result, a major consideration is reducing the direct solar gain via the windows. In many modern buildings, this can be achieved by applying reflective coatings to the glazing. In the style of building being considered here, shading by overhanging panels also reduces solar gain. For this reason, these two measures are considered together.

The effects of solar gain were studied for the standard flat, located in Hong Kong. In all variations, there were no air conditioning systems, so that the interior temperature was a free response to the outdoor temperature and solar gain. The temperature for design day – June 21st – for a building with no shading panels is shown in Fig. 5, for both uncoated glass and 50% reflective glass. The effects of shading can be seen in Fig. 6. This shows the vertical extent of the area which receives direct sunlight (between the top of one panel and the shadow of the overhanging panel), and the resultant insolation. The results are shown for the winter solstice. (In summer, the entire wall is shaded at this latitude.) The effect of shading on the free-response interior

Table 2
Types of glazing meeting the requirements of regulation JGJ 26-95, for representative cities in Northern China. *U*-values in brackets – W/m^2 K – based on 20 mm spacing (data from JGJ 26-95 [4]; Kreider [8]).

Representative cities	Mean temperature in heating period	Maximum *U*-value (W/m^2 K)	Double (2.84)	Triple (1.79)	e-glass (1.6)	e-glass argon (1.33)
Luoyang Beijing	2.0 to −1.0 °C −1.1 to −2.0 °C	4.00	Yes	Yes	Yes	Yes
Shenyang Huarhate	−5.1 to −6.0 °C −6.1 to −7.0 °C	3.00	Yes	Yes	Yes	Yes
Changchun Haerbin	−8.1 to −9.0 °C −9.1 to −10.0 °C	2.50	No	Yes	Yes	Yes

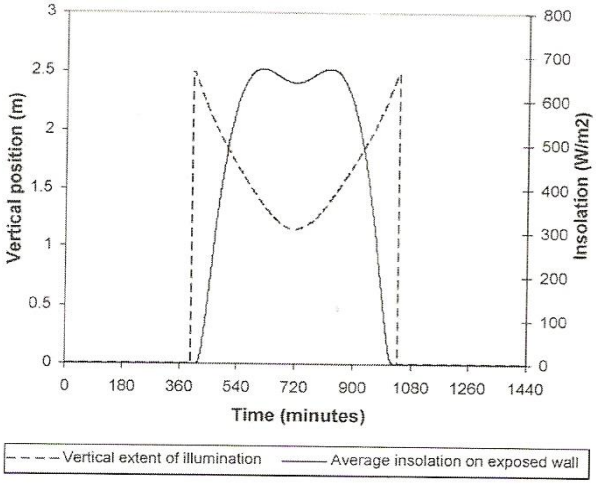

Fig. 6. Shading effect of panels (vertical extent of unshaded wall), and resultant area-averaged insolation, for a standard flat in Hong Kong, with shading by solar or passive panels.

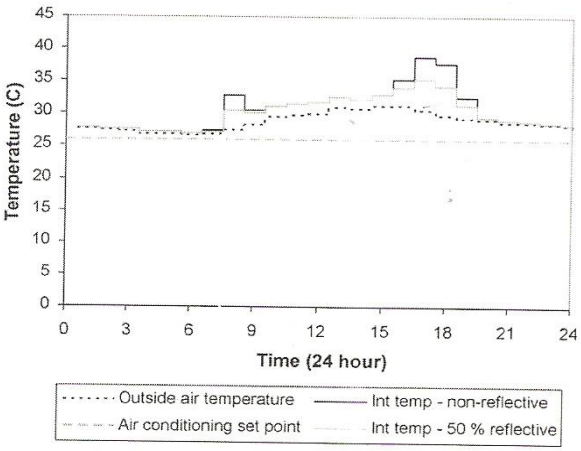

Fig. 7. Free-response interior temperature, and outdoor air temperature, for a standard flat in Hong Kong, with shading by solar or passive panels.

temperature is shown in Fig. 7, again for uncoated and 50% reflective glazing.

The annual air conditioning demands for each case are shown in Table 3. Reflective coatings provide an annual energy saving of over 25%. Shading, in conjunction with uncoated glass, reduces energy demand by approx. 40%. Thus shading is more effective in reducing air conditioning demand than reflective coatings alone. Combining

Table 3
Annual air conditioning demand for standard flat, with and without shading by solar panels, for uncoated and 50% reflective glazing.

Features affecting direct solar gain	Air conditioning demand (heat transfer) (GJ)	Air conditioning demand (electrical) (GJ)
No shading—uncoated glass	31.8	7.2
No shading—50% reflective glass	22.3	5.3
Shading by panels—uncoated glass	18.9	4.6
Shading by panels—50% reflective glass	16.6	4.2

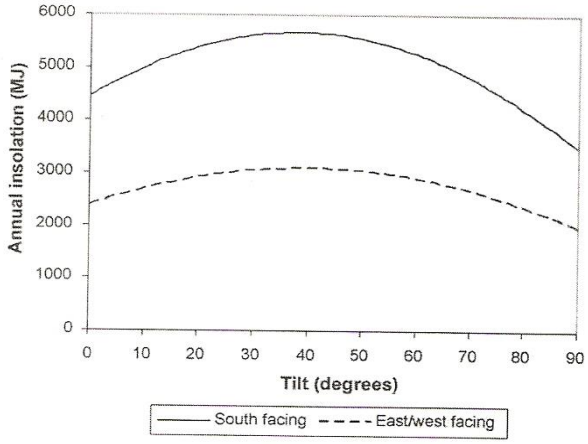

Fig. 8. Annual insolation vs. panel tilt for Haerbin (latitude = 46°N).

both reflective coatings and shading results in only a marginal saving, compared to shading alone. Thus in this climatic zone, for conventional buildings, reflective coatings provide useful energy savings, whereas for the style of building being studied here, these coatings provide little improvement over shading alone, and would probably not be cost-effective. For aesthetic reasons, it is preferable that the eaves run the full length of each side of the building. Therefore, even if the full length is not required for active solar (photovoltaic and/or thermal) panels, it is advantageous to have shading panels along the full length, in order to derive the maximum energy saving.

5. Results (c): solar panels

For active solar panels, three factors need to be considered – total array area, position around the building – i.e., which wall(s) they are installed on, and tilt. For a south-facing panel, a simple calculation shows the optimum tilt for maximum annual insolation to be equal to the latitude. More realistic calculations will give results, which differ slightly from this. For aesthetic reasons, it would be preferable if the panels on all of the walls could be mounted at the same tilt. Fig. 8 shows annual insolation (based on clear sky irradiance) for south-facing and east/west-facing solar panels in Haerbin (latitude = 46°N). Maximum insolation of the south-facing panels occurs over a range of tilt from 36° to 42°, whereas for east/west-facing panels, maximum insolation occurs from 37° to 44°. Thus panels with a tilt between 36° and 42° will receive the optimum insolation, for all three orientations. Seasonal variations in cloud cover, etc., may require slight modifications of this calculation. Similar results for Hong Kong (latitude = 22°N), shown in Fig. 9, give 24–31° as the optimum range for south-facing panels, and 31–39° for east/west-facing panels. Thus 31° is the optimum tilt for panels on all walls. Calculations based on clear sky insolation will apply to all locations at the same latitude, with modifications being required for local climate (cloud cover).

In order to match supply and demand, the results for positioning and size of solar arrays are considered together. A photovoltaic array on the south-facing wall receives the maximum annual insolation. Generation is highest during the period of the day (mid morning to late afternoon) when air conditioning demand tends to be highest. Solar electricity generation is compared to electrical demand for heating/cooling, to give the instantaneous electrical export or import. These are integrated to give the annual electrical export and import. Fig. 10 shows the

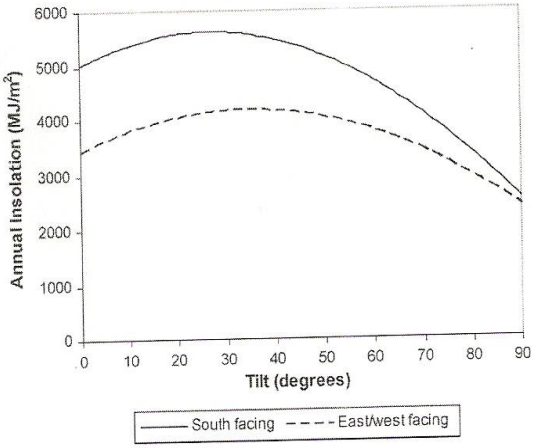

Fig. 9. Annual insolation vs. panel tilt for Hong Kong (latitude = 22°N).

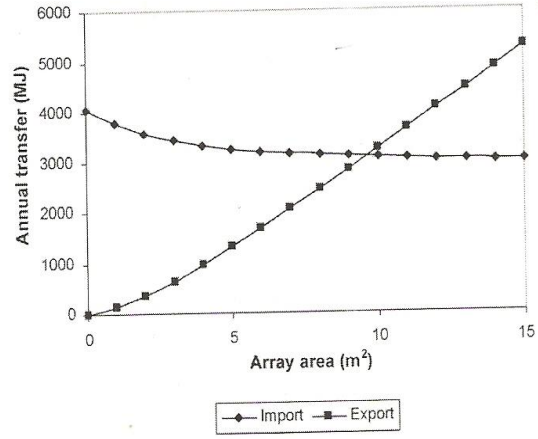

Fig. 10. Annual electrical export and import vs. photovoltaic array area for Dalian.

results for a range of array areas, for a standard flat located in Dalian. The annual export just exceeds the import for an array size of 10 m^2. This is slightly smaller than the available area (12 m^2– based on 1 m × 1 m panels) on the south-facing wall based on an array. Similar calculations for Haerbin show that an array size of 14 m^2 would be required for annual export to equal import. This is smaller than the available area, but a few additional panels on the east- and west-facing walls could provide a total power, such that annual export would equal or exceed annual import. Solar array sizes are shown in Table 4 for these locations, and for other locations, based on similar calculations. Solar thermal panels could be installed on the remaining available areas on the east- and west-facing walls. East-facing panels would provide heat for the morning setback recovery and for the morning peak demand for hot water. West-facing panels would provide space heating into the evening and hot water for the evening peak demand.

Table 4
Photovoltaic array size required for annual electrical export to equal or exceed annual import.

Location	PV array size (south-facing)	PV array size (east/west-facing)
Haerbin	12	2
Beijing	8	0
Dalian	10	0
Shanghai	12	0
Chongqing	12	0
Hong Kong	10	0

6. Conclusions

In most cases, appropriate selection from commonly used materials give good energy savings, without the need for (generally more expensive) high performance materials. However, in some cases higher performance materials could be justified, e.g., "cool paints" to minimise indirect solar gain in hot climates. The installation of solar panels, in the style proposed, influences both the passive and active solar performance of buildings. The shading provided by the panels to underlying walls and windows significantly reduces solar gain, which decreases cooling demand in hot ambient temperatures. As a result, reflective coatings on glass proved unnecessary, thus eliminating an additional cost. Installing photovoltaic panels predominantly on the south-facing wall makes maximum use of the available energy, and matches it well to air conditioning demand. This approach also leaves space on east and west-facing walls for solar thermal panels, which are thus most effective during the morning and early evening peak demand periods.

Future work includes simultaneous optimisation of sets of parameters, and consideration of vertical distribution of energy between storeys. In many situations, a number of parameters of the building cannot be changed, and in general will not be optimised for energy efficiency. These can be the basis of case studies, to investigate the extent to which energy efficiency can be improved by optimisation of those remaining parameters which can be adjusted. These case studies could then act as templates for energy efficient design or modification of actual buildings.

Acknowledgements

I would like to thank Dr. Chris Underwood (School of Built Environment) for his advice on energy supply and demand in buildings.

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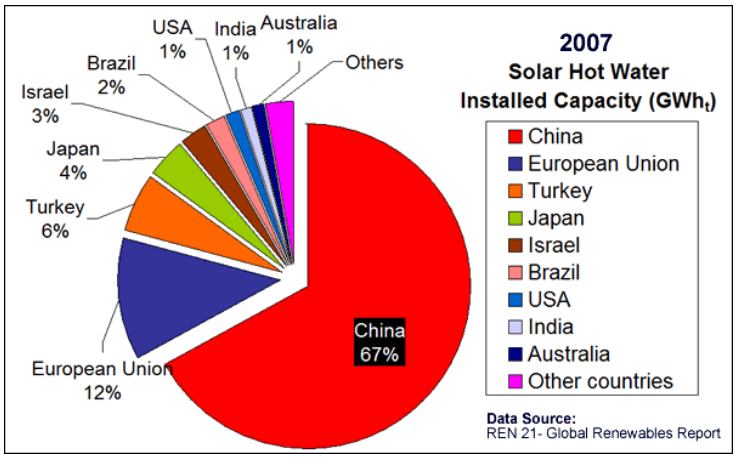
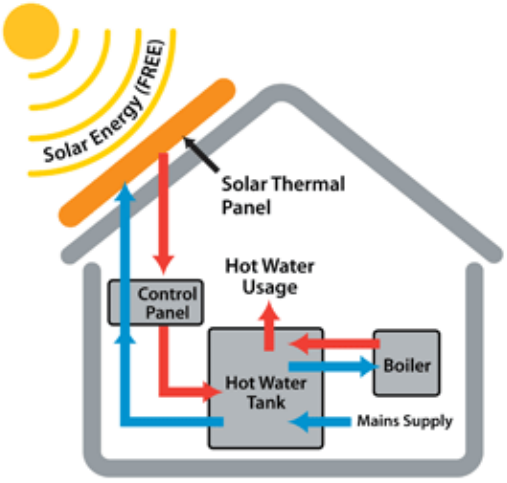
Review Section 3

Activity 1:Look at the pictures and comment on them.



Retrieved February 6, 2012 from http://blog.cleantechies.com/2010/03/16/solar-thermal-markets-set-for-rapid-growth/



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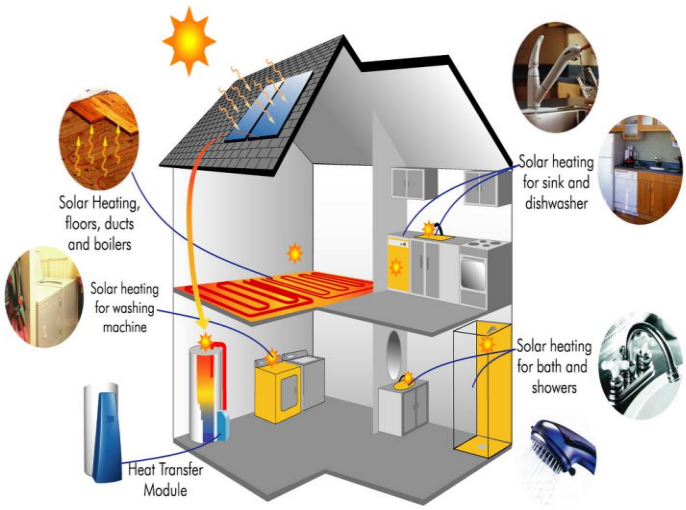
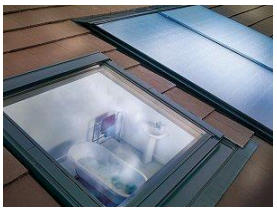


Retrieved February 6, 2012 from http://ccsolar.net/thermal-power-for-your-home/

Activity 2: Now scan the text below. What information about Solar Thermal Energy do we read about?

Solar Thermal Energy - Solar Hot Water - Solar Heating

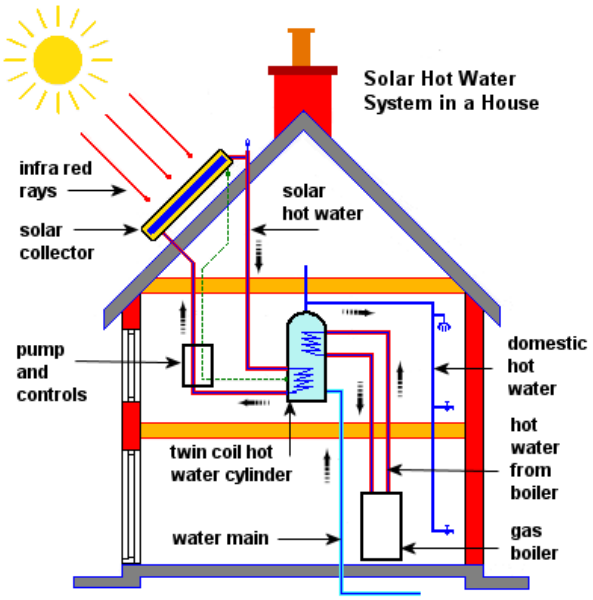


Solar thermal energy is a method of heating water using heat from the sun. A solar thermal energy system can be installed in a home to provide domestic hot water for sinks, washbasins, baths and showers. Infra red rays will travel through clouds and provide heat to a solar thermal energy system even on cloudy days

Advantages of Solar Thermal Energy

A well designed solar thermal energy system can provide half the heat required to supply a household's hot water throughout the year. Where there is a shortfall, the temperature of the water can be raised to the required level using hot water from the central heating boiler, in the conventional way.

Solar thermal energy panels can save money because they use free energy from the sun. They are also environmentally friendly, as they produce no greenhouse gas emissions, in use.



Orientation

Ideally, a home needs to have a south facing roof that has an uninterrupted view of the sun. The roof can be either flat or pitched and the collectors can be fitted on the roof with special fixings.

Solar thermal energy panels can face anywhere in the south-east to south-west quadrant without losing much efficiency and should be angled about 35 degrees from the horizontal.

Glass Tube

An evacuated glass tube solar thermal panel is made up of a row of long glass tubes. A combined absorber plate and heat transfer tube is fitted into each glass tube during manufacture. The air is then drawn from the glass tubes and they are hermetically sealed to minimize heat loss.

The absorber plate is treated with an efficient selective coating and the heat transfer tube is made from a highly conductive material which contains a refrigerant that boils at a low temperature. A heat exchanger is fitted along the top end of the tubes where water is heated by the boiling refrigerant.

The advantage of this type of solar thermal energy panel is that the refrigerant responds very quickly to short spells of sunlight and the heat created is quickly transferred to the water.

Evacuated glass tubes are fitted individually within the solar thermal panels and, once in position, can be rotated to improve the absorber plate's position relative to the sun and consequently improve the level of heat absorption.

Protection Against Frost

In the UK, the water in the solar hot water coils must have anti freeze added to prevent the system from freezing. It is important to note that water from the solar thermal panel is in its own separate system and does not mix with the domestic hot water or the water in the heating system.

Water Storage

The heat extracted from the solar thermal energy panel is pumped through a domestic hot water cylinder. It is usual for the existing domestic hot water cylinder to be upgraded to a new twin coil cylinder. The top coil will be connected to the condensing boiler and the bottom coil will be connected to the solar heating panel. It is important to note that combi boilers are not suitable for use with a solar thermal energy system.

Primary Circuit

The heated water travels from the solar thermal energy panel in a pipe system that passes through the water storage cylinder in the airing cupboard and heats the domestic hot water. The circuit is continuous so when the water has passed through the hot water cylinder it returns to the solar thermal energy panel to be reheated.

Boiler Heat Primary Circuit

On days when the solar thermal energy installation does not produce water at a temperature that is high enough for normal use, the control system will ensure that the condensing domestic boiler fires and makes up the shortfall.

Solar Thermal Energy System

Installation of a solar thermal energy system normally takes two or three days. During this time the hot water system is turned off. Apart from this, there is usually no major disruption.

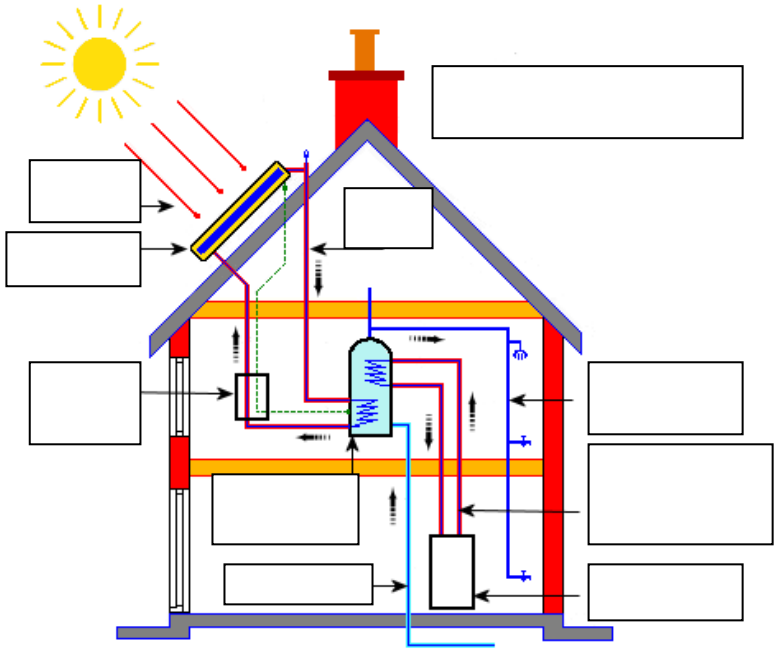
Warranty and Maintenance Costs of Solar Thermal Energy

A solar thermal energy system generally comes with a 10 year warranty and requires little maintenance. Pumped systems incur a low cost when the electric pump is in operation.

Before considering any system of renewable energy, it is advisable to improve the energy efficiency of your house through improved: insulation, draught proofing, low energy lights and heating controls

Retrieved and adapted August 6, 2010 from http://www.solarthermalenergy.co.uk/

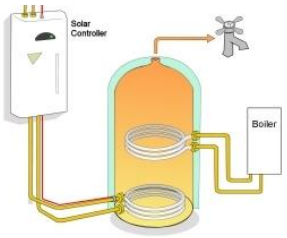
Actividad 3: Write the labels of the picture in Spanish.



Activity 4: What does this picture illustrate?

Activity 5: Now complete the definitions with the expressions below.

absorber plate - twin coil hot water cylinder - solar collector - refrigerant –



a- A ……. is a device that collects heat by absorbing sunlight.
b- The …….. is a cylinder containing two heat exchanger coils arranged one above the other.
c- An ……. is a part of a flat-plate solar collector that provides a surface for absorbing incident solar energy.
d- A …… is a substance used in a heat cycle usually including, for enhanced efficiency, a reversible phase change from a liquid to a gas.

Activity 6: Complete the following table with information in the text.

Ventajas de la energía termal solar	
Cuestiones relacionadas con la orientación de la casa	
Prevención de congelamiento del agua	
Funcionamiento del circuito primario	

Activity 7: Look at the following noun phrases. Identify the head, premodification and postmodification. Then, comment orally on what they refer to.

a- a method of heating water using heat from the sun (line 2)
b- the temperature of the water (line 8)
c- a south facing roof that has an uninterrupted view of the sun (line 14)
d- an efficient selective coating (line 26)
e- a highly conductive material which contains a refrigerant (line 27)
f- a refrigerant that boils at a low temperature (line 27)
g- a pipe system that passes through the water storage cylinder in the airing cupboard (45)

	Pre-modification	**Head**	**Post-modification**	**Value in Spanish**
a-	*a*	*method*	*of heating water using heat from the sun*	*un método de calentamiento de agua que utiliza calor del sol*
b-				
c-				
d-				
e-				
f-				
g-				

Activity 8: Identify the reference of the words highlighted.

a- **They** are also environmentally friendly, as **they** produce no greenhouse gas emissions. (line 11)
b- Ideally, a home needs to have a south facing roof **that** has an uninterrupted view of the sun. (line 14)
c- The air is then drawn from the glass tubes and **they** are hermetically sealed to minimize heat loss. (line 23)
d- **It** is important to note that the water from the solar thermal panel is in **its** own separate system… (line 36)
e- **It** is usual for the existing domestic hot water cylinder to be upgraded to a new twin coil cylinder. (line 40)
f- **It** is important to note that combi boilers are not suitable for use with a solar thermal energy system. (line 42)
g- During **this time** the hot water system is turned off. (line 52)

Activity 9: What have you learned about Solar Thermal Energy? Comment on this orally.

8A Segmentos significativos en el texto: La frase verbal para describir el tiempo pasado

1- Scan the text and underline the answers to the questions below in the text. An example is given

History of Engineering

Question **a**

Engineering is one of the oldest professions in the world. Around 2550 BC, Imhotep**,** the first documented engineer, built a famous stepped pyramid of King Zoser located at Saqqarah.

With simple tools and mathematics he created a monument that stands to this day. His greatest contribution to engineering was his discovery of the art of building with shaped stones. Those who followed him carried engineering to remarkable heights using skill and imagination. Vitruvius' *De architectura* was published 1AD in Rome and survived to give us a look at engineering education in ancient times.

photo courtesy of Dr. R. Loov

Military Engineering

The first engineers were military engineers, combining military and civil skills. During periods of conflict the engineers made and used instruments of war such as catapults, battering rams, towers, and ramps to aid in attacking their enemies' forts & encampments and also to defend their own. During the periods of peace, they were involved in many military and civil activities such as building fortifications for defence against further attacks, roads, bridges, aqueducts, canals and cathedrals. The construction and hydraulics techniques used by the medieval engineers in China, Japan, India and other regions of the Far East were far more sophisticated than those of the medieval European engineers.

Machu Picchu, Peru is considered a civil engineering marvel. It was built high in the Andes Mountains assisted by some of history's most ingenious water resources engineers. The people of Machu Picchu built a mountain-top city complete with running-water, drainage systems, food production and stone structures so advanced that they have endured for over 500 years.

Civil Engineering

Civil engineering is the oldest of the main disciplines of engineering. The first engineering school, the National School of Bridges and Highways in France, was opened in 1747. John Smeaton was the first person to actually call himself a "Civil Engineer". These civil engineers built all types of structures, designed water-supply and sewer systems, designed railroads and highways, and planned cities. In 1828 the world's first engineering society was created, the Institution of Civil Engineers in England.

Mechanical Engineering

Mechanical engineering was the second branch of engineering to emerge in the last part of the 1700s. The invention of the steam engine was the starting point for the Industrial Revolution. All types of machinery were being developed then and so a new kind of engineer, one dealing with tools and machines, was born. Mechanical engineers received formal recognition in 1847 with the founding of the Institution of Mechanical Engineers in England.

Electrical Engineering

Knowledge of electricity grew slowly during the 1800s: the original electric cell was invented by Alessandro Volta in 1800, the Gramme dynamo and electric motor were invented in 1872, the transistor and the vacuum tube appeared by the mid 1900s and by the end of the 1900s electrical and electronics engineers outnumbered all the other types of engineers in the world.

Chemical Engineering

In the 1800s, industry was using more and more chemical processes in many areas such as metallurgy, food production and textiles. At the end of the 19th century, the increased use of chemicals in the manufacturing industry eventually created a new industry, an industry whose main function was the production of chemicals. The new chemical engineer was involved in the design and operation of these new chemical producing plants.

Around 1900, the term "Chemical Engineer" was being used, but it wasn't until the development of the petroleum industry that chemical engineering became recognized as a unique engineering discipline.

Retrieved and adapted July 6, 2010 from http://whatiscivilengineering.csce.ca/history_engineering.htm

a- Who was the first engineer?
b- What did Imhotep build?
c- Where did he build it?
d- When was Vitruvius' book published?
e- What kind of skills did military engineers have?
f- Why is Machu Picchu considered a civil engineering marvel?
g- Which engineering discipline is the oldest one?
h- What was the name of the first civil engineering school?
i- Did the first civil engineers build different types of structures?
j- Was the steam engine important in the development of mechanical engineering?
k- When was the electric cell invented?
l- What areas were chemicals being used in at the beginning of the 19th century?

2- Indentify the questions that refer to past events or states.

a-, b-, ……

3- Complete the table below. Scan the text and isolate the dates and events in the history of engineering

Date	**Relevant Event**
Around 2550 BC	Imhotep **built** a famous stepped pyramid.
1 AD	
	The first engineering school **was opened**.
	The world's first engineering society **was created**.
In the last part of the 1700s	
In 1847	
	Knowledge of electricity **grew** slowly
In 1800	
In 1872	
By the mid 1900s	
By the end of the 1900s	
	The increased use of chemicals in the manufacturing industry **created** a new industry

4- Complete the table with the forms of the verbs used in activity 3. Use APPENDIX 11.

BASE	**PASADO (2da columna)**	**PASADO PARTICIPIO (3era columna)**
build		
publish		
open		
create		
be		
receive		
grow		
invent		
appear		
outnumber		

La frase verbal en tiempo pasado

Como vimos en la unidad 5A, los verbos pueden ser identificados por el tiempo al que hacen referencia. El texto de arriba, por tratarse de los comienzos de las distintas disciplinas de la ingeniería, presenta verbos en tiempo pasado en distintas formas. Algunas de ellas se encuentran en voz activa, otras en voz pasiva, otras en pasado simple y algunas en pasado progresivo.

Antes de introducir las distintas combinaciones de tiempo y aspecto, recordemos el significado de estas dos categorías gramaticales explicadas en el APÉNDICE 8:

> Cabe destacar que cuando hablamos de *tiempo* nos referimos a un punto particular en la línea temporal ya sea, pasado, presente o futuro. Cuando nos referimos a la categoría gramatical de *aspecto* de un verbo queremos representar una cierta *característica* de la acción a la que se hace referencia. Por ejemplo: si la acción, ya sea en tiempo presente o pasado, es descripta en progreso o no (aspecto progresivo) o si la acción denotada por el verbo se extiende de un tiempo a otro (aspecto perfecto) o si la acción denota la idea de rutina, hechos habituales o verdades eternas (aspecto simple). (*último párrafo de la segunda página del Apéndice 8)*

Entonces, en la presente unidad estamos hablando del tiempo pasado, el cual combinado con los distintos aspectos mencionados arriba genera distintos significados. Ellos son:

a- El Pasado Simple

El pasado simple se utiliza básicamente para hablar de:

- Hechos y estados que pertenecen al pasado y que fueron realizados en una instancia única (él construyó, ellos crearon, yo inventé, etc.): Around 2550 BC, Imhotep *built* a famous stepped pyramid (lineas 1-2).
- Hechos que representan acciones habituales en el pasado (construían, utilizaban, hacían, etc.): During periods of conflict, the engineers *made* and *used* instruments of war such as catapults, battering rams, towers, and ramps (lineas 13-14).

Descriptores de tiempo utilizados con el pasado simple son *in 1967, in those days, in the 16th century, yesterday, last year,* etc.

El verbo en tiempo pasado simple se reconoce muy fácilmente cuando éste es un verbo regular pues se presenta en su forma –ed. Si el verbo no es un verbo regular, se utilizará el verbo de la segunda columna de los listados que encontramos en los diccionarios o en el APÉNDICE 11. Por ejemplo, en el caso de un verbo regular podemos decir: The first engineers *used* many resources from nature(= Los primeros ingenieros usaron muchos recursos de la naturaleza.). Si hablamos de un verbo irregular decimos: They *built* many different types of structures (Ellos construyeron muchos tipos de estructuras diferentes.)

b- Pasado Continuo o Progresivo

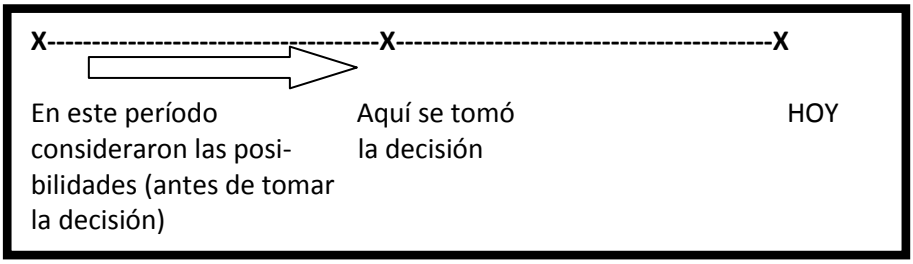
El aspecto progresivo le agrega al verbo en pasado la idea de una acción en progreso o en desarrollo en algún momento en particular del pasado. Entonces el pasado progresivo generalmente se utiliza para:

- Hablar de acciones que estaban en progreso en un punto determinado del pasado: They *were experimenting* with dangerous chemicals when the lab exploded.
- Hablar de acciones que estaban en progreso en un periodo que se extiende más allá de "un punto determinado del pasado": In the 1800s, industry *was using* more and more chemical processes in many areas such as metallurgy, food production and textiles. (linea 42)

c- El Pasado Perfecto

El aspecto perfecto le agrega al verbo en pasado la idea de que una acción tomó lugar antes de otra ocurrida en el pasado. Es decir que el pasado perfecto es "el pasado del pasado":

They *had considered* several possibilities before they decided to cancel the project.



Para que un texto tenga instancias de verbos en pasado perfecto ("el pasado del pasado") siempre tiene que haber una referencia a una acción o evento en el pasado simple primero.

Los verbos en 3era columna en función de verbo conjugado, función adjetivo y función QUE o –ado, -ido

Un aspecto a tener en cuenta es que los verbos en tercera columna ya sean regulares o irregulares van a poder estar cumpliendo distintas funciones- función de verbo conjugado, función adjetivo (antes del sustantivo) y función QUE o –ado, -ido (después del sustantivo)- dependiendo del lugar que ocupan dentro de la oración. Entonces, para lograr asignarle el valor que le corresponde es importante conocer las distintas funciones que cumplen estas palabras y si el valor que uno le da a una determinada oración no tiene sentido, lo más probable es que tengamos que volver sobre esta forma y reasignarle un significado distinto.

The construction and hydraulics techniques *used*[1] by the medieval engineers in China, Japan, India and other regions of the Far East far more sophisticated than those of the medieval European engineers.
Mechanical engineers *received*[2] formal recognition in 1847

1- Este verbo que está en una forma –ed está cumpliendo la función QUE o –ado, -ido después del sustantivo *techniques*. Recordemos que éste es un caso de postmodificación en la frase nominal y que sería una forma reducida de …techniques that *were used* by the medieval engineers in …. (línea 17).
2- Aquí tenemos una forma –ed cumpliendo la función de verbo principal.

Otros verbos: Verbos auxiliares modales con noción de pasado

Los verbos modales son verbos especiales cuyos significados varían de acuerdo con el contexto en el que son usados. Como veremos a continuación, una misma forma que se usa con cierto significado en el presente, puede ser también utilizada para el pasado o situaciones hipotéticas cuando el verbo modal se combina con HAVE + Verbo participio (tercera columna – ver APÉNDICE 11). Entonces la fórmula podría ser expresada así:

COULD/etc + HAVE + Verbo en Pasado Participio (3era columna) = acción/evento con noción de pasado que debería/podría/podrá/etc. haber ocurrido

	Ejemplo en voz activa	**Significado**
CAN'T HAVE (combinado con HAVE, se usa en negativo)	This system *can't have solved* the energy problem.	Este sistema no *puede haber solucionado* el problema de energía.
COULD	The system *could have solved* the energy problem.	El sistema *podría haber solucionado* el problema de energía.
MAY	This *may have caused* a problem.	Esto *puede haber causado* un problema.
MIGHT	This *might have caused* a problem.	Esto *podría haber causado* un problema.
MUST	Researchers *must have found* a solution to the problem by now.	Los investigadores ya *deben haber encontrado* una solución.
SHOULD	Researchers *should have found* a solution by now.	Los investigadores ya *deberían haber encontrado* una solución.
WILL	Researchers *will have found* a solution by the year 2025.	Los investigadores habrán *encontrado* una solución para el año 2025. (=se expresa pasado en el futuro)
WOULD	Researchers *would have found* a solution by now if they had more resources.	Los investigadores ya *habrían encontrado* una solución si tuvieran más recursos.

Para repasar:

Explain the difference in meaning when different verbs are used:

1- They **built/had built/may have built** the bridge in the year 1876.
2- Researchers **worked on/were working on/must have worked on** a new action plan then.
3- We **will have found/may have found/might have found** a new researching technique by that year.
4- Alessandro Volta **was inventing/invented/must have invented** the electric cell in 1800.

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

8B Over to your Career Path

Activity 1: Scan the text below. Look at the pictures and write the name of the landmark.

a- Statue of Liberty
b- Hudson and Manhattan Railroad Tunnel
c- Croton Water Supply System
d- First New York City Subway
e- Manhattan Bridge
f- Ward House
g- Empire State Building
h- Brooklyn Bridge
i- Holland Tunnel

Historic Civil Engineering Landmarks

Designated Historic Civil Engineering Landmarks

ASCE's Historic Civil Engineering Landmark program recognizes historically significant national and international engineering projects, structures, and sites. To be nominated, a project must be of historical civil engineering significance, have a special uniqueness (e.g., a first project constructed) or utilized a unique or significant construction or engineering technique, and contributed to the development of the nation or at least a very large region. Projects nominated as landmarks should also be at least 50 years old. Twelve projects in the Met Section have been designated as National Historic Civil Engineering Landmarks and one project has been designated as an International Historic Civil Engineering Landmark.

1_____

Completed 1842

Unsanitary conditions in Manhattan's limited water supplies, combined with a rapid expansion of wood frame buildings and fires led New York City to search for a new supply of clean water. The Croton Water Supply System was designed by John B. Jervis, consisting of a dam on the Croton River, a 41-mile (66 km) iron pipe aqueduct encased in brick masonry, a bridge across the Harlem River, a receiving reservoir, and a distributing reservoir. The aqueduct transported approximately 85 million gallons (322,000 cubic meters) of water per day. To meet the City's growing demand for water, the New Croton Aqueduct was completed in 1890, tripling the original capacity of the Old Croton Aqueduct. The Croton Water Supply System was designated as a National Historic Civil Engineering Landmark by ASCE in 1975.

2_____

Completed 1875

Built by William E. Ward in Rye Brook, New York, this structure was the first reinforced concrete building constructed in the United States. The house has over 12 rooms and was entirely constructed of concrete reinforced with iron I-beams and rods, except for only the doors, window frames, and trim. Architect Robert Mook's design accentuated the use of concrete as a building material and the structure is dominated by a four-story, castle-like octagonal tower at one corner. The building introduced the practicability of reinforced concrete as a building material as well as its fireproof benefits. The Ward House was designated as a National Historic Civil and Concrete Engineering Landmark by ACI and ASCE in 1977.

3_____

Completed 1883

The Brooklyn Bridge was a feat in nineteenth century civil engineering. At the time of its completion, the 1,595-foot (486 m) main span over the East River made it the world's longest suspension bridge and its 276-foot (84 m) Neo-Gothic granite towers were taller than New York's highest office building. It was the first bridge to use galvanized steel wire in cable construction and the project took over 13 years to complete. The bridge was designed by John A. Roebling, who died before construction began. He was succeeded as chief engineer by his son Washington Roebling, and when he became stricken with caisson disease during construction, his wife Emily faithfully carried out his orders. The Brooklyn Bridge was designated as a National Historic Civil Engineering Landmark by ASCE in 1972.

4_____

Completed 1886

French sculptor Frédéric-Auguste Bartholdi commissioned engineer Alexandre-Gustave Eiffel to design a structural framework to support the colossal 151-foot (46 m) tall copper sculpture that stands on Liberty Island in New York Harbor. Eiffel designed an iron skeleton with horizontal struts and diagonal cross braces to support a secondary structural frame, which conforms to the outer contour of the statue's hammered copper sheets. Eiffel went on to design the tower that bears his name in Paris, which is also an ASCE International Civil Engineering Landmark. The Statue of Liberty was designated as an International Historic Civil Engineering Landmark by ASCE and the Société des Ingénieurs et Scientifiques de France in 1985.

5 _____

Completed 1904

The first segment of the New York City subway system ran nine miles from City Hall to 145th Street and Broadway, following the routes of today's IRT Lexington Avenue Line (4/5/6), 42nd Street Shuttle (S), and Seventh Avenue/Broadway Line (1/2/3). It was the first major subway system constructed in the United States and featured four separate tracks, two for local service and two for express service. Designed by William Barclay Parsons, the first subway was primarily built using shallow cut-and-cover construction to avoid the need for deep tunnels. The First New York City Subway was designated as a National Historic Civil and Mechanical Engineering Landmark by ASCE and ASME in 1977.

6 _____

Completed 1908

The Hudson and Manhattan Railroad Tunnel, which currently carries Port Authority Trans-Hudson (PATH) trains between Manhattan and Hoboken, New Jersey, was the first railroad tunnel constructed under a major river in the United States. Construction of the uptown tunnel began in 1874 and was abandoned twice due to a lack of funds before completion in 1908. In order to construct the tunnel through the mud beneath the Hudson River, a pneumatic shield was developed to support the tunnel's walls before they were lined with tubular cast iron plates. In 1909, a second tunnel was opened from the Hudson Terminal (now the World Trade Center) in Lower Manhattan to Jersey City, New Jersey. The Hudson and Manhattan Railroad Tunnel was designated as a National Historic Civil Engineering Landmark by ASCE in 1978.

7 _____

Completed 1909

Built to help satisfy the ever increasing demand for travel between Manhattan and Brooklyn, the Manhattan Bridge is considered to be the forerunner for modern suspension bridges as it was the first to be designed using the deflection theory. The bridge also pioneered the use "two-dimensional" slender steel towers and was the earliest bridge to incorporate nickel steel to a large extent in construction. Each day, the Manhattan Bridge carries a third of a million passengers in nearly 1,000 subway trains, making it the busiest public transit crossing into Manhattan. The Manhattan Bridge was designated as a National Historic Civil Engineering Landmark by ASCE in 2009.

8_____

Completed 1927

The Holland Tunnel consists of two 29-foot (9 m) diameter, 8,500-foot (2591 m) long tubes that each carries two lanes of vehicular traffic under the Hudson River between Manhattan and Jersey City, New Jersey. It was the first tunnel specifically designed for automobiles and trucks, which necessitated the design of a mechanical ventilation system. It also employed the use of a pneumatic-driven shield through difficult river bottom conditions. The tunnel was named after Clifford M. Holland, the first chief engineer on the project, who died before it was completed. Subsequent engineers leading the project were Milton H. Freeman and Ole Singstad. The Holland Tunnel was designated as a National Historic Civil and Mechanical Engineering Landmark by ASCE and ASME in 1982.

9_____

Completed 1931

New York City's Empire State Building was selected as ASCE's Monument of the Millennium representing civil engineering achievements in skyscrapers. The 1,250-foot (381 m) skyscraper became the world's tallest building at the time of its completion and remained the tallest for over forty years until it was surpassed by the 1,368-foot (417 m) One World Trade Center in 1972. In addition to its record setting height, the Empire State also revolutionized the construction of tall buildings with its innovative project management and speed of construction. Portions of the building were prefabricated off-site and assembled in place. The entire structure was completed with a crew of 3,000 workers in a time period of just one year and 45 days, rising at a rate of four and a half stories per week. The Empire State Building was formally dedicated as a Monument of the Millennium by ASCE President Robert W. Bein on July 18, 2001. ASCE previously named the Empire State Building as one of the *Seven Wonders of the Modern World* in 1996 and one of *America's Seven Modern Civil Engineering Wonders* in 1955.

Retrieved and adapted July 10, 2010 from http://www.ascemetsection.org/content/view/286/815/

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

Activity 2: Find and underline the following information.

a- Reason for the construction of the Croton Water Supply System
b- Date the water supply system was finished
c- Special characteristic of the Ward House
d- Period of time taken to build the Brooklyn Bridge

e- Material used to make the Statue of Liberty
f- Construction method used to build the first New York City subway
g- Construction method used to build the railroad tunnel under the river
h- Material used in the construction of the Manhattan Bridge
i- Physical characteristics of the Holland Tunnel
j- Period of time taken to build the Empire State Building

Activity 3: Find the following information in the text stating line number. Underline the verbs in the sentences below and compare them to the original verbs in sentences.

Text #	Line #	Information from the text
1		John B. Jervis designed the Croton Water Supply system.
1		Approximately 85 million gallons of water were transported by the aqueduct.
2		A four-story, castle-like octagonal tower at one corner dominates the structure.
3		His orders were carried out by his wife, Emily.
6		They abandoned the construction of the uptown tunnel twice due to a lack of funds before completion in 1908.
7		A million passengers in nearly 1,000 subway trains are carried each day by the Manhattan Bridge.
8		The use of a pneumatic-driven shield through difficult river bottom conditions was also employed.

Activity 4: Match the information given to texts 3, 8, 9. Then, classify the verb phrase highlighted.

(Nota: la frase verbal en voz pasiva se estudiará en detalle en la Unidad 9. En esta actividad sólo se intenta hacer un reconocimiento preliminar.)

Text #	Information	Acción realizada en una instancia única	Acción habitual en el pasado	Acción en progreso	Acción pasada anterior a otra en el pasado	Voz pasiva	Voz activa
	Too many cars **were using** the ferry system between Manhattan and Jersey City.						
	There **had never been** a tall building like this one.						
	When the construction of the bridge **was begun**[1], its designer **had** already **died**[2].						
	When it **was being built**[1], its chief engineer **became**[2] ill.						
	The World Trade Center **was built** in 1972.						
	Three thousand people **worked** on the project.						
	A mechanical ventilation system **was used**.						
	Galvanized steel wire **was not being used** in cable construction at that time.						

Activity 5: State function of the –ed word. Two examples are given.

-ed word	**Line number**	**Parte de frase verbal conjugada**	**Función adjetivo (antes del sustantivo)**	**Función QUE o –ado, -ido**
nominated	5			X
designated	6	X		
limited	10			
designed	13			
encased	15			
transported	17			
completed	20			
reinforced	26			
reinforced	28			
accentuated	30			
introduced	32			

Activity 6: State function of the -ing word. Two examples are given.

-ing word	**Line #**	**-ing como verbo conjugado**	**-ing como sust**	**-ing como adjetivo (antes del sust)**	**-ing QUE (después del sust)**	**-ing función preposición + ar, er, ir**
engineering	3		*X*			
distributing	16					
growing	19					
building	33					
engineering	40					
increasing	96					
building	132					

Activity 7: Choose the best answer.

1- The ASCE's Historic Civil Engineering Landmark program aims at…
   a. …restoring old buildings.
   b. …building new landmarks in New York City.
   c. …valuing landmarks.
2- The Croton Water Supply System was built…
   a. …because authorities wanted to find a solution to the water supply problem.
   b. … because authorities wanted to provide clean water to hospitals.
   c. … because authorities wanted to give water to the population.
3- The New Croton Aqueduct was completed in 1890, …
   a. …and it became the largest building project in Manhattan.
   b. …and it solved the water supply problem in hospitals.
   c. …and it increased the water supply for the city.
4- The Ward House was the first building….

a. …that had reinforcing in concrete in the country.
b. …that had reinforced concrete in every part of the building.
c. …that used reinforcing in concrete to build the window frames.

5- When the building of the Brooklyn Bridge began…
a. …the designer of the bridge had already died.
b. …there was a terrible accident.
c. …the designer's son died.

6- Building the Hudson and Manhattan Railroad Tunnel presented problems because…
a. …a major explosion stopped the construction.
b. …there was not enough money to complete it.
c. …the pneumatic shield was not very effective in supporting the tunnel's walls.

7- The Manhattan Bridge is very important to Civil Engineering history because it was built…
a. …using highly advanced building construction techniques and materials.
b. …to bring a solution to the traffic problem.
c. …with very little money.

8- Designed to carry automobiles and trucks, the Holland Tunnel was provided with…
a. …a special mechanical system for ventilating it.
b. …a system of mechanical ventilation.
c. …both *a* and *b* above.

9- When the tunnel was finished, Clifford M. Holland…
a. …was being treated at a hospital.
b. …had already died.
c. …died.

10- The Empire State Building was constructed by ….
a. …employing a large number of construction workers.
b. …managing time, construction workers and building speed very well.
c. …neither *a* nor *b* above.

To turn in!

What characteristics do experts analyze to designate National Historic Civil Engineering Landmarks? Give examples.

Cuidar la manera en que expresamos los conceptos e ideas. Una respuesta bien redactada, tiene un impacto mayor en nuestros lectores.

9A Los verbos y la voz pasiva

1- Scan the text below and quickly identify:

a- Title: .....
b- Author: .....
c- Author's affiliation: .....
d- Journal name: .....

2- Write the outline of the paper.

Abstract
1. .....
2. Global Competence: Why is it needed?
   2.1.....
   2.2.....
   2.3.....
   .....
   .....
   .....
   Chemical Engineering
   2.4.....
   2.5.....
3. .....
4. .....
5. A Larger Question
6. .....
7. .....
8. .....

Cuando nos encontramos con un texto extenso, primero debemos hacer un mapeo del mismo para explorar su contenido. Luego, nos podemos focalizar ya sea en la lectura completa del mismo o en alguna sección que nos resulta de interés para cumplir con un cierto propósito.

3- Isolate the three questions that control the development of the paper:

a- .....
b- .....
c- .....

4- Find the sections where these topics are discussed. Then, comment on these aspects.

a- Changes in world history that have resulted in the need for global competence.
b- An example of globalization connected with electronics.
c- Experts' opinion about engineering education today.
d- The thirteen attributes/dimensions/aspects of global competence.

5- Go back to the text and check (√) the sentence below that matches the exact sentence in the text.

1- Line 28
   a. This paper **addresses** three questions related to the rationale of global engineering education.
   b. Three questions **are addressed** in this paper related to the rationale of global engineering education.
2- Line 33
   a. To answer the third question, survey results from engineering educators and leaders in industry regarding the importance of these dimensions **are presented** (by us).
   b. To answer the third question, we **present** survey results from engineering educators and leaders in industry regarding the importance of these dimensions.
3- Line 42
   a. We **address** this question from several perspectives: …
   b. This question **is addressed** from several perspectives (by us): …
4- Line 70
   a. These systems (CAD systems) **have made** possible high fidelity representations of products…
   b. High fidelity representations of products **have been made** possible by these systems (CAD systems).
5- Line 76
   a. Along with enabling technologies, the geopolitical landscape **has** fundamentally **been changed** by a number of political events in ways which promote globalization.
   b. Along with enabling technologies, a number of political events **have** fundamentally **changed** the geopolitical landscape in ways which promote globalization.
6- Line 258
   a. However, if we look at where we **are building** the largest, most revolutionary structures, we find that the center of activity is in Asia and the Middle East.
   b. However, if we look at where the largest, most revolutionary structures **are being built**, we find that the center of activity is in Asia and the Middle East.

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The Rationale for Developing Global Competence

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Abstract

This paper addresses three questions related to the rationale for global engineering education. These questions are, Why do engineering students need to have a new set of skills, which we will collectively refer to as “global competence?” What does it mean for students to have global competence? and, What are the most important attributes of global competence? In answer to the first question, we discuss the forces and events of the past 20 years which have driven the globalization of engineering. In answer to the second question, we present 13 dimensions of global competence. To answer the third question, we present survey results from engineering educators and leaders in industry regarding the relative importance of these dimensions. We then discuss some implications of the answers to these questions.

KEYWORDS: geopolitical events, global engineering examples, global challenges

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1 Introduction

This paper addresses three questions related to the rationale for global engineering education. These questions are, Why do engineering students need to have a new set of skills, which we will collectively refer to as "global competence?" What does it mean for students to have global competence? and, What are the most important attributes of global competence? In answer to the first question, we discuss the forces and events of the past 20 years which have driven the globalization of engineering. In answer to the second question, we present 13 dimensions of global competence. To answer the third question, we present survey results from engineering educators and leaders in industry regarding the relative importance of these dimensions. We then discuss some implications of the answers to these questions.

2 Global Competence: Why is it Needed?

The first part of this paper deals with the need for global engineering education. Specifically, what has happened in terms of the environment and context of engineering to make it different from how it was a generation ago? We address this question from several perspectives: formative world events, recommendations from credible sources, examples of globalization from engineering disciplines, and global challenges confronting humankind.

2.1 Formative World Events

The globalization of engineering has resulted from a confluence of trends and events which have taken place over the past two decades. These include advances in telecommunications and other enabling technologies (made possible by engineers), political events which have opened up many formerly closed societies, the adoption of economic policies which have promoted free trade, and the expansion of multi-national corporations.

Advances in communications and computers have been a powerful driving force for globalization. The 1990's saw the development of a digital worldwide data network based on optical fiber. At the time, a single fiber pair could replace hundreds of equivalent copper lines; fiber transmission rates have continued to increase from Mbps in the 1990's to Gbps and even Tbps today.[1] Extensive wireless networks are also a product of this time period. These have been especially important in developing countries, as they have made it possible to leapfrog over the need for landline infrastructure. The wireless industry hit a landmark in 2007 with one billion wireless handsets shipped that year.[2] Computer processing speed has continued to follow Moore's law, doubling roughly every two years, and data storage costs have fallen by a factor of 1000. Further, systems which were configured largely as stand-alone machines or were tied to a local network now have worldwide network access.

Along with the physical means of transmission, during the last 20 years the Internet has developed as a way to share and organize data and facilitate communication among geographically diverse groups. It is estimated the Internet grew by 100% per year during the 1990's. Since 2000, Internet users have grown 300%, with a 500% percent increase in Asia, to an estimated 1.6 billion users worldwide.[3] Servers have grown from approximately 25 million in 1998 to 540 million today.[4]

Advanced CAD systems also represent a noteworthy technology achievement. These systems have made possible high fidelity representations of products (including design intent, manufacturing process plans, etc.) which can be shared, via the Internet, with design groups across the world. In some respects, a common CAD system becomes a lingua franca for product development which ties widely dispersed design and manufacturing groups together.

Along with enabling technologies, a number of political events have fundamentally changed the geopolitical landscape in ways which promote globalization. One of these political events was the breakup of the Soviet Union in 1991, whereby the 15 member states of the Soviet Union declared their independence. Many of these former members of the Soviet republic have moved towards democratic governments (with varying success) and free-market economies. With the end of the cold war, relationships between the Eastern bloc nations and countries in the West were able to move from confrontation to cooperation and participation in the world economy.

Another major political event impacting globalization was the formation of the European Union (EU) in 1993. Now with 27 member states, the EU has grown to become one of the largest single markets in the world, with nearly 500 million citizens and a combined $16.8 trillion economy, representing 23% of the world's gross domestic product.[5] Through a common set of policies and laws, the EU promotes freedom of movement of people, goods, and capital, all fundamental elements of global trade.[6] During the past two decades China and India, countries which comprise 36% of the world's population, have adopted market economies and opened their doors to foreign investment.[7]

Concurrent with these developments, the 1990's saw the formation or growth of several important economic institutions which promote world trade; among these are the World Trade Organization (WTO), the International Monetary Fund (IMF), and the World Bank. The WTO, formed in 1995 as a successor to the General Agreement on Tariffs and Trade, has grown to include 153 nations[8] representing more than 95% of world trade. A primary purpose of the WTO is to promote free trade among member states by lowering tariffs and eliminating protectionist policies. After years of negotiations, China joined the WTO in 2001. The IMF and World Bank provide capital in the form of loans to developing nations. To qualify, these nations must adopt economic policies which promote trade, such as abolishing import licenses and tariffs, providing for protection of property and permitting foreign direct investment.[9]

What has all this meant for world trade? Quoting from a report from the WTO, "in 2006 the volume of world merchandise trade grew by 8% while the world gross domestic product recorded a 3.5% increase. This confirms the trend of world merchandise trade growing by twice the annual growth rate of output since 2000."[10] In the U.S., foreign trade in goods and services has grown from $1.7 trillion in 1995 (sum of imports and exports) to $4.0 trillion in 2007, with imports exceeding exports by $700 billion.[11] For comparison purposes, the gross domestic product of the U.S. was estimated to be $13.8 trillion in 2007.[12]

These technological, political and economic developments have all contributed to the growth and influence of multi-national companies. To illustrate their size, Steger writes, "51 of the world's 100 largest economies are corporations; only 49 are countries. Accounting for over 70% of world trade, [multi-national corporations] have boosted their foreign direct investments by approximately 15% annually during the 1990s."[13] A free flow of goods and capital across national boundaries encourages companies to develop international operations to decrease costs and develop new markets. Indeed, for many companies, globalization represents not just an opportunity but an imperative if they are to remain competitive. As examples of the importance of global markets, 67% of Hewlett Packard's revenues, 79% of Intel's revenues, and 60% of General Motor's revenues in 2007 were from abroad.[14]

2.2 Recommendations from Credible Sources

In the previous section we described world events which have helped drive the globalization of engineering. In this section we present comments from a number of sources regarding what should be done in light of these events. These sources were selected as representative of many which might have been chosen.

A recently released report entitled, *Engineering for a Changing World*, authored by James Duderstadt, former president and dean of engineering at the University of Michigan, examines the major forces acting as drivers of change in engineering and discusses how engineering education must respond. [15] According to Duderstadt:

> *…it is important to stress the importance of a global perspective for engineering practice. Key is not only a deep understanding of global markets and organizations, but the capacity to work in multidisciplinary teams characterized by high cultural diversity, while exhibiting the nimbleness and mobility to address rapidly changing global challenges and opportunities.*

He indicates that the goal of American engineering schools should be "to focus more on quality, producing engineers capable of adding exceptional value through innovation, entrepreneurial skills, and *global competence*" (italics added).

Patricia Galloway, former president of the American Society of Civil Engineers, addresses globalization issues in her book, *The 21st-Century Engineer, A Proposal for Engineering Reform,* where she writes, [16]

> *A solid understanding of globalization is key to an engineer's success in today's global society. Globalization involves the ability to understand that the world economy has become tightly linked with much of the change triggered by technology; to understand other cultures, especially the societal elements of these cultures; to work effectively in multinational teams; to communicate effectively—both orally and in writing—in the international business language of English; to recognize and understand issues of sustainability; to understand the importance of transparency while working with local populations; and to understand public policy issues around the world and in the country in which one is working. It will be these fundamental capacities that will enable 21st-century engineers to develop into professionals capable of working successfully both domestically and globally, highly respected by the general public and regarded…the world over as professionals of the highest order.*

A relatively comprehensive study on international engineering education was commissioned by Continental AG, a large industrial supplier to the automotive industry.[17] Continental asked eight universities, known for their engineering programs, to identify critical factors necessary for educating tomorrow's engineering workforce. A main recommendation of the study is that "global competence needs to become a key qualification of engineering graduates."

As an additional perspective from industry, Theodore Kennedy, founder of the engineering construction firm BE&K Inc., and a National Academy of Engineering member, writes,

> *Businesses need graduates who know something about working with others—not just teamwork, which is a given—but a basic understanding that our culture is not the only one around! …We must prepare engineers to be global citizens. …They must learn to translate ideas and plans into reality for cultures that may not look, sound or dress the way we do. Unless we can do that, a large part of our engineering business will soon leave our shores." [18]*

2.3 Four Examples of Globalization in Engineering

To illustrate the breadth of the globalization in engineering, we present here examples from four different disciplines.

Mechanical Engineering

The example from Mechanical (and Aerospace) Engineering involves the development of the Boeing 787 "Dreamliner." This plane represents the most successful introduction of a commercial jetliner for Boeing, with over 800 orders received from customers in 32 countries. Figure 1 (on page 5) shows where parts of this plane will be manufactured.[19] It is clear from this figure that the 787 is a globally developed and manufactured product, with major subassemblies of the plane coming from the United States, Canada, Italy, Korea, Australia, Japan, England, Sweden and France.

Although Boeing has been very successful in obtaining orders for the 787, production of the aircraft has been hampered by delays, with first flight of the aircraft currently 24 months behind schedule. Based on news reports, it appears much of the delay is associated with managing the global supply chain.

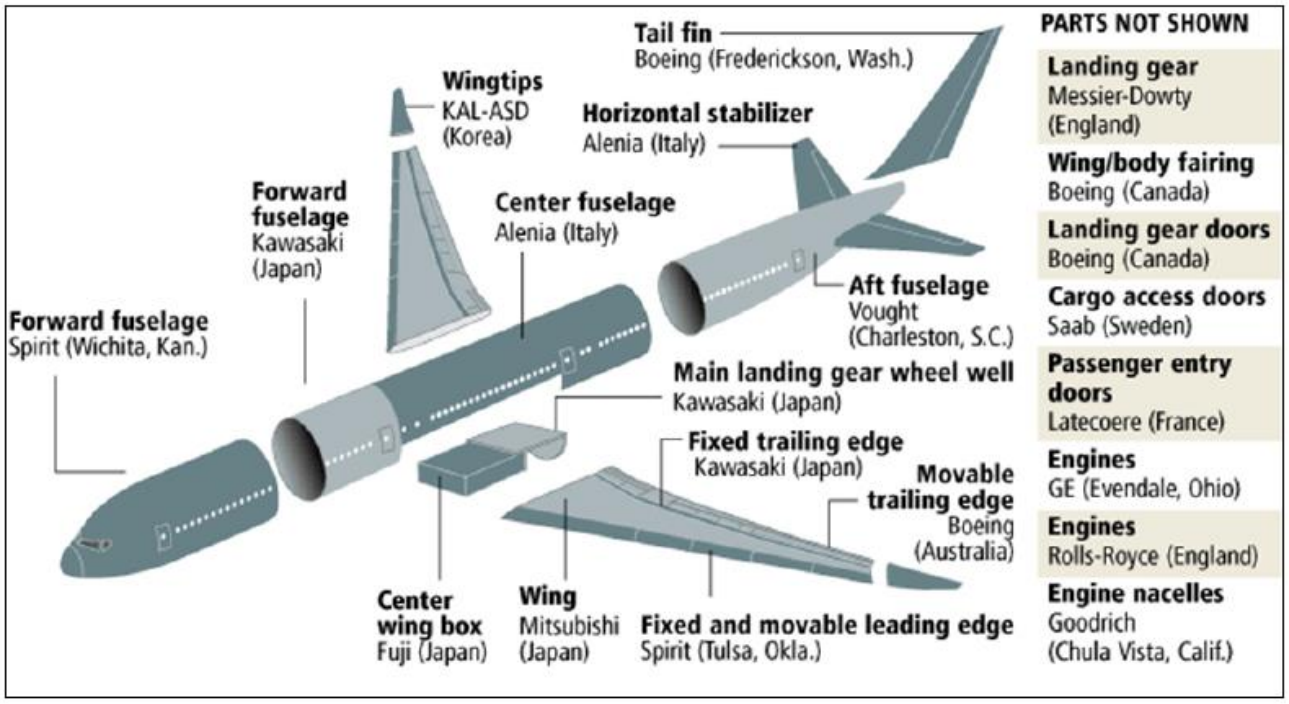

Figure 1 Subassemblies of the Boing 787 showing country of origin. Used by permission.[19]

Electrical Engineering

Rather than focus on a particular company or product, the example from Electrical Engineering focuses on an entire industry: electronics. The term "electronics" is used in a broad sense to include all computer and communication devices as well as electronics for automotive, industrial/medical and military uses, and consumer electronics. A graph showing the value of electronic shipments by region is given in Figure 2.[20] In the graph, the value shown for each region is the system value of the finished electronics produced in that region. If, for example, Hewlett Packard assembles a PC in the Americas using a motherboard, disk drive and memory cards produced in Asia, the value of the finished PC is credited to the Americas. If the value of components were credited to the region of origin, the graph would be much more heavily weighted towards Asia. Total market size is estimated at $1.2 trillion.

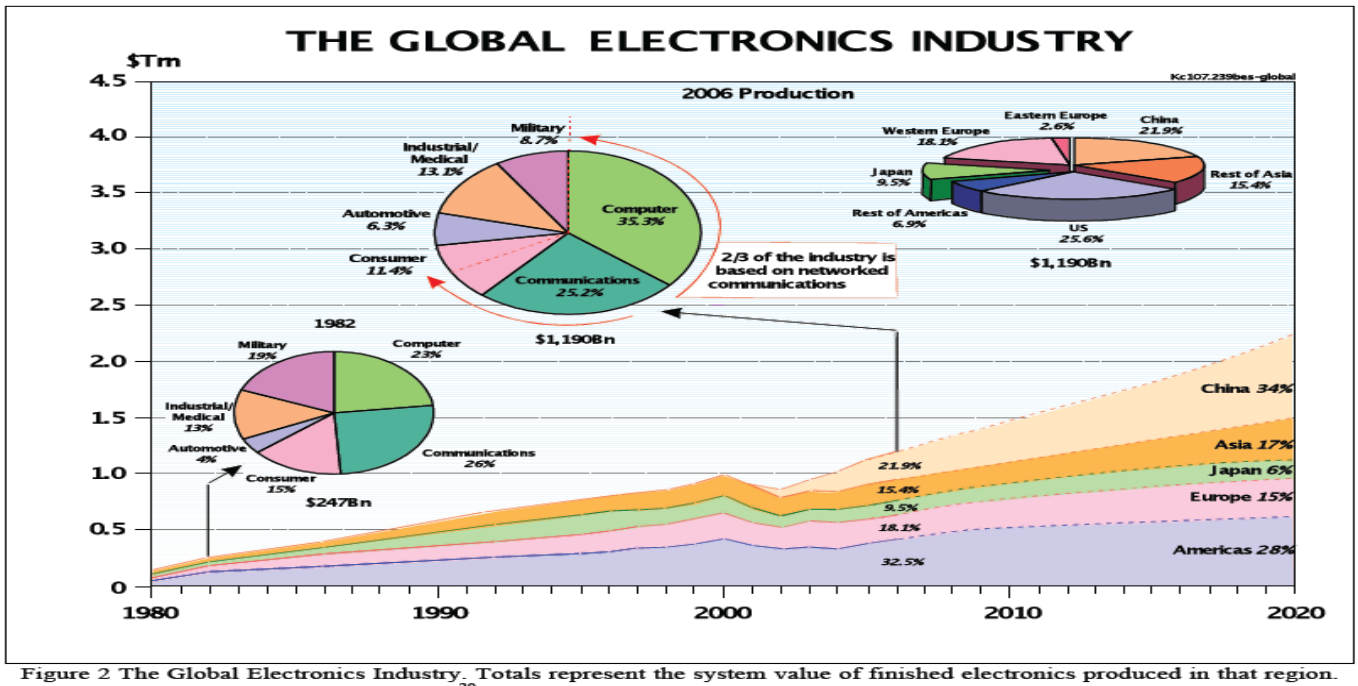

Figure 2 The Global Electronics Industry. Totals represent the system value of finished electronics produced in that region. Based on 2006 data. Used by permission.[20]

220

225 The graph shows that 37% of electronics production in 2006 came from Asia (China and Asia in the graph), 10% from Japan, 18% from Europe, and 33% from the Americas. The projected growth of Asia is shown. Clearly the electronics industry is a global industry which will continue to shift towards Asia in the next decade.

230 A diagram showing the geographical distribution and sales of the top 100 electronics companies is given in Figure 3.[20] All of the companies shown in the figure design and distribute products for worldwide markets.

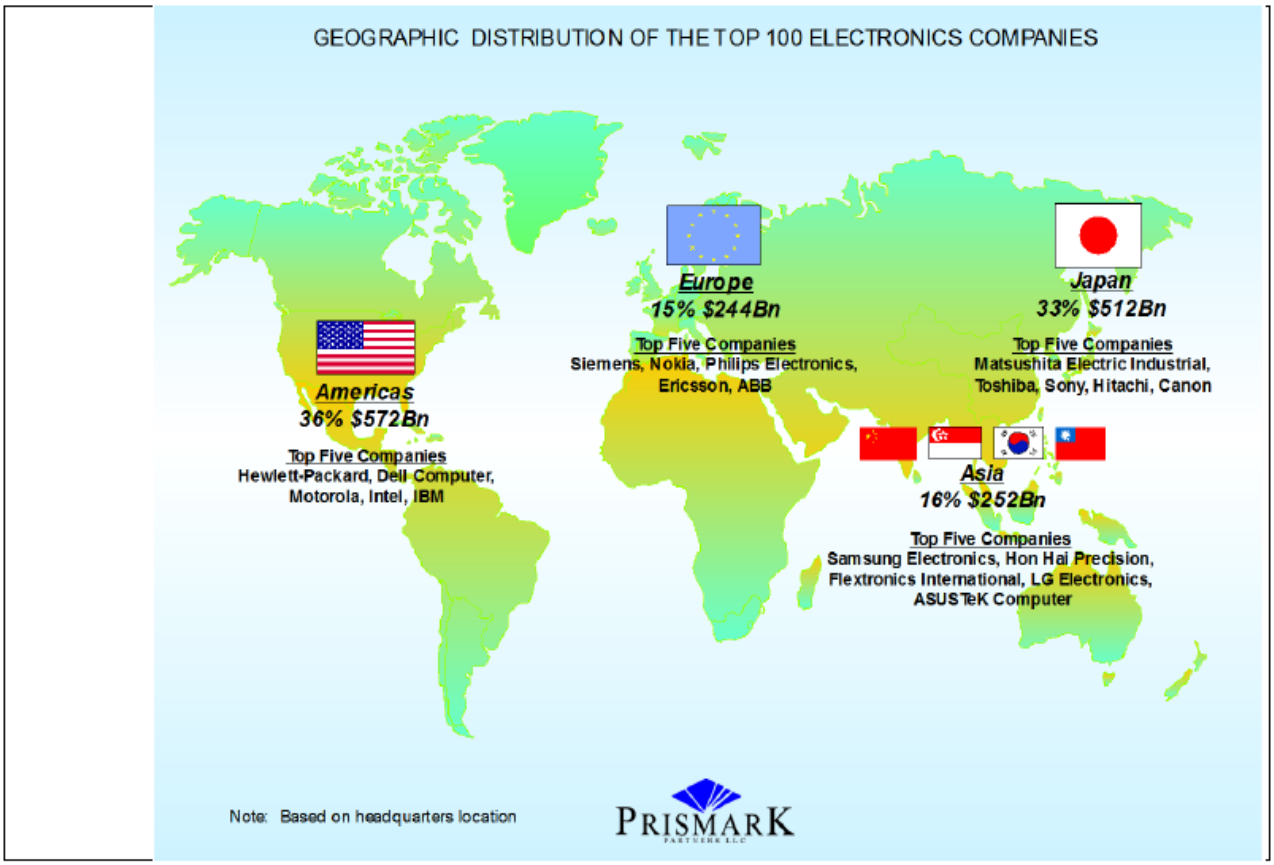

Figure 3 Geographical distribution and revenues of the top 100 electronics companies, based on 2006 data. Used by permission.[22]

What does the global nature of the electronics industry mean for a U.S. company like Hewlett Packard (HP)? First, it means HP must compete with multi-national companies (Hitachi, Siemens, Sony, Philips, etc.) operating in global markets. It implies that HP must develop and deploy assets (such as engineering resources) wherever it is most efficient to do so, in order to remain competitive over the long term. It suggests HP may engage in partnerships to further realize the advantages of scale or to acquire specialized expertise. HP's relationship with Canon is instructive in this regard. HP and Canon are fierce competitors in the ink jet printer market but are collaborators in the laser printer market. A worldwide presence implies worldwide employee recruiting. HP now operates research laboratories in Palo Alto, United States; Beijing, China; Tokyo, Japan; Bristol, England; Haifa, Israel; Bangalore, India; and St. Petersburg, Russia. Obviously it now finds such talent worldwide.

Civil Engineering

Upon first consideration, it would seem Civil Engineering might be less affected by globalization. After all, buildings, bridges and other such works are designed for a specific site and built on that site—they cannot be manufactured off-shore.

However, if we look at where the largest, most revolutionary structures are being built, we find that the center of activity is in Asia and the Middle East. For example, Table 1 lists the tallest completed skyscrapers in the world, along with country and date of construction; of the 15 tallest buildings, 13 are located in Asia or the Middle East. Table 2 shows the world's longest cablestayed bridges. Of the 15 longest bridges, 12 are in Asia. Similar results could be shown for steel arch bridges and suspension bridges—a high percentage of the largest are in Asia.

Table 1. Tallest Buildings in the World[21]

	Tallest Skyscrapers (excluding antennas)	City	Country	Ht (m)	Year
1	Taipei 101	Taipei	Taiwan	509	2004
2	World Financial Center	Shanghai	China	492	2008
3-4	Petronas Towers	Kuala Lampur	Malaysia	452	1998
5	Sears (Willis) Tower	Chicago	USA	442	1974
6	Jin Mao Tower	Shanghai	China	421	1999
7	Two Int'l Finance Center	Hong Kong	China	415	2003
8	CITIC Plaza	Guangzhou	China	391	1997
9	Shun Hing Square	Shenzhen	China	384	1996
10	Empire State Building	New York	USA	381	1931
11	Central Plaza	Hong Kong	China	374	1992
12	Bank of China Tower	Hong Kong	China	367	1990
13	Almas Tower	Dubai	UAE	363	2000
14	Emirates Tower One	Dubai	UAE	355	1999
15	Tunex Sky Tower	Kaohsiung	Taiwan	348	1997

Table 2. Longest Cable-Stayed Bridges

	Cable-Stayed Bridges	City	Country	L (m)	Year
1	Sutong	Nantong	China	1088	2009
2	Stonecutters	Hong Kong	China	1018	2008
3	Tatara	Honshu	Japan	890	1999
4	Pont de Normandie	Le Havre	France	856	1995
5	Incheon-2	Inchon	South Korea	800	2009
6	Chongming	Chongming	China	730	2010
7	Nanjing-3	Nanjing	China	648	2005
8	Nanjing-2	Nanjing	China	628	2001
9	Jingtang	Zhou Shan	China	620	2008
10	Baishazhou	Wuhan	China	618	2000
11	Mingjiang	Qinzhou	China	605	1999
12	Yangpu	Shanghai	China	602	1993
13	Xupu	Shanghai	China	590	1997
14	Mieko Chuo	Nagoya	Japan	590	1998
15	Rio Antirio	Rio	Greece	560	2004

To illustrate further the global nature of advanced structural design, recently five structures which are considered to be among the most "arresting" buildings in the world have opened in Beijing: Terminal 3 of the Beijing International Airport, The Bird's Nest Olympic stadium, shown in Figure 4a, the National Aquatics Center, the National Center for the Performing Arts, and the Central Chinese Television (CCTV) Tower, shown in Figure 4b.

a) b)

Figure 4 a) "Bird's Nest" Olympic Stadium, b) The Central Chinese Television Tower. Both structures are located in Beijing, China.

What are the implications for Civil Engineering? Radical new designs often push and define the state-of-the-art; they may require new analysis techniques, new materials and new construction techniques. Connecting the two 50 story columns of the CCTV tower with a large cantilevered "corner" structure required innovative design and construction methods. Many of these structures are being designed by international design firms which employ engineers from different countries. The state-of the-art in design and construction of large structures is no longer primarily a U.S. or European activity—it is a global activity with a focus outside the U.S.

Chemical Engineering

As an example from Chemical Engineering, we will mention the operations of a medium size chemical company: Celanese Corporation. Celanese is an integrated producer of specialty and intermediate chemical products such as acetyl intermediates, polyvinyl alcohol, emulsion polymers, technical polymers, cellulose acetate and food ingredients. The company operates on five continents, including 40 locations in Europe alone. Global operations include manufacturing, research and development, and administration.

Sixty percent of its sales come from outside the U.S. The company just completed its newest and largest chemical processing plant, located in Nanjing China, and shown in Figure 5.

Figure 4 New Celanese chemical plant located in Nanjing China.

In response to the survey which is discussed later in this paper, the senior vice president of operations for Celanese, James Alder, wrote the following about globalization:

> *Global competence or a strong interest in becoming globally competent is a clear differentiator in an engineer's ability to progress in their career. Gone are the days when someone could be U.S. centric and reach a senior leadership position or even have a relatively secure job…Those that have the interest and capability to move abroad significantly expand their long term career opportunities. In the chemical industry, for example, there are tens of thousands of Chinese engineering graduates every year. These engineers have an incredible drive to succeed so they can achieve "Western standards of living." Engineers in more developed countries need to realize who their future competition is and respond accordingly. 22*

2.4 Global Engineering Challenges

The previous discussion has centered largely on economic justification for global competence—the need for U.S. engineers and companies to adapt to an increasingly competitive global engineering environment. There are, however, critical challenges facing humankind which provide additional and perhaps even more compelling reasons for engineers to be globally competent.

The National Academy of Engineering, with support from the National Science Foundation, has released a set of "Grand Challenges for Engineering."[23] In introducing these challenges, the report states,

> *The century ahead poses challenges as formidable as any from millennia past.*
>
> *As the population grows and its needs and desires expand, the problem of sustaining civilization's continuing advancement, while still improving the quality of life, looms more immediate. Old and new threats to personal and public health demand more effective and more readily available treatments. Vulnerabilities to pandemic diseases, terrorist violence, and natural disasters require serious searches for new methods of protection and prevention. And products and processes that enhance the joy of living remain a top priority of engineering innovation, as they have been since the taming of fire and the invention of the wheel.*
>
> *Foremost among the challenges are those that must be met to ensure the future itself. The Earth is a planet of finite resources, and its growing population currently consumes them at a rate that cannot be sustained. Widely reported warnings have emphasized the need to develop new sources of energy, [while] at the same time preventing or reversing the degradation of the environment.*

Among the grand challenges listed, many are directed towards mitigating the effects of humans on the environment and/or providing for a sustainable means of human existence. These challenges include 1) making solar energy economical, 2) providing energy from fusion, 3) developing carbon sequestration methods, 4) managing the nitrogen cycle, 5) providing access to clean water, 6) storing and improving urban infrastructure, 7) securing cyberspace, and 8) preventing nuclear terror.

What do these challenges have to do with global competence? Nearly all of these challenges are global in nature: they cut across ethnic, cultural and national boundaries, and they require cooperation among nations and peoples if they are to be solved. As the Grand Challenges report notes, "governmental and institutional, political and economic, and personal and social barriers will repeatedly arise to impede the pursuit of solutions to problems." Engineers must not only be able to navigate these barriers if progress is to be made, but, as members of society who understand the technologies involved, they must provide leadership in developing, negotiating and implementing solutions.

2.5 Summary: Global Competence: Why is it Needed?

The previous sections have discussed world events, recommendations from engineering leaders, examples of globalization taken across a range of disciplines, and the critical challenges facing humankind. We believe the evidence is persuasive in demonstrating that engineering increasingly takes place in a global context. The engineers who will be the leaders of the future will often manage and direct global engineering activities. They will need an expanded set of skills to do this. In the next section we discuss what some of those skills should be.

3 Global Competence: What Does it Mean?

Many of the previously mentioned studies argue that engineers should develop "global competence." Although this term is becoming more widely used, it isn't always clear what it means. A good discussion of "the elusive concept of global competence" is given by Grandin and Hedderich.[24] Lohmann et al., Hunter et al., and Deardorff all give definitions for this term that emphasize skills such as cultural empathy, foreign language ability, or the ability to practice one's profession in an

international setting. [25,26,27] Downey et al. discuss global competence in terms of being able to work effectively with others who define problems differently.[28] Based on definitions found in the literature, experience running study abroad programs, and stated objectives of courses and programs which prepare students to be globally competent, Parkinson et al.[29] proposed 13 dimensions or attributes of global competence, some of which are specific to the engineering profession. These are,

Global competence means engineering graduates,

1. Can appreciate other cultures.

Explanation: This attribute is focused partly on understanding and avoiding *ethnocentrism*, the idea that one's own culture is superior to all others. "All cultures, to some degree, display ethnocentrism, which can be the greatest single obstacle to understanding another culture."[30] Engineers may be susceptible to a particular form of ethnocentrism: the assumption that if their country is more technologically advanced, their culture must be superior. Engineering graduates need to be aware of these potential problems and develop the capacity to appreciate and be sensitive to other cultures.

2. Are able to communicate across cultures (understand cultural differences in communication regarding such things as status, formality, saving face, directness, the meaning of "yes", non-verbal cues, etc.).

Explanation: Communication in some form is the foundation upon which most engineering activities build. To avoid misunderstandings, the substantial influence of culture on how people communicate should be understood.

3. Are familiar with the history, government and economic systems of several target countries.

Explanation: This dimension refers to understanding important elements of the context of a society. For example, as students visit factories in China owned by Taiwanese companies, how is their appreciation of this situation deepened by knowing the history of China and Taiwan?

4. Speak a second language at a conversational level.

Explanation: Learning the language of another country is a key in developing a deep understanding of the culture and is an impressive gesture of goodwill and reaching out to cross cultural boundaries. Learning a second language also promotes tolerance for others who have learned English as a second language.

5. Speak a second language at a professional (i.e. technical) level.

Explanation: This attribute takes Dimension 4 a step further to being able to conduct engineering activities in a second language. This provides a significant reduction in the possibility of misunderstandings arising from poor translations or cultural gaps.

6. Are proficient working in or directing a team of ethnic and cultural diversity.

Explanation: Much engineering work is conducted in teams. As engineering work becomes more global in nature, engineering teams become more diverse and may include members of various ethnic, cultural and national origins. Developing this attribute relies heavily on developing communication skills across cultures (Dimension 2).

7. Can effectively deal with ethical issues arising from cultural or national differences.

Explanation: Ethical issues can be magnified when cultural issues come into play. For example, it is common in some cultures or countries for business to be conducted via bribes or kickbacks. Whereas in the U.S. such conduct is considered to be unethical and illegal, how does an engineer approach these issues in a society that does not feel this way? Similar issues come up relative to safety.

8. Understand cultural differences relating to product design, manufacture and use.

Explanation: Being global often means designing, manufacturing and selling products in multiple countries. A deep understanding of customer needs can be heavily influenced by cultural values.

9. Have an understanding of the connectedness of the world and the workings of the global economy.

Explanation: This dimension relates to having a basic understanding that the world's economies are now very interconnected. How does demand for commodities in China affect prices in the U.S.? How do interest rates in Europe affect the exchange rate between the Euro and the dollar? How do exchange rates affect exports?

10. Understand implications of cultural differences on how engineering tasks might be approached.

Explanation: This dimension is closely related to the attribute of being able to work in diverse teams. As an example, how does Japanese culture influence how Japanese engineers approach manufacturing? How does Japanese culture affect how design decisions are made?

11. Have some exposure to international aspects of topics such as supply chain management, intellectual property, liability and risk, and business practices.

Explanation: These are all topics which can directly affect doing business abroad.

12. Have had a chance to practice engineering in a global context, whether through an international internship, a service learning opportunity, a virtual global engineering project or some other form of experience.

Explanation: Whereas the other attributes focus on knowledge or understanding, this dimension focuses on practice. Many of the above attributes have to be practiced to achieve competence.

13. View themselves as "citizens of the world," as well as citizens of a particular country; appreciate challenges facing mankind such as sustainability, environmental protection, poverty, security, and public health.

Explanation: Many of the greatest challenges facing humankind are challenges which cut across national boundaries, such as energy production, environmental protection, access to clean water, and security. Solutions to these problems will require cooperation across national boundaries. Thus we can see that the term "global competence" can encompass a wide set of attributes and abilities. Since it might not be possible to develop all of these attributes within the constraints of a typically crowded engineering curriculum, it would be helpful to know which of these are most important. In the next section we provide some preliminary information in that regard.

Thus we can see that the term "global competence" can encompass a wide set of attributes and abilities. Since it might not be possible to develop all of these attributes within the constraints of a typically crowded engineering curriculum, it would be helpful to know which of these are most important. In the next section we provide some preliminary information in that regard.

4 Global Competence: What is Most Important?

To gain further insight into the attributes of global competence, a survey of their relative importance was conducted of persons in academia and industry. The survey asked respondents to evaluate each attribute according to the scale, 1—Not important, 2—Of Some Advantage, 3—Desirable, 4—Highly Desirable, 5—Essential.

Surveys were sent to attendees to the NSF Summit on the Globalization to be held at the University of Rhode Island, Nov 5-6, 2008. The survey was completed by 15 individuals from 11 universities, 14 individuals representing 12 companies, and two respondents from government or ASEE.

The university respondents all held positions which would involve them in this issue—such as engineering deans, chairs, study abroad directors, or other university administrators. Thus it was to be expected that they would feel global competence was important. All of the industry respondents worked at the management level (several were retired) for companies which have global operations. Besides indicating how essential each attribute is to global competence, industry respondents also answered the question, "How important is it that the engineering graduates of today (in many cases, you own employees) are globally competent? The same scale was used to answer this question.

The relative importance of the attributes is shown in Figure 6, with separate bars for academia and industry. The chart shows relatively consistent rankings, given the small sample size, across academia and industry. Four of the top five attributes were common between the two groups. We also note that industry respondents indicated the importance of global competence for engineering graduates to be between "highly desirable" and "essential."

Based on a sum of the rankings, the five most important attributes of global competence are that engineering graduates,

1. Can appreciate other cultures.
2. Are proficient working in or directing a team of ethnic and cultural diversity.
3. Are able to communicate across cultures.
4. Have had a chance to practice engineering in a global context, whether through an international internship, a service learning opportunity, a virtual global engineering project or some other form of experience.
5. Can effectively deal with ethical issues arising from cultural or national differences.

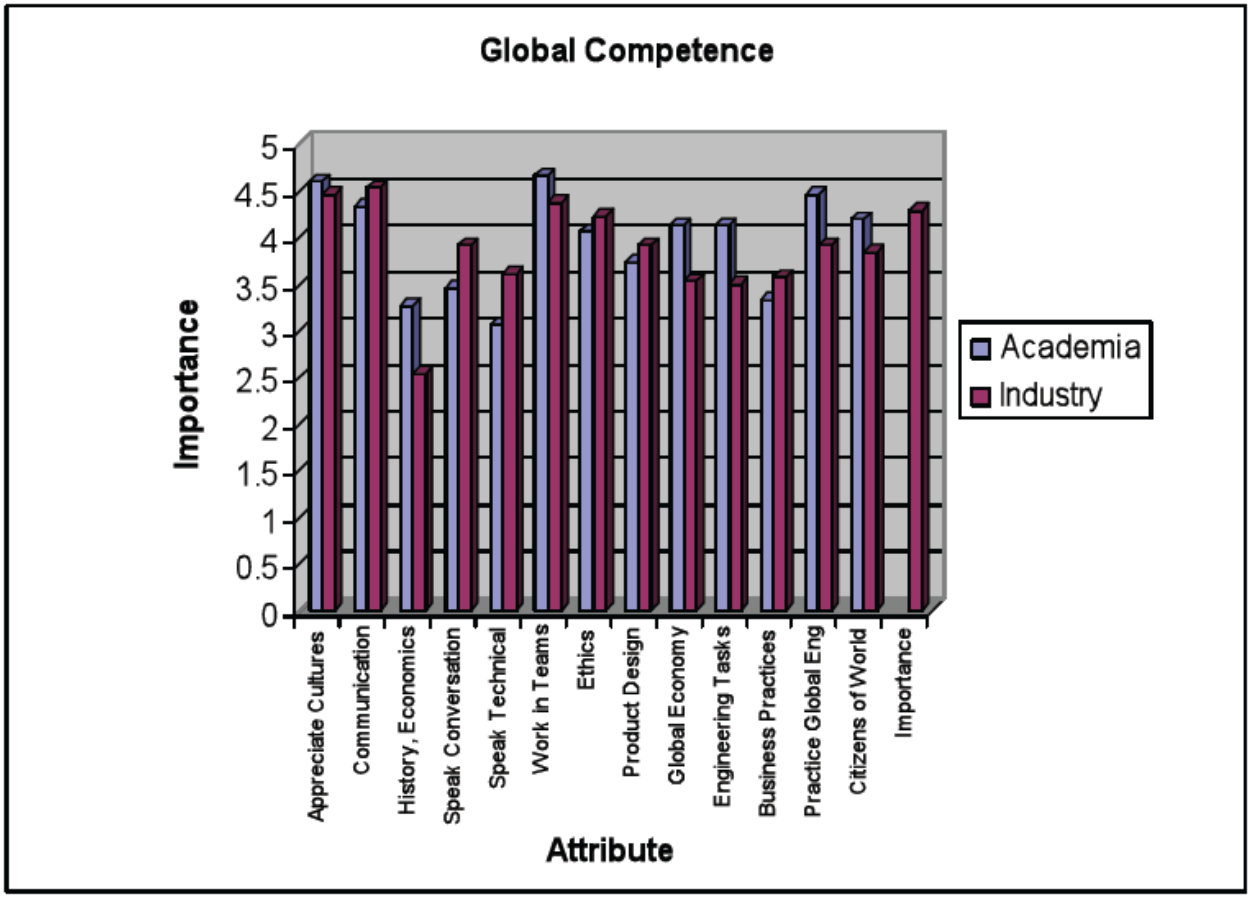

Figure 5 Fig. 6. Relative importance of 13 dimensions of global competence as ranked by academia and industry.

We note that 12 of the 13 attributes were ranked as "Desirable" (corresponding to a score of 3.0) or higher. Further information is provided in Parkinson et al.[29]

5 A Larger Question

So far we have discussed several questions such as: Why is global competence important? and, Which attributes of global competence are most important? These questions point to, but do not answer, another larger question: How can global competence be achieved? Regardless of the specific discipline, the curriculum for engineering is demanding and full, with more topics to be covered than there is time for. How can global competence be fit into a highly constrained program? Although a full response to this question is beyond the scope of the paper, some observations can be made.

First, if there is not time or resources to address all the dimensions of global competence, then it would seem to be of benefit to determine which dimensions are of the highest priority and to focus on those. Second, within the constraints of a crowded curriculum, it would be of benefit to identify areas where global competence could be integrated into the existing sequence of courses.

The results of the paper provide some clues as to ways this might be done. For example, the second most important attribute, "Engineering graduates are proficient working in or directing a team of ethnic and cultural diversity," could be developed a number of ways, such as through a collaborative design experience, that would not have to require travel. Such an experience could involve having U.S. student teams collaborate with abroad student teams on a design project via video-conferencing and other Internet-based design tools. Since design activities are already a part of the curriculum, it may be possible to integrate this type of experience more easily into existing programs. This kind of activity would also require students to learn about communication across cultures and give them a chance to

practice global engineering skills, two of the other "top five" attributes. Thus by defining global competence more precisely, engineering colleges could focus more specifically on the attributes they are trying to develop. By breaking global competence into smaller "chunks," it may be easier to integrate it into existing programs or tailor learning activities to produce specific outcomes.

6 Summary

In this paper we have discussed the rationale for developing global competence. We looked at this from several perspectives. We discussed of the technological, geopolitical and economic changes that have been drivers for globalization. In light of these developments, we gave opinions from credible sources regarding what should be done. We presented examples from engineering disciplines, and mentioned the global nature of grand engineering challenges. We proposed and explained 13 separate dimensions of global competence. These dimensions encompass a broad set of attributes and skills. Since it may not be possible to develop all of these within the constraints of existing programs, we presented survey results from engineering educators and leaders in industry regarding the relative importance of these dimensions. Four of the five top attributes were common between the rankings of industry and academia. Industry respondents also indicated the importance of global competence for engineering graduates to be between "highly desirable" and "essential."

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Más acerca de la frase verbal

Como vimos en la unidad 5A, la frase verbal puede ser descripta de muchas maneras, dependiendo del aspecto del verbo que se toma en consideración. En esta unidad nos focalizaremos en los verbos en voz pasiva en todas las formas verbales que hemos estudiado hasta ahora (ver Unidades 5 y 8 para los verbos en presente y pasado). Entonces podemos hablar de:

Clasificación	**Ejemplo**
Frase verbal en voz activa	….we **discuss** the forces and events of the past 20 years which **have driven** the globalization of engineering. (linea 19)
Frase verbal en voz pasiva	It **is estimated** that the Internet grew by 100% per year during the 1990s. (linea 66)

El verbo y la voz pasiva

Utilizamos la voz pasiva para cambiar la manera en que presentamos la información. Es decir, en vez de la siguiente fórmula para la voz activa:

entidad que realiza la acción[1] + acción[2] + entidad afectada por la acción[3]: This paper[1] addresses[2] three questions[3] (voz activa)

decimos

entidad afectada por la acción[1] + acción[2] + (entidad que realiza la acción)[3:] Three questions[1] are addressed[2] by this paper[3].

La voz pasiva se utiliza principalmente con el propósito de:

- Dejar de lado a la entidad (no siempre ser humano) que realiza una acción. En los géneros académicos, esta entidad es usualmente dejada de lado puesto que se entiende por el contexto. Por ejemplo, si se están presentando los datos de una investigación, no es necesario decir que los datos fueron encontrados por los investigadores (= la entidad que realiza la acción de recolección de datos):

  A new problem **is identified**. = Un nuevo problema **es identificado**. (no es de interés/necesario saber quién)

  He **identifies** a new problem. = Él **identifica** un nuevo problema.

  New concepts **are introduced**. = Nuevos conceptos **son introducidos**.
  This project **introduces** new concepts. = Este proyecto **introduce** nuevos conceptos.

- Poder focalizar la atención en la entidad que realiza o experimenta la acción, ubicándola al final de la oración (lugar de prominencia en la oración puesto que es el lugar donde usualmente aparece la información nueva o la de mayor peso) en una frase introducida por *by*. Por ejemplo:

  Parkinson **addresses** three questions.

  Three questions **are addressed** *by Parkinson*.

  En este caso el emisor tiene como intención poner el foco de atención en *Parkinson*, para destacarlo. Si *Parkinson* quedara al principio de la oración, que sería el lugar usual del Sujeto de la oración, no ocuparía un lugar prominente. El mismo principio se puede aplicar a *three questions*. Esta frase en voz activa cumple la función de objeto del verbo *address*, en su lugar habitual – después del verbo. Al mover este elemento de la oración al principio de la misma, el emisor lo pone en un lugar que lo hace foco de atención puesto que no es el espacio que usualmente ocupa. En resumen, el movimiento de elementos de la oración a lugares que no les son habituales hace que los mismos reciban una atención especial en el mensaje emitido.

  En los ejemplos de arriba, no decimos que una opción es correcta y la otra no. Por alguna razón, la persona que ejecuta la oración decide por un modo de decirlo u otro.

La fórmula básica para la voz pasiva es:

Be + verbo en Pasado Participio (3era columna)

El verbo *to be* siempre va a tomar la forma que deja el verbo principal en la voz activa, ya que éste, al pasar a la voz pasiva, debe tomar la forma de la tercera columna, el pasado participio (ver APÉNDICE 11). Lo importante a tener en cuenta es que si encontramos una forma del verbo *to be* seguida de un verbo en pasado participio estamos ante una frase verbal en voz pasiva. Ahora veamos cómo se forma la voz pasiva en los tiempos presente que vimos en la unidad 5A (Ver cuadro en APÉNDICE 8).

a- El Presente Simple y la Voz Pasiva

La voz pasiva se forma de la siguiente manera con verbos que expresan un hecho de la vida cotidiana, una verdad eterna, etc.:

verbo auxiliar BE (am, is, are) **+ Verbo en Pasado Participio** (3era columna)

= algo **ES** **hecho/realizado/estudiado/comprado** (por alguien)

o

SE realiza/estudia/compra

Veamos los siguientes ejemplos en voz activa:

I
YOU **give** examples of globalization; **address** three questions; **identify** a new problem
WE
THEY

HE
SHE **gives** examples of globalization; **addresses** three questions; **identifies** a new problem
IT

Entonces estos ejemplos podrían expresarse de la siguiente manera en la voz pasiva en Presente Simple:

Examples of globalization **are given**		**me.**
Three questions **are addressed**	by	**you.**
A new problem **is identified**		**him/her/it.**
		us.
		them.

La diferenciación de persona en un verbo en voz pasiva en el Presente Simple va a ser entre las formas AM (I), IS (he, she, it) y ARE (you, we they) del verbo BE. Se deja de lado el agregado de –s, -es, o –ies en el verbo principal ya que éste pasa a la tercera columna como requisito indispensable para la voz pasiva.

Para repasar:

Información del texto	**Linea #**	**Voz Activa?**	**Voz Pasiva?**
a- Much engineering work **is conducted** in teams	454		
b- The first part of this paper **deals** with the need for global engineering education	40		
c- It **is estimated** the Internet grew by 100% per year during the 1990s.	66		
d- The term electronics **is used** in a broad sense..	207		
e- …buildings, bridges and other such works **are designed** for a specific site…	255		
f- In some respects, a common CAD system **becomes** a lingua franca for product development…	72		
g- A good discussion of the “elusive concept of global competence” **is given** by Grandin and Hedderich.	397		

b- El Presente Perfecto y la voz pasiva

La voz pasiva se forma de la siguiente manera con verbos que hacen una conexión entre el pasado y el presente, o verbos que expresan lo que se ha hecho desde un tiempo atrás hasta ahora:

HAVE/HAS + BEEN + Verbo en Pasado Participio (3era columna)

=algo **HA SIDO** **hecho/estudiado/comprado** (por alguien)

o

SE HA hecho/estudiado/comprado

Veamos los siguientes ejemplos en voz activa:

I
YOU **have given** examples of globalization; **have addressed** three questions; **have**
WE **identified** a new problem
THEY

HE
SHE **has given** examples of globalization; **has addressed** three questions; **has**
IT **identified** a new problem

Los mismos ejemplos en voz pasiva en el tiempo Presente Perfecto Simple se forman de la siguiente manera:

		me.
Examples of globalization **have been given**		**you.**
Three questions **have been addressed**	by	**him/her/it.**
A new problem **has been identified**		**us.**
		them.

Para repasar:

Información del texto	**Linea #**	**Voz Activa?**	**Voz Pasiva?**
a- The globalization of engineering **has resulted** from a confluence of trends and events…	47		
b- ….political events which **have opened up** many formerly closed societies…	49		
c- Advances in communications and computers **have been** a powerful driving force for globalization.	53		
d- …production of the aircraft **has been hampered** by delays…	194		

c- El Presente Progresivo y la Voz Pasiva

El verbo en voz pasiva en el tiempo Presente Progresivo se reconoce por la siguiente forma:

BE (am, is, are) **+ BEING + Verbo en Pasado Participio** (3era columna)				
=algo	**ESTÁ**	**SIENDO**	**estudiado/investigado/escrito**	(por alguien)
		o		
		SE ESTÁ estudiando/investigando/escribiendo		

Veamos el siguiente ejemplo en la voz activa:

I	**am**	
HE/SHE/IT	**is**	**researching** new globalized engineering markets.
WE/YOU/THEY	**are**	

Ahora veamos el mismo ejemplo en voz pasiva:

New globalized engineering markets **are being researched** (by me, you, him, them, us).

Para repasar:

Información del texto	**Linea #**	**Voz Activa?**	**Voz Pasiva?**
a- …to understand public policy issues around the world and in the country in which one **is working**.	157		
b- …if we look at where the largest, most revolutionary structures **are being built**…	258		
c- Although this term **is becoming** more widely used, it isn't always clear what it means.	397		
d- …engineering colleges could focus more specifically on the attributes they **are trying** to develop.	594		

d- El Pasado Simple y la Voz Pasiva

Veamos la siguiente oración en voz activa:

The end of the Cold War **brought** new relationships between the Eastern Bloc nations and countries in the West.

Ahora estudiemos la misma oración en voz pasiva:

New relationships between the Eastern Bloc nations and countries in the West **were brought** by the end of the Cold War.

Entonces, la frase verbal en pasado simple en voz pasiva se reconoce por la siguiente fórmula:

verbo auxiliar BE (was/were) **+ Verbo en Pasado Participio** (3era columna)
(=algo **ERA/FUE** **estudiado/realizado/escrito** por alguien)
o
SE estudió/realizo/hizo
SE estudiaba/realizaba/hacía

e- El Pasado Progresivo y la Voz Pasiva

Un verbo en pasado progresivo voz pasiva se forma de la siguiente manera:

BE (was/were) **+ BEING + Verbo en Pasado Participio** (3era columna)
=algo **ESTABA** **SIENDO** **estudiado/escrito/evaluado** (por alguien)
o
SE ESTABA estudiando/escribiendo/evaluando

A modo de ejemplo:

Researchers **were making** many changes in the electronics industry at that time.

Many changes in the electronics industry **were being made** (by researchers) at that time.

f- El Pasado Perfecto y la Voz Pasiva

Un verbo en pasado perfecto voz pasiva se forma de la siguiente manera:

HAD + BEEN + Verbo en Pasado Participio (3era columna)
=algo **HABÍA** **SIDO** **estudiado/investigado/escrito** (por alguien)
o
SE HABÍA estudiado/investigado/escrito

Sponsors **had considered** several possibilities before they decided to cancel the project.

Several possibilities **had been considered** before they decided to cancel the project.

Para un resumen de los tiempos verbales presentados aquí en voz pasiva ver APÉNDICE 8 (cuadro de VOZ PASIVA) y APÉNDICE 12 (cuadro de VOZ PASIVA).

Para repasar:

Lee las oraciones y decide si se necesita una frase verbal en voz activa o pasiva.

1- Advances in communications .....the doors to new areas of industry. (**opened/were opened**)
2- One billion wireless handsets ..... that year. (**shipped/were shipped**)
3- At that time companies ..... their products locally only. (**were selling/were being sold**)
4- Commercial world leaders ..... business at such a large scale before that year. (**had not done/had not been done**)
5- Changes ..... at all levels of industry and commerce. (**were making/were being made**)

g- Verbos auxiliares modales con noción de presente y la voz pasiva:

Para formar la voz pasiva con estos verbos auxiliares se utiliza la siguiente fórmula:

CAN/COULD/etc + BE + Verbo en Pasado Participio (3era columna)

(= algo **puede podría, etc** **ser** **resuelto/estudiado/escrito** por alguien)

Entonces, tomando los ejemplos de arriba diríamos:

	Ejemplo en voz pasiva	**Significado**
CAN	The energy problem *can be solved* by the system.	El problema de energía *puede ser solucionado* por el sistema. (= El problema de energía *se puede solucionar* con el sistema.)
COULD	The energy problem *could be solved* by the system.	El problema de energía *podría ser solucionado* por el sistema. (= El problema de energía *se podría solucionar* con el sistema.)
MAY	A problem *may be caused* by this.	Un problema *puede ser causado* por esto. (= *Se puede causar* un problema por esto.)
MIGHT	A problem *might be caused* by this.	Un problema *podría ser causado* por esto. (O también, *Se presentaría/causaría* un

		problema por esto.)
MUST	A solution *must be found* soon by researchers.	Una solución *debe ser encontrada* pronto por los investigadores. (*Se debe encontrar* una solución pronto.)
SHOULD	A solution *should be found* soon by researchers.	Una solución *debería ser encontrada* pronto por los investigadores. (= *Se debería encontrar* una solución pronto)
WILL	A solution *will be found* soon by researchers.	Una solución *va a ser encontrada* pronto por los investigadores. (=*Se encontrará* una solución pronto.)
WOULD	A solution *would be found* if researchers had more resources.	Una solución *sería encontrada* si los investigadores tuvieran más recursos. (= *Se encontraría* una solución si los investigadores tuvieran más recursos.)

Para repasar: Elije la opción correcta.

1- "…We **must** *prepare* engineers to be global citizens…They **must** *learn* to translate ideas and plans into reality for cultures that **may not** *look, sound* or *dress* the way we do. Unless we **can** *do* that, a large part of our engineering business **will** soon *leave* our shores." (linea 176)

Podemos/Debemos/Deberíamos *preparar* a los ingenieros para ser ciudadanos del mundo. **Pueden/Deben/Deberían** *aprender* a convertir en realidad las ideas y planes para culturas que **pueden no/deben no/deberían no** *verse*, *sonar* o *vestirse* en la manera que lo hacemos nosotros. A menos que **podamos/debamos/deberíamos** *hacer* eso, una gran parte de nuestros negocios ingenieriles pronto **dejarán/dejarían/podrán dejar** nuestras costas.

2- …among the challenges are those that **must be** *met* to ensure the future itself. The Earth is a planet of finite resources, and its growing population currently consumes them at a rate that **cannot be** *sustained*. (linea 364)

…entre los desafíos encontramos aquellos que **deben ser/deberían ser/podrían ser** *atendidos* para asegurar el futuro. La tierra es un planeta de recursos limitados, y su población creciente los consume a un ritmo que **no debe ser/no puede ser/no debería ser** *sostenido*.

3- Solutions to these problems **will require** cooperation across national boundaries. (513)

Las soluciones a estos problemas **requieren/requerirían/requerirán** cooperación traspasando fronteras.

4- The results of the paper provide some clues as to ways this **might be** *done*. For example, the second most important attribute…**could be** *developed* in a number of ways. (linea 583)

Los resultados de este trabajo ofrecen algunas pistas de cómo esto **puede ser/podría ser/ debería ser** *hecho*. Por ejemplo, el segundo atributo más importante **debería ser/podría ser/debe ser** *desarrollado* de varias maneras.

h- Verbos auxiliares modales con noción de pasado o situaciones hipotéticas y la voz pasiva:

Para formar la voz pasiva con estos verbos auxiliares se utiliza la siguiente fórmula:

CAN'T/COULD/etc. + HAVE BEEN + Verbo en Pasado Participio (3era columna)

(=algo **no puede/puede haber sido hecho/comprado/estudiado** por alguien)

Entonces, tomando los ejemplos del cuadro de arriba diríamos:

	Ejemplo en voz pasiva	**Significado**
CAN	The energy problem *can´t have been solved* by the system.	El problema de energía *no puede haber sido solucionado* por el sistema.
COULD	The energy problem *could have been solved* by the system.	El problema de energía *podría haber sido solucionado* por el sistema.
MAY	A problem *may have been caused* by this mistake.	Un problema *puede haber sido causado* por este error.
MIGHT	A problem *might have been caused* by this mistake.	Un problema *podría haber sido causado* por este error.
MUST	A solution *must have been found* by now by researchers.	Una solución ya *debe haber sido encontrada* por los investigadores.
SHOULD	A solution *should have been found* by now by researchers.	Una solución ya *debería haber sido encontrada* pronto por los investigadores.
WILL	A solution *will have been found* by researchers by the year 2025.	Una solución *habrá sido encontrada* por los investigadores para el año 2025.
WOULD	A solution *would have been found* by now if researchers had more resources.	Una solución ya *habría sido encontrada* si los investigadores tuvieran más recursos.

Este tipo de frase verbal no es muy frecuente en los textos expositivos/explicativos como puede ser un manual o una nota de aplicación. Su uso es más frecuente en textos argumentativos- o partes argumentativas en un texto- en los que puede ser más factible hacer deducciones, críticas o conjeturas puesto que su propósito es presentar al lector un tema desde un cierto punto de vista para su posible consideración. Para más información ver APÉNDICE 13 – Verbos Modales.

Para repasar: ¿Cuáles de estas preguntas están en voz pasiva?

a- Why do engineering students need to have a new set of engineering skills…? (linea 29)
b- What does it mean for students to have global competence? (linea 30)
c- What are the most important attributes of global competence? (linea 31)
d- Global Competence: Why is it needed? (Section 2)
e- What has all this meant for world trade? (linea 103)
f- What does the global nature of the electronics industry mean for a US company like Hewlett Packard (HP)? (linea 241)
g- What do these challenges have to do with global competence? (linea 377)
h- Summary: Global Competence: Why is it needed? (linea 386)
i- Global Competence: What Does it Mean? (Section 3- linea 394)
j- How does demand for commodities in China affect prices in the US? (linea 479)
k- How do interest rates in Europe affect the exchange rate between the Euro and the dollar? (linea 480)
l- How do exchange rates affect export? (linea 481)
m- How does Japanese culture influence how Japanese engineers approach manufacturing? (linea 488)
n- How does Japanese culture affect how design decisions are made? (Line 479)
o- Global Competence: What is most important? (Section 4 – linea 527)
p- Why is global competence important? (linea 573)
q- Which attributes of global competence are most important? (linea 574)
r- How can global competence be achieved? (linea 575)

Para más información acerca de los verbos ver APÉNDICES 8 y 12.

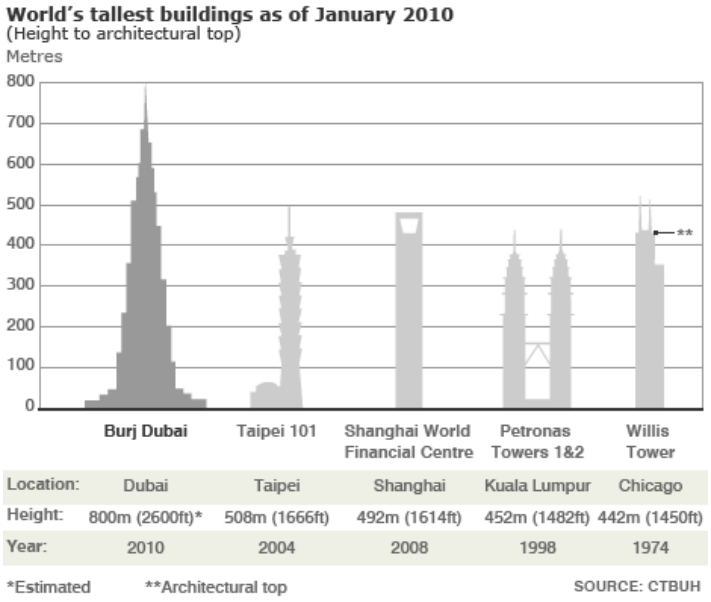
Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

9B Over to your Career Path

Activity 1: Turn to the text "The Rationale for Developing Global Competence", section *2.1 Formative World Events*. Match the five ideas below to five of the paragraphs in this section.

a- The creation of economic institutions has promoted better world trade.
b- CAD systems have changed the way products are represented and shared.
c- Internet has markedly grown in the last ten years.
d- Communications and computers have led to globalization.
e- Political events have impacted globalization.

Activity 2: Look at the following picture sown also on the screen and compare it to the data given on TABLE 1 in the *Civil Engineering* section.

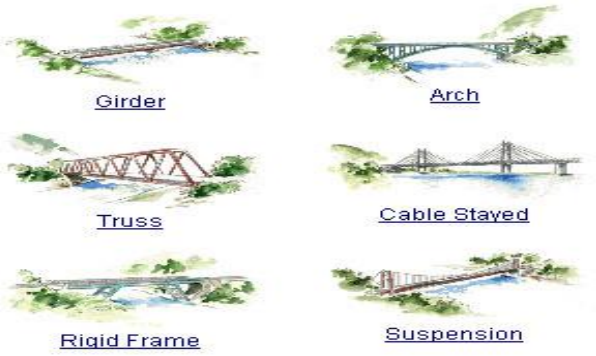


Location:	Dubai	Taipei	Shanghai	Kuala Lumpur	Chicago
Height:	800m (2600ft)*	508m (1666ft)	492m (1614ft)	452m (1482ft)	442m (1450ft)
Year:	2010	2004	2008	1998	1974

*Estimated **Architectural top SOURCE: CTBUH

Retrieved January 29, 2012 from http://www.zimbio.com/Tallest+buildings+in+the+world

Activity 3: Now, look at the following picture on the screen. Which of these bridges corresponds to the one described on TABLE 2? Can you find examples of this type of bridge in Argentina?



Retrieved January 29,2012 from
http://www.google.com.ar/imgres?q=types+of+bridges&um=1&hl=es&sa=N&qscrl=1&nord=1&rlz=1T4RNRN_esAR443AR444&biw=775&bih=359&tbm=isch&tbnid=QmdsML1q9s1k8M:&imgrefurl=http://www.fka.utm.my/bridge/printed.asp%3Factive_page_id%3D431&docid=gRdbplBtXQnW1M&imgurl=http://www.fka.utm.my/bridge/images/Literature/typeofbridges.jpg&w=298&h=277&ei=q4AqT5iFOou5tweN4PzRDw&zoom=1&iact=hc&vpx=495&vpy=2&dur=4274&hovh=216&hovw=233&tx=177&ty=67&sig=106182657265505864642&page=1&tbnh=98&tbnw=110&start=0&ndsp=12&ved=1t:429,r:5,s:0

Activity 4: Work out the following glossary before you turn to the section *Civil Engineering*.

1	skyscrapers	___	puente en arco
2	arch bridge	___	esquina
3	***suspension bridge***	___	puente voladizo
4	cable stayed bridge	___	levadizo
5	state-of-the-art	___	puente colgante, puente suspendido
6	story	___	puente atirantado
7	cantilevered	___	viga voladiza
8	cantilever beam	___	rascacielos
9	cantilever bridge	___	***de vanguardia, tecnología de punta***
10	corner	___	planta, piso

Activity 5: Turn to the section that makes reference to *Civil Engineering* and state True or False.

a- This section is about globalization in Civil Engineering.
b- Four tables are presented in this section.
c- Figures a) and b) are used to show the tallest buildings in the world.
d- The World Financial Center is the second tallest building.
e- The Pont Normandie Bridge was built in 1995.
f- The explanation for the acronym CCTV is given in the text.

Activity 6: State whether the underlined verb phases are in active or passive voice. Then, state value in Spanish of whole sentence, commenting on it.

a- …it would seem Civil Engineering might be (less) affected by globalization. (line 254)
b- …buildings, bridges and other such works are designed for a specific site and built on that site- they cannot be manufactured off-shore. (line 255)
c- However, if we look at where the largest, most revolutionary structures are being built, we find that the center of activity is in Asia and the Middle East. (line 258)
d- For example, Table 1 lists the tallest completed skyscrapers in the world…(line 279)
e- Table 2 shows the world's largest cable-stayed bridges. (line 261)
f- Of the 15 longest bridges, 12 are in Asia. (line 260)
g- Similar results could be shown for steel arch bridges and suspension bridges, a high percentage of the largest are in Asia. (line 263)

h- To illustrate further the global nature of structural design, recently five structures which are considered to be among the most "arresting" buildings in the world have opened in Beijing. (line 278)
i- Connecting the two 50 story columns of the CCTV tower with a large cantilevered "corner" structure required innovative design and construction methods. (line 288)
j- Many of these structures are being designed by international design firms which employ engineers from different countries. (line 279)

Activity 7: Scan the section again and answer the questions below orally.

a- Why does it say that "it would seem Civil engineering might be less affected by globalization" (line 254)?
b- What are the implications of globalization for Civil Engineering?

Activity 8: The following statements are taken from Section 3. Match statements in a-g to similar ideas in 1-7. Then, pay attention to the verb forms in a-g and 1-7.

a- Although this term is becoming more widely used, it isn't always clear what it means. (line 397)
b- A good discussion of "the elusive concept of global competence" is given by Grandin and Hedderich. (line 398)
c- This attribute is focused partly on understanding and avoiding ethnocentrism…(line 412)
d- Learning a second language also promotes tolerance for others who have learned English as a second language. (line 441)
e- Much engineering work is conducted in teams. (455)
f- […engineering graduates] have had a chance to practice engineering in a global context…(499)
g- …this dimension focuses on practice. (503)

1- Grandin and Hedderich give a good discussion of "the elusive concept of global competence".
2- Engineers conduct much of the work in teams.
3- The term "global competence" is being widely used but it is not clear what it is meant by it.
4- The focus of this dimension is practice.
5- Tolerance for others who have been taught English as a second language is promoted by learning a second language.
6- Many engineering graduates have been given a chance to practice engineering in a global context.
7- This attribute focuses partly on trying to understand and avoid ethnocentrism.

Activity 9: What do the following ideas mean in Spanish? Choose the best option.

1. "All cultures…display ethnocentrism, which **can be** the greatest single obstacle to understanding another culture." (line 412)

a- Todas las culturas demuestran etnocentrismo, que **puede ser** el mayor obstáculo para entender otra cultura.
b- Todas las culturas demuestran etnocentrismo, que **debe ser** el mayor obstáculo para entender otra cultura.
c- Todas las culturas demuestran etnocentrismo, que **podría ser** el mayor obstáculo para entender otra cultura.

2. …if their country is more technologically advanced, their culture **must be** superior. (line 414)
   a- …si su país es más avanzado tecnológicamente, su cultura **debería ser** superior.
   b- …si su país es más avanzado tecnológicamente, su cultura **debe ser** superior.
   c- …si su país es más avanzado tecnológicamente, su cultura **podría ser** superior.

3. Ethnical issues **can be magnified** when cultural issues come into play. (462)
   a- Cuestiones étnicas **podrían ser exageradas/podrían exagerarse** cuando cuestiones culturales intervienen.
   b- Cuestiones étnicas **deberían ser exageradas/deberían exagerarse** cuando cuestiones culturales intervienen.
   c- Cuestiones étnicas **pueden ser exageradas/pueden exagerarse** cuando cuestiones culturales intervienen.

4. […engineering graduates] understand implications of cultural differences on how engineering tasks **might be approached**. (484)
   a- ….los graduados de ingenierías entienden las implicaciones de las diferencias culturales en cuanto a cómo las tareas ingenieriles **podrían ser abordadas**.
   b- ….los graduados de ingenierías entienden las implicaciones de las diferencias culturales en cuanto a cómo las tareas ingenieriles **deberían ser abordadas**.
   c- ….los graduados de ingenierías entienden las implicaciones de las diferencias culturales en cuanto a cómo las tareas ingenieriles **pueden ser abordadas**.

Activity 10: Find the results of a survey that was conducted by the researcher and state:

a- Purpose of survey:
b- People surveyed:
c- Scale used to evaluate each attribute of global competence:
d- Ranking of the 5 most important attributes of global competence based on people's answers:

Homework – To turn in

Describe in Spanish the attributes/dimensions of "global competence".

Los ingenieros graduados que han estudiado aspectos de la ingeniería desde una visión global pueden…

Nota importante: Los textos utilizados en este cuadernillo tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

10A Verbos especiales

1 - Watch the video Grand Challenges for Engineering by the National Academy of Engineering (available at http://www.youtube.com/watch?v=1GGupkdsX5E) and put the challenges below in the order they appear on the video.

According to the National Academy of Engineering it is important to:

a	 Advance health informatics	h	 Provide energy from fusion
b	 Make solar energy economical	i	 Manage the nitrogen cycle
c	 Develop carbon sequestration methods	j	 Provide access to clean water
d	 Secure cyberspace	k	 Prevent nuclear terror
e	 Restore and improve urban infrastructure	l	 Engineer better medicines

f	 Enhance virtual reality	**m**	 Reverse-engineer the brain
g	 Advance personalized learning	**n**	 Engineer the tools of scientific discovery

Retrieved and adapted February 6, 2012 from http://www.engineeringchallenges.org/

2- Now match the extracts from the *Grand Challenges for Engineering* Booklet to the challenges above.

1	Web-based education systems are already common. Systems have been designed for storing instructional content, delivering it to students, and facilitating the interaction between instructors and learners.	**8**	The growth in emissions of carbon dioxide, considered a prime contributor to global warming, is a problem that can no longer be swept under the rug. But perhaps it can be buried deep underground or beneath the ocean.
2	Engineering shares theformidable challenges of finding all the dangerousnuclear material in the world, keeping track of it, securing it, and detecting its diversion or transportfor terroristuse.	**9**	Personal privacy and national security in the 21st century both depend on protecting a set of systems that didn't even exist until late in the 20th — the electronic web of information-sharing known as cyberspace.
3	To make solar energy economicallycompetitive,engineers must find ways to improve the efficiency of the cells and to lower their manufacturing costs.	**10**	For decades, some of engineering's bestminds have focused their thinking skills onhow to create thinking machines — computerscapable of emulating human intelligence.
4	In 2005, the American Society of Civil Engineers issued a report card, grading various categories of U.S. infrastructure. The average grade was "D." … Engineers of the 21st century face the formidable challenge of modernizingthe fundamental structures that supportcivilization.	**11**	A robust health informaticssystem would give health professionals the possibility to detect,track, and mitigate both natural health andterrorismemergencies … New strategies for producingvaccines in large quantities must bedevised, using faster cellculturemethods.
5	Developing organismspecific antibiotics could become one of the century's most important biomedical engineering challenges.	**12**	"Overcoming the crisis in water and sanitation is one of thegreatest human development challenges ofthe early 21st century."
6	Maintaining a sustainablefood supply in the future withoutexcessive environmental degradationwill require finding clever methods forremediating the human disruption of the nitrogencycle.	**13**	Engineers are creatingentire cars and airplanes "virtually" in order to test design principles, ergonomics,safety schemes, access for maintenance, and more.
7	Humanengineered fusion has already been demonstrated on a small scale. The challenges are to find ways to scale up the fusion process to commercial proportions.	**14**	Engineers will continue tobe partners with scientists in the great quest for understanding manyunanswered questions of nature.

Excerpts retrieved and adapted February 6, 2012 from
http://www.engineeringchallenges.org/Object.File/Master/11/574/Grand%20Challenges%20final%20book.pdf

Nota importante: Los textos utilizados en esta unidad tienen exclusivamente la función de ejemplos con fines didácticos y serán retirados inmediatamente si existe algún reclamo de propiedad intelectual.

3- What are the different challenges about? Comment on them.

Verbos especiales

En esta unidad nos vamos a concentrar en aquellos verbos que no están conjugados, es decir, aquellos verbos que en su forma no hacen referencia a una persona en especial o a un tiempo determinado y que cumplen diferentes funciones. Estas formas ya han sido estudiadas a lo largo de este cuadernillo pero en esta unidad serán revisadas nuevamente con más profundidad.

Cuando decimos verbos especiales nos referimos a aquellas formas no conjugadas que hemos llamado hasta ahora –ing, -ed y to-infinitivo. Como hemos estudiado, estas formas pueden representar muchos significados distintos en el castellano por lo que hay que reconocerlas para saber qué valor asignarle en nuestra lengua. Veamos algunos ejemplos:

Extracto 2 –Engineer**ing**[1] shares the formidable challenges of find**ing**[2] all the dangerous nuclear material in the world, keep**ing**[3] track of it, secur**ing**[4] it, and detect**ing**[5] its diversion or transport for terrorist use.

1- Aquí la palabra en –ing cumple la función de sustantivo y la tomamos como la "ingeniería" (ver Unidad 3A)
2- 3, 4 y 5 son instancias de la forma –ing después de una preposición por lo que la interpretamos como –ar, -er, -ir o como un sustantivo si podemos encontrar un equivalente (ver Unidad 3A)

Entonces decimos que:

La **ingeniería** comparte los formidables desafíos de **encontrar** todo el material nuclear peligroso en el mundo, **mantener**registro del mismo, **asegurar**lo y **detectar**su desviación y transporte para uso terrorista.

Como se puede apreciar en el ejemplo de arriba la forma –ing puede, en este caso, ser interpretada con dos formas y ninguna de ellas son el –ando, -endo del castellano, forma que los estudiantes tienden a darle al verla.

Las formas de verbos no conjugados son cuatro: forma *–ed (= verbo en tercera columna),* forma *–ing, to*-infinitivo y el infinitivo sin *to (esta última* no será discutida puesto que su frecuencia no es alta). A continuación se presenta un detalle de estas formas no conjugadas y sus posibles funciones para resumir todo lo estudiado hasta este punto.

Forma -ed		**Ejemplos y Discusión**
Función adjetivo	Como adjetivo (pre-modificación del núcleo)	Web-bas**ed** education systems… (extracto 1) = los sistemas de educación basados en la web.. Aquí la forma –ed funciona como premodificador del sustantivo *sistemas*.
Función QUE o –ado,-ido	Como postmodificación del sustantivo	…the electronic web of information-sharing **known** as cyberspace. (extracto 9) = … la red electrónica de intercambio de información conocida como el ciberespacio. Si bien la palabra **known** no pareciera ser un ejemplo claro de la forma –ed, la misma corresponde a la forma que toma el verbo irregular **know** en la tercera columna –forma a la que hacemos referencia cuando hablamos de –ed. Veamos un ejemplo con la forma –ed propiamente dicha ahora: The growth in emissions of carbon dioxide, consider**ed** a prime contributor to global warming, is a problem that can no longer be swept under the rug. (extracto 8) = El crecimiento de emisiones de dióxido de carbono, **considerado** el primer contribuyente al calentamiento global, es un problema que no puede seguir siendo barrido bajo la alfombra (=expresión idiomática para decir "no se puede ocultar más").
Función verbo conjugado	Verbos en voz pasiva, en el presente perfecto (o en el pasado, pasado perfecto)	In 2005, the American Society of Civil Engineers issued a report card … (extracto 4) = En 2005, la Sociedad Americana de Ingenieros Civiles **emitió** una libreta de calificaciones … En este ejemplo estamos ante un verbo conjugado en pasado; se hace referencia a una actividad realizada por la Asociación en el año 2005.

Forma -ing		**Ejemplos y discusión**
Función sustantivo (se puede reemplazar por *esto*)	La palabra en –ing es el núcleo de la frase nominal	Engineer**ing** shares the formidable challenges of finding all the dangerous nuclear material in the world… (extracto 2) = La **ingeniería** comparte los formidables desafíos de encontrar todo el material nuclear peligroso en el mundo,…
Función sujeto/objeto – también reemplazable por *esto* - (se interpreta como sustantivo o –ar, -er, -ir)	Función sujeto(es una estructura encabezada por la forma –ing usualmente más larga que la simple palabra en –ing)	Develop**ing** organism specific antibiotics could become one of the century's most important biomedical engineering challenges (extracto 5) = **Desarrollar/ El desarrollar/El desarrollo de** antibióticos específicos del organismo podría convertirse en uno de los retos más importante de la ingeniería biomédica. Toda la estructura encabezada por una forma (no conjugada) –ing actúa como sujeto de la oración. Esta estructura podría ser reemplazada por un pronombre como IT, THIS, THAT (ESTO- como lo hemos llamado hasta ahora) si el tema ya se hubiese mencionado en una oración anterior.
	Función Objeto (después de ciertos verbos) ***Nota: Las funciones sujeto y objeto pueden ser consideradas variaciones de la función sustantivo puesto que se pueden reemplazar por ESTO***	Maintaining a sustainable food supply in the future without excessive environmental degradation will require find**ing** clever methods for remediating the human disruption of the nitrogen cycle. (extracto 6) = Mantener el suministro sustentable de comida en el future sin una excesiva degradacipon ambiental requerirá **encontrar** métodos inteligentes para remediar la disrupción humana del ciclo del nitrógeno. En este caso la construcción con la forma –ing actúa como objeto directo del verbo *require*. Algunos verbos requieren que su complemento tome la forma de una estructura encabezada por –ing. Nuevamente, esta parte de la oración podría ser reemplazada por un pronombre como IT, THIS, THAT (ESTO): Mantener el suministro sustentable de comida en el future sin una excesiva degradacipon ambiental requeriráesto (= encontrar métodos….)

Función QUE	Como post-modificación del sustantivo	Another major political event impact**ing** globalization was the formation of the European Union (EU) in 1993. (no es ejemplo del texto de arriba) = Otro evento político importante **que impactó** la globalización fue la formación de la Unión Europea. En este caso la construcción como –ing agrega información acerca del sustantivo *event*. Esta ocurrencia gramatical fue presentada en la unidad 6A como postmodificación del núcleo en la frase nominal. El tiempo verbal que se le asigna a la forma –ing va a depender del contexto de la oración en general. En el caso anterior dijimos *Otro evento político de relevancia* ***queimpactó***(verbo en tiempo pasado) *la globalización* ***fue*** *la formación de la Unión Europea*. El verbo principal de la oración (was-fue) está en pasado, entonces le asignamos pasado al verbo de la forma –ing. Si la oración hubiese sido: *Another major political event* ***impacting globalization is****the European economic crises*, diríamos Otro *evento político de relevancia* ***que impacta*** *a la globalización* ***es*** *la crisis económica europea.*
Función adjetivo	Como pre-modificación de un sustantivo	…their manufactur**ing** costs (extracto 3) = sus costos **defabricación**. Si bien al traducir la frase al castellano tenemos un sustantivo (fabricación) decimos que toda la frase "de fabricación" cumple la función adjetiva ya que nos especifica de qué tipo de costos estamos hablando.
Función Preposición + –ar, -er, -ir (o sustantivo)	Después de una preposición	…the formidable challenge of moderniz**ing** the fundamental structures that support civilization (extracto 4) = … el formidable desafío de**modernizar** las estructuras que sustentan la civilización. Aquí la construcción –ing actúa como complemento de la preposición. Las frases preposicionales se caracterizan por tener una preposición a la cabeza y una construcción nominal como complemento, en este caso en la forma un -ing. Su calidad de construcción nominal se puede apreciar si encontramos un sustantivo con el cual sustituir a la forma –ing o cuando la reemplazamos por "esto": el formidable desafío de la modernización/esto.
Función verbo conjugado	Verbos en presente o pasado continuo	Engineers are creat**ing** entire cars and airplanes "virtually"… (extracto 13) = Los ingenieros están**creando** autos y aviones "virtualmente"… Aquí la forma –ing está precedida por el verbo BE en el presente, lo que la convierte en una forma verbal conjugada.

Función verbo no conjugado –ando, -endo	Como agregado de información de una idea entera	New strategies for producing vaccines in large quantities must be devised, us**ing** faster cell culture methods. (extracto 11) = Nuevas estrategias para producir vacunas en grandes cantidades deben ser ideadas, **utilizando** métodos de cultivo celular más rápidos. Aquí la estructura encabezada por la –ing nos proporciona más información acerca de cómo se puede realizar lo que se especifica en la parte anterior de la oración. Como se puede observar, en esta función la –ing se interpreta como –ando, -endo.

Para más información y ejemplos de formas –ing ver APÉNDICE 14.

Forma to-infinitivo		**Ejemplos y discusión**
Función –ar, -er, -ir (sujeto/objeto – reemplazable por ***esto*** o un sustantivo	Como construcción nominal funcionando como sujeto	**To find a solution to the problem soon** is researchers' most pressing issue.(este ejemplo no se encuentra en el texto de arriba) = **Encontrar pronto una solución al problema** es elasunto más urgente para los investigadores. **Esto** es el asunto más urgente para los investigadores. La construcción to-infinitivo cumple la función de sujeto. Si bien esta construcción es posible y se usa, la forma –ing es más frecuente en esta función: **Finding a solution to the problem soon** is researchers' most pressing issue. En este caso, así como ocurre con la forma –ing, la construcción con el to-infinitivo puede ser reemplazada por un pronombre como IT, THIS, THAT: **This** is researchers' most pressing issue.
	Como construcción nominal funcionando como objeto de un verbo	Researchers have decided **to work on a solution to the problem now**. (Los investigadores han decido **trabajar en una solución para el problema**. Los investigadores han decidido **esto**). Aquí la construcción con to-infinitivo actúa como complemento del verbo *decide*. Así como hay verbos que requieren que su complemento tome la forma –ing, otros requieren que su complemento tome la forma del to-infinitivo. Esta construcción también podría ser reemplazada por un pronombre (esto).

Función PARA	Como información extra acerca de un sustantivo (postmodificación)	Globalization involves the ability**to understand** that the world economy has become tightly connected….=La globalización implica la habilidad**de comprender** que la economía del mundo se ha vuelto íntimamente conectada. Those that have the interest and capability **to move abroad** significantly expand their long term career opportunities. = Aquellos que tienen el interés y la capacidad**para moverse al exterior** expanden significativamente sus oportunidades en la carrera a largo plazo. En este caso las construcciones con to-infinitivo agregan información acerca de los sustantivos *ability* y*capability.*
	Como información extra de un adjetivo o adverbio (postmodificación)	The researchers are too preoccupied **to leave this problem unattended**.= Los investigadores están demasiado preocupados **para dejar** este problema sin prestarle atención. Aquí la estructura to-infinitivo se utiliza para agregar información relacionada con el adjetivo *preocupados*. Junto con la palabra *too* (= demasiado) forman una modificación llamada discontinua porque consta de dos partes: *too…(+ adjetivo/adverbio)…to do something.* Otro ejemplo: They are prepared **to provide answers to the community** = Ellos están preparados **para dar** respuestar a la comunidad.
	Como información del propósito para lo que se realiza una acción	**To open this lock**, the user has to move the handle counter-clockwise. = **Para abrir esta cerradura**, el usuario deberá mover la manija en dirección opuesta a las agujas del reloj. En el ejemplo de arriba, el segmento que contiene el *to-infinitive* nos indica para qué debemos realizar la acción expresada en la otra parte de la oración.
	En síntesis	En relación con esta forma, más allá de las categorías gramaticales presentadas aquí (simplificadas para el estudiante de lengua extranjera) se deberá recordar que ante la presencia de esta forma se debe elegir básicamente entre dos significados: PARA (u otra preposición) + -ar, -er,-ir o directamente el significado –ar, -er,-ir. Las actividades que se realizan en clase para identificar cuál es exactamente la función de la forma son simplemente para ayudar al estudiante a sistematizar los significados de la misma y no para que se convierta en un experto en gramática inglesa.

Es importante aclarar que si bien se hacen estas clasificaciones y se espera que el estudiante de lengua extranjera pueda identificar las funciones de las formas estudiadas en esta unidad y a lo largo del cuadernillo, la finalidad última es posibilitar una sistematización de los distintos patrones gramaticales de la lengua dado que el estudiante

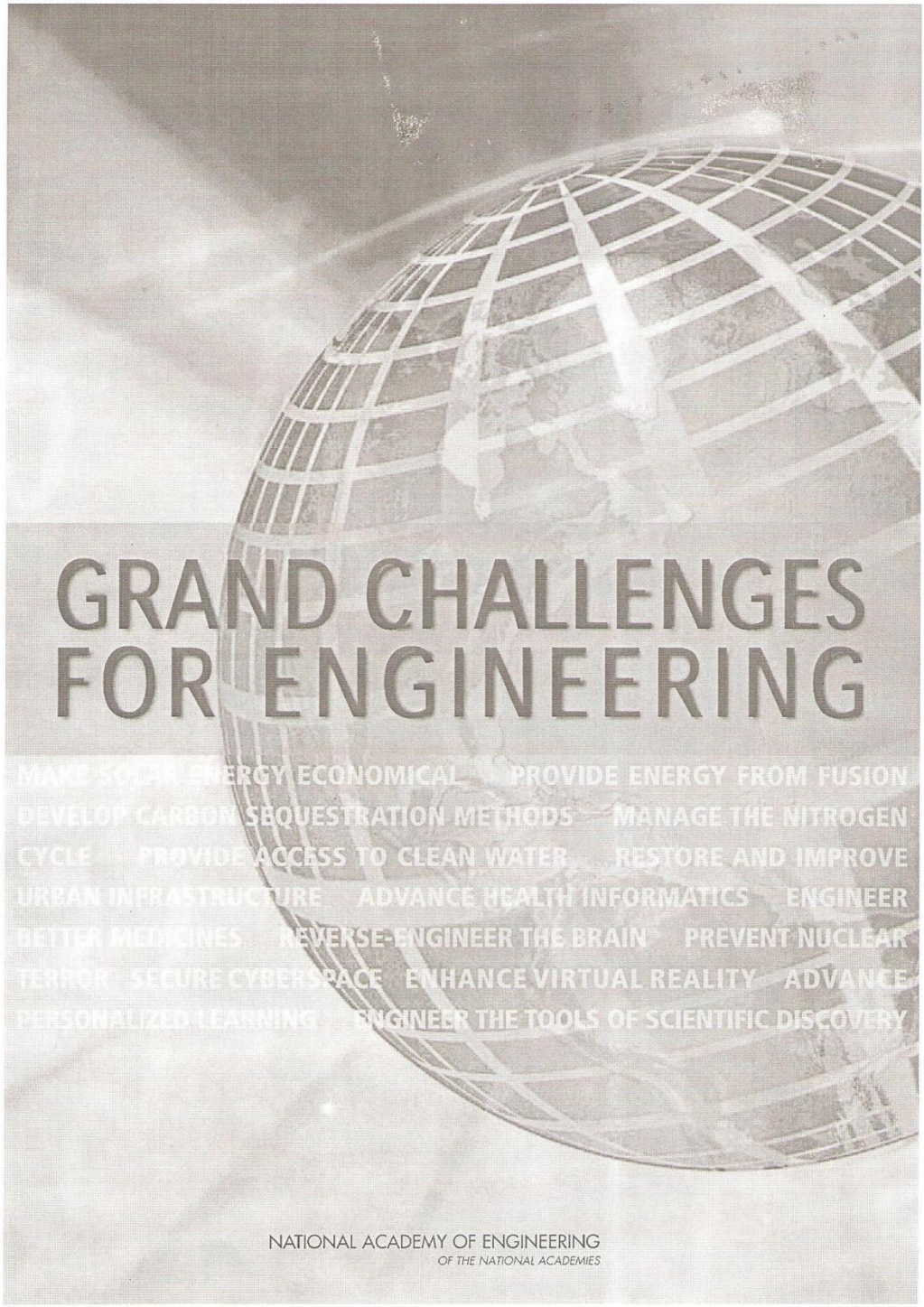
no posee conocimiento suficiente de la lengua extranjera. De esta manera se espera poder facilitar su reconocimiento e incorporación y que ante una forma específica como ser la –ing el estudiante, ante la imposibilidad de obtener el significado correcto de lo que está leyendo, pueda preguntarse ¿será que tengo que interpretarla como –ar, -er, -ir, como –ando, -endo, como verbo conjugado o como preposición –ar, -er, -ir? Las clasificaciones realizadas en el cuadernillo permiten tomar un trozo de lengua y estudiarlo, buscando más ejemplos de la misma ocurrencia en distintos textos y así incorporarlos aunque al principio parezca una tarea difícil de realizar.

Para repasar: Choose the correct option

1- "storing" in extract 1 means…
   a. …para guardar
   b. …guardar
   c. …guardando
2- "facilitating" in extract 1 means…
   a. …para facilitar
   b. …facilitar
   c. …facilitando
3- "to make" in extract 3 means…
   a. …para hacer
   b. …el hacer
   c. …hacer
4- "to improve" in extract 3 means…
   a. …de mejorar
   b. …el mejorar
   c. …mejorar
5- "grading" in extract 4 means…
   a. …calificando
   b. …calificar
   c. …la calificación
6- "protecting" in extract 9 means…
   a. …proteger
   b. …protegiendo
   c. …para proteger

10B Over to your Career Path

Activity 1: Scan the section *Restore and improve urban infrastructure* from the *Grand Challenges for Engineering Booklet* and state what this section is about. (The complete booklet can be retrieved from http://www.engineeringchallenges.org/Object.File/Master/11/574/Grand%20Challenges%20final%20book.pdf



Restore and improve urban infrastructure

In 2005, the American Society of Civil Engineers issued a report card, grading various categories of U.S. infrastructure. The average grade was "D."

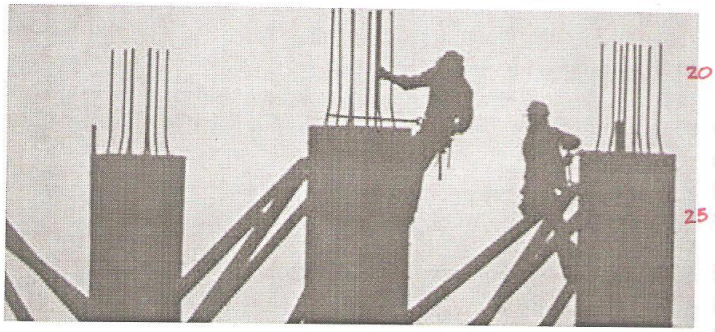
What is infrastructure?

Infrastructure is the combination of fundamental systems that support a community, region, or country. It includes everything from water and sewer systems to road and rail networks to the national power and natural gas grids. Perhaps there will be a hydrogen grid in the future as well.

What is the current state of our infrastructure?

It is no secret that America's infrastructure, along with those of many other countries, is aging and failing, and that funding has been insufficient to repair and replace it. Engineers of the 21st century face the formidable challenge of modernizing the fundamental structures that support civilization.

The problem is particularly acute in urban areas, where growing populations stress society's support systems, and natural disasters, accidents, and terrorist attacks threaten infrastructure safety and security. And urban infrastructure is not just a U.S. issue; special challenges are posed by the problems of megacities, with populations exceeding 10 million, which are found mostly in Asia. In many parts of the world, basic infrastructure needs are still problematic, and engineers will be challenged to economically provide such services more broadly.



Furthermore, solutions to these problems must be designed for sustainability, giving proper attention to environmental and energy-use considerations (though cities take up just a small percentage of the Earth's surface, they disproportionately exhaust resources and generate pollution), along with concern for the aesthetic elements that contribute to the quality of life.

What is involved in maintaining infrastructure?

Of course, maintaining infrastructure is not a new problem. For thousands of years, engineers have had to design systems for providing clean water and disposing of sewage. In recent centuries, systems for transmitting information and providing energy have expanded and complicated the infrastructure network, beginning with telegraph and

telephone lines and now encompassing all sorts of telecommunications systems. Cable TV, cell phones, and Internet access all depend on elaborate infrastructure installations. Development of remote wind and solar energy resources will add more.

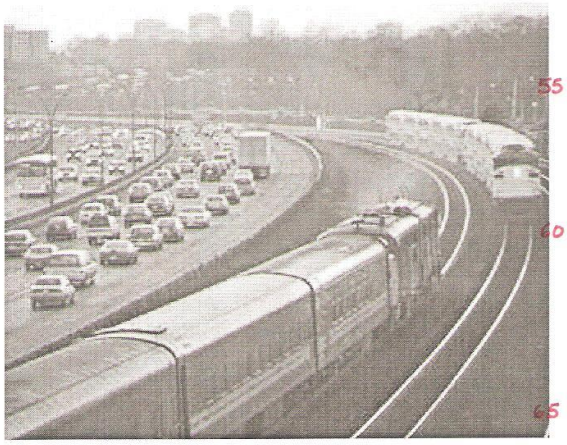
Much of the existing infrastructure is buried, posing several problems for maintaining and upgrading it. For one thing, in many cases, records of the locations of all the underground pipes and cables are unavailable or incomplete. One major challenge will be to devise methods for mapping and labeling buried infrastructure, both to assist in improving it and to help avoid damaging it.

A project of this sort is now underway in the United Kingdom, with the aim of developing ways to locate buried pipes using electromagnetic signals from above the ground. The idea is to find metallic structures capable of reflecting electromagnetic waves through soil, much as a reflector makes a bicycle easier to see at night.

Engineers of the 21st century face the formidable challenge of modernizing the fundamental structures that support civilization.

How can you improve transportation systems?

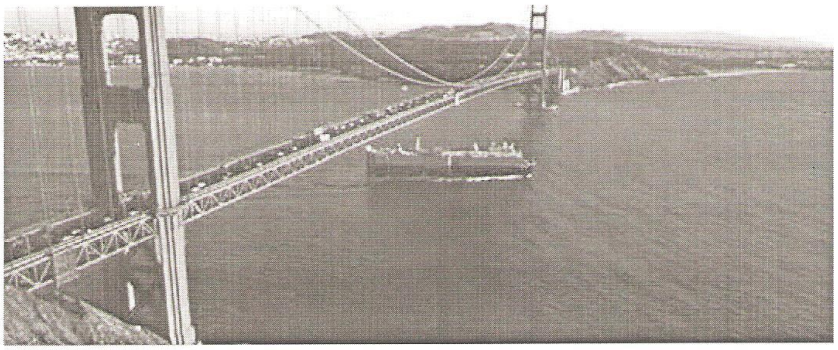
Other major infrastructure issues involve transportation. Streets and highways will remain critical transportation conduits, so their maintenance and improvement will remain an important challenge. But the greater challenge will be engineering integrated transportation systems, making individual vehicle travel, mass transit, bicycling, and walking all as easy and efficient as possible. An increasingly important question is the need to provide better access to transportation for the elderly and disabled.



Cities around the world have begun developing integrated approaches, by establishing transportation hubs, for instance, where various transportation elements — rail, bus, taxi, walking and bicycle paths, parking lots — all conveniently meet. In Hong Kong, several transportation services are linked in a system that allows a single smart card to be used to pay for all the services, including gas and parking.

A similar integrated approach combining energy, water, and wastes (liquid and solid) into "neighborhood" systems could be considered in certain urban areas. This approach would increase sustainability while relieving pressure to meet all citizens' needs through city-scaled infrastructures. It would be best to introduce such systems in new development areas (e.g. urban revitalization areas) and new cities, which will spring up over the next few decades in places like China and India.

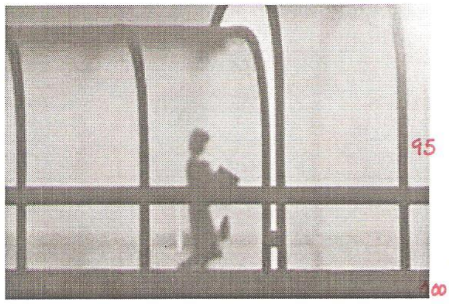
While such services can help support growing urban populations, they must be accompanied by affordable and pleasant places for people to live. Engineers must be engaged in the architectural issues involved in providing environmentally friendly, energy-efficient buildings both for housing and for business.



How do you build better infrastructure?

Novel construction materials may help address some of these challenges. But dramatic progress may be possible only by developing entirely new construction methods. Most of the basic methods of manual construction have been around for centuries — even millennia. Advances in computer science and robotics should make more automation possible in construction, for instance, greatly speeding up construction times and lowering costs. Electricity networks linking large central-station and decentralized power sources will also benefit from greater embedded computation.

All of these endeavors must be undertaken with a clear vision for the aesthetic values that go beyond mere function and contribute to the joy of living. Major bridges, for instance, have long been regarded almost as much works of art as aids to transport. Bridges, buildings, and even freeways contribute to the aesthetical appeal of a city, and care in their design can contribute to a more enjoyable urban environment.



In previous decades, much of the rest of urban infrastructure has been erected without as much concern for its impact on a city's appearance and cultural milieu. Recently, though, awareness of the aesthetics of engineering has begun to influence infrastructure design more generally. Integrating infrastructure needs with the desire for urban green spaces is one example.

Projects to deal with urban stormwater runoff have demonstrated opportunities to incorporate aesthetically pleasing projects. Using landscape design to help manage the flow of runoff water, sometimes referred to as "green infrastructure," can add to a city's appeal in addition to helping remove pollution. The vast paved area of a city needs to be rethought, perhaps by designing pavements that reduce overhead temperatures and that are permeable to allow rainwater to reach the ground table beneath. Proper engineering approaches can achieve multiple goals, such as better storm drainage and cleaner water, while also enhancing the appearance of the landscape, improving the habitat for wildlife, and offering recreational spaces for people.

Rebuilding and enhancing urban infrastructure faces problems beyond the search for engineering solutions. Various policies and political barriers must be addressed and overcome. Funding for infrastructure projects has been hopelessly inadequate in many areas, as the American Society of Civil Engineers' "report card" documented. And the practice of letting infrastructure wear out before replacing it, rather than incorporating technological improvements during its lifetime, only exacerbates the problems.

And so, a major grand challenge for infrastructure engineering will be not only to devise new approaches and methods, but also to communicate their value and worthiness to society at large.

Activity 2: Find the following information and underline it in the text. Then complete the table below in Spanish.

Definition of Infrastructure	
Characteristics of US and other countries' infrastructure today	
The main reason it is difficult to maintain infrastructure	
Description of an integrated approach related to transportation	
Description of an integrated approach related to services	
Elements needed to build better infrastructure	

Activity 3: Choose the *best* option:

6- According to the text, having a hydrogen grid in cities…
   a. …is not a possibility in the future.
   b. …is a possibility in the future.
   c. …is a fact in the future.

7- Modernizing the fundamental structures in cities….
   a. …is one of the plans for the future.
   b. …is an impossible plan for the future.
   c. …is one of the grand challenges for the future.

8- The problem of infrastructure has to be solved ….
   a. …by paying attention to environmental sustainability as well.
   b. …by investing great sums of money as well.
   c. …by providing better services as well.

JUSTIFICATION: ……

9- Systems for transmitting information and providing energy have…
   a. …expanded connectivity in recent years.
   b. …aggravated the problem of infrastructure in recent years.
   c. …not changed much in recent years.

10- Integrated transportation systems involve…
   a. …combining all kinds of transportation for the elderly and disabled.
   b. …incorporating all kinds of transportation into a single structure efficiently.

c. …providing better transportation possibilities.

11- According to the text, one urgent need in relation to transportation is …

a. …to offer cheaper services.
b. …to offer better services for people who are old or disabled.
c. …to provide cheaper and better services for the population.

12- In terms of housing, it is important for engineers…

a. …to build environmentally friendly structures.
b. …to provide people with comfortable places to live in.
c. …to offer people comfortable and environmentally friendly places to live in.

JUSTIFICATION:

13- To build better infrastructure…

a. …new materials are needed.
b. …new building methods are needed.
c. …new materials and better building methods are needed.

14- Projects to deal with urban stormwater runoff…

a. …can be designed to be pleasant to the eye.
b. …can be designed to be affordable.
c. …can be designed to be pollution free.

JUSTIFICATION:

Cuando se pide una justificación, se debe explicar la razón por la que se ha elegido una opción. No es suficiente con poner la línea en la que aparece lo que se interpreta como la respuesta.

Activity 4: State the function and value of the *–ing* words in context. Then comment on the meaning of the whole section in which you find the word.

Forma-ing	**line**	**-ing como parte de frase verbal conjugada**	**-ing sustantivo (esto)**	**-ing adjetivo (antes del sust)**	**-ing QUE (después del sust)**	**-ing prep +ar, -er,-ir**	**-ing –ar, -er, -ir como sujeto/ objeto**	**-ing –ando, -endo (información adicional)**
funding	**12**							
giving	**28**							
maintaining	**33**							
mapping	**43**							
engineering	**54**							
combining	**71**							

Activity 5: State the function and value of the *to-infinitive*words in context. Then comment on the meaning of the whole section in which you find the word.

To -infinitivo	line	Función –ar, -er, -ir (o sustantivo)	Función PARA + -ar, -er, -ir (u otra preposición)
to provide	**24**		
to devise	**42**		
to find	**47**		
to pay	**70**		
to help	**102**		

Homework – To turn in

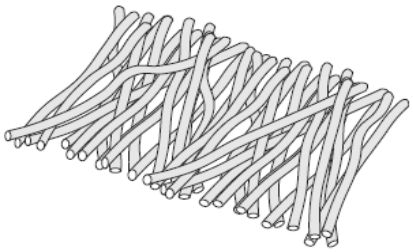
Write a summary of the text considering the following aspects:

1- Definition of infrastructure
2- Current state of infrastructure
3- Aspects to be considered by engineers to maintain and improve infrastructure

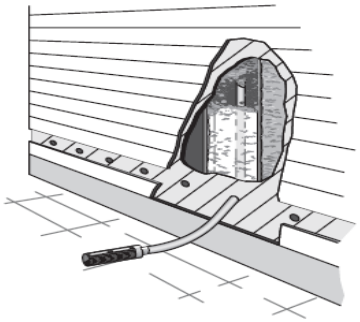
Review Section 4B

Activity 1: Match the picture to its caption. What do they show?

Trapped Air Slows Heat Flow

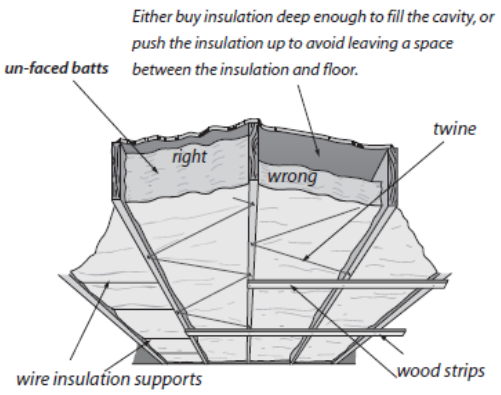


Dense-Packed Wall Insulation



Retrofit Attic Insulation

Insulating the Floor Above Your Crawl Space



Exterior walls of older homes are best insulated using a fill tube inserted into the wall cavity. The tube helps achieve the high density needed to prevent settling by packing the insulation throughout the height of the wall.

1

There are a number of effective ways to attach and support floor insulation, including twine, wire insulation supports, and wood strips.

2

Fiberglass, like all types of insulation, traps air between loosely packed rows of fibers. The trapped air provides the insulating value, not the fiberglass itself.

3

Either loose-fill fiberglass or loose-fill cellulose insulation are good choices for attic insulation because they form a seamless blanket. Insulation dams are installed to maintain clearance around the attic hatch and chimney.

4

Activity 2: Complete in English.

The text was retrieved September 3, 2010 from
http://www.aeromt.org/PDFs/ncc/Insulation_Tip%20_Sheet.pdf

Source: .....
Title: .....
Subheadings: .....
Date of publication: .....
Date of retrieval: .....
Meaning of R-value: .....

Activity 2: Identify the following information in the text. Use { } to do it.

a. The different insulation types that can be used to insulate a home
b. The benefits of installing retrofit attic insulation
c. The reason it is difficult to know how much insulation there is in the walls of a home
d. The best way to insulate crawl space
e. The common way to insulate a basement
f. The best way to insulate a basement
g. The house locations where air leaks can be found

Activity 3: Match the picture to the type of insulation. Then, complete the table in English.




Insulation Types	Characteristics	Used to insulate
Fiberglass batts		
Loose-fill insulation		
Plastic foam insulation		
Sprayed polyurethane		

Activity 4: Match the expression in English to its value/approximation in Spanish.

a- loose-fill insulation (line 14)	1. paredes construidas a base de marcos de madera
b- fiberglass batts (11)	2. enmasillado
c- frame walls (24)	3. paredes de ladrillo
d- masonry wall (23)	4. aislamiento de ático reacondicionado
e- sheeting (24)	5. aislamiento de fibras sueltas/ aislamiento rellenable suelto /a granel
f- sprayed polyurethane (25)	6. plancha de espuma
g- heat flow (17)	7. flujo de calor / transferencia de calor
h- moisture (27)	8. laminado
i- caulking (107)	9. bloques/placas de fibra de vidrio
j- foamboard (10)	10. humedad
k- siding (55)	11. cavidades / huecos
l- cavities (41)	12. cámara de aire / hueco sanitario
m- crawl space (64)	13. revestimiento de pared
n- retrofit attic insulation (subheading)	14. poliuretano proyectado/ aplicado/ inyectado (in situ)

Activity 5: Scan the sections and choose the best option.

a- In retrofit attic insulation **plastic foam insulation / sprayed polyurethane / loose-fill insulation** is used.
b- Insulating the attic is cost-effective because **it is not expensive / it reduces the amount of energy used / it is easy to do**.
c- To retrofit wall insulation, it is necessary to know **who built the house / how much insulation there is / where the house was built**.
d- Two know how much insulation there is one of the walls, you can do **two / three / four** things.
e- In retrofit crawl-space insulation there are **two / three / four** methods to insulate this space.
f- To insulate the foundation, a framed wall filled with fiberglass batts **may not be / will not be / must not be** the best option.
g- It is important to seal air leaks because energy **can be lost / can be harvested / can be saved** through them.

Activity 6: Scan the section INSULATION TYPES AND CHOICES and state the function of the –ed words specified. Then, state value in Spanish of the whole sentence.

a- Fiberglass batts are the most common insulation found in existing homes.
b- Many homes have batts installed in both wall cavities and in the attic.
c- Loose-fill insulation, either fiberglass and cellulose, is also used as both attic and wall insulation.
d- This type of blown blanket has no voids or edge gaps, if installed properly, loose-fill usually has more resistance to heat flow than fiberglass batts.
e- Foam sheets can be used to insulate masonry walls or as insulated sheeting on frame walls.
f- Sprayed polyurethane is sometimes used to insulate walls, foundations, or roofs.
g- Sprayed polyurethane insulation is usually applied by professional crews with truck-mounted equipment.

-ed word	**Line number**	**-ed como parte de frase verbal conjugada**	**-ed como adjetivo**	**-ed en function QUE o -ado, -ido**
found	11			
installed	12			
used	15			
installed	16			
used	23			
insulated	24			
sprayed	25			
applied	30			
mounted	30			

Activity 7: Scan the section RETROFIT WALL INSULATION and state function of to infinitive form. Then, give value of the whole sentence.

a- Since your home's wall cavities are out of sight, it's hard to know how much insulation is installed in them.
b- One of the best ways is to remove the cover plate of an electrical outlet (be sure to turn off power first).
c- Another trick is to drill a small inspection hole in an inconspicuous place such as a closet.
d- This type of loose-fill insulation should be installed at sufficient density to avoid settling.
e- If you plan to install new siding on your house, or to paint the interior or exterior, you'll have a good opportunity to blow insulation into uninsulated or partially insulated wall cavities

to infinitive	linea	Función –ar, -er, -ir	Función *para*
to know	42		
to remove	44		
to drill	48		
to avoid	53		
to install	55		
to paint	55		
to blow	57		

Para saber cuánto aislamiento tiene una casa en las paredes, se pueden hacer dos cosas:

1- .....

2- .....

Activity 8: Scan the section RETROFIT CRAWL-SPACE INSULATION and state reference of following words and phrases.

Word/Phrase	Line number	Reference
it	64	
it	68	
This	68	
this type	71	
they	73	
the best choice	79	
it	83	

El mejor aislamiento para la cámara de aire es.....

Activity 9: Scan the section SEALING YOUR HOME'S AIR LEAKS and state function and value of the -ing words below.

a- Air leaks in the ceilings, walls and floors of your home can waste up to 30% of the energy consumed by your heating and cooling equipment.
b- Sealing air leaks reduces this energy loss and also keeps airborne moisture from entering building cavities, where it could encourage the growth of mold and mildew.
c- Gaps between structural framing and door or window frames.

Word	Line	-ing como verbo conjugado	-ing como sust	-ing como adjetivo	-ing QUE	-ing como – ar, -er, -ir (Sujeto/ Objeto)	-ing function prep + ar, er, ir	-ing como verbo no conjugado (información extra)

ceilings	88							
heating	90							
cooling	90							
Sealing	92							
entering	94							
building	94							
framing	103							

Es importante sellar los escapes de aire porque……

Activity 10: Choose the best option based on your comprehension of the complete text.

a. Insulation **is / will be / could be** important in making a home comfortable and energy-efficient.
b. If your home is well-insulated, more energy **will be saved / could be saved / might be saved**.
c. There are different insulations options that **may be used / must be used / will be used** to insulate your home.
d. To insulate the foundation and crawl space more than one method **must be used / can be used / should be used**.
e. To avoid air leaks, there are several locations that **must be checked / may be checked / could be checked**.

Activity 11: True, False, Don't know? Justify your answers.

a. Insulation has only been effective to protect a house from cold weather.
b. A new insulation method is being developed these days.
c. All the materials used for insulation have the same R-value.
d. If loose-fill insulation has been applied properly, it provides better results than fiberglass batts.
e. Sprayed polyurethane insulation is not usually applied by home owners themselves.

Activity 12: Where can you find the answers to the following questions? Then, answer them.

a- What are the different types of insulation?
b- What kind of insulation can be used to retrofit an attic?
c- How can you evaluate the amount of insulation on your house walls?
d- What is the disadvantage of building a framed wall and filling it with fiberglass batts to insulate a foundation?
e- Why should you seal your home's air leaks?

ncc
neighborhood
conservation clubs

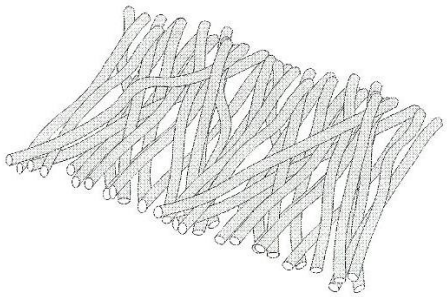
Energy Conservation Tip Sheet

Improving Your Home's Insulation

Insulation is the key element in making a home comfortable and energy-efficient during both cold and hot weather. In many homes, retrofit attic and wall insulation improvements are the best energy investments of all.

Insulation is rated by R-value, which measures resistance to heat flow. Each type of insulation has a different R-value for each inch of thickness, hence 3 inches of fiberglass will have a value of about R-10 while 3 inches of foamboard has a value of about R-15.

Trapped Air Slows Heat Flow



Fiberglass, like all types of insulation, traps air between loosely packed rows of fibers. The trapped air provides the insulating value, not the fiberglass itself.

Insulation Types and Choices

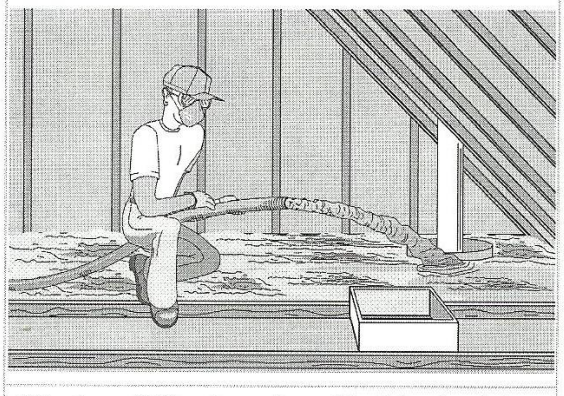
Fiberglass batts are the most common insulation found in existing homes. Many homes have batts installed in both wall cavities and in the attic.

Loose-fill insulation, either fiberglass and cellulose, is also used as both attic and wall insulation. This type of blown blanket has no voids or edge gaps, if installed properly, loose-fill usually has more resistance to heat flow than fiberglass batts.

Plastic foam insulation, like polystyrene and polyurethane, is available in 4-foot by 8-foot or 2-foot by 8-foot sheets of various thicknesses. Plastic foam insulation is a moisture and air barrier, unlike fibrous insulation. Foam sheets can be used to insulate masonry walls or as insulated sheeting on frame walls.

Sprayed polyurethane is sometimes used to insulate walls, foundations, or roofs. It is costly to install, but worth its higher price when adhesion, moisture-resistance, air-sealing ability, and structural strength are important. Sprayed polyurethane insulation is usually applied by professional crews with truck-mounted equipment.

Retrofit Attic Insulation



Either loose-fill fiberglass or loose-fill cellulose insulation are good choices for attic insulation because they form a seamless blanket. Insulation dams are installed to maintain clearance around the attic hatch and chimney.

Retrofit Attic Insulation

Loose-fill insulation is blown into attics using an insulation-blowing machine. It is inexpensive and easy to install. If your ceiling has less than 5 inches of insulation (about R-19), adding insulation to a total of 12-16" (about R-49) is an excellent investment. Attic insulation provides a better return than most energy investments since it increases comfort and lowers consumption in both summer and winter.

A joint effort of the Alternative Energy Resources Organization (AERO), The S.A.V.E. Foundation, and Saturn Resource Management

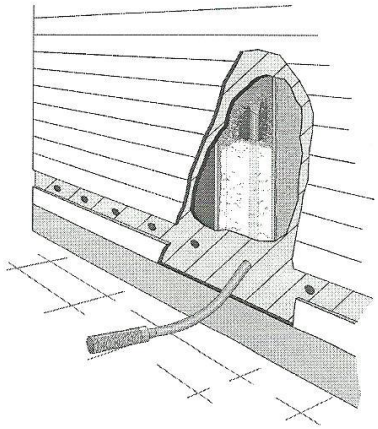
Retrofit Wall Insulation

Many older homes were built with little or no wall insulation. Since your home's wall cavities are out of sight, it's hard to know how much insulation is installed in them. But if your home is more than 30 years old, it's worth the time to find. One of the best ways is to remove the cover plate of an electrical outlet (be sure to turn the power off first). Use a flashlight to peer around the electrical box into the wall cavity. Another trick is to drill a small inspection hole in an inconspicuous place such as a closet. The wall cavity should be full.

Wall insulation is usually blown into the wall cavities of existing homes through a series of holes in the interior or exterior wall surfaces. This type of loose-fill insulation should be installed at sufficient density to avoid settling.

If you plan to install new siding on your house, or to paint the interior or exterior, you'll have a good opportunity to blow insulation into uninsulated or partially insulated wall cavities. During these major jobs, you can reduce or eliminate the cost of patching the holes need to install cavity insulation. Insulating foam sheets can also be attached to walls after existing siding is removed and before a home is re-sided, adding valuable extra thermal resistance.

Dense-Packed Wall Insulation



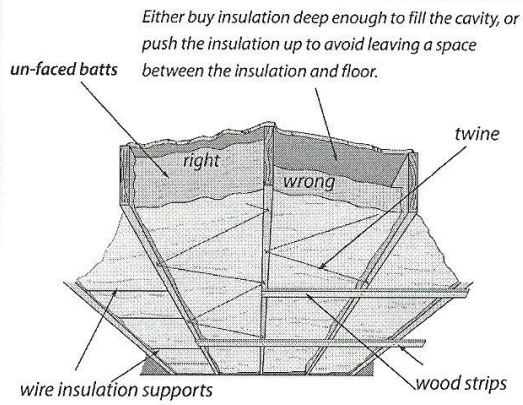
Exterior walls of older homes are best insulated using a fill tube inserted into the wall cavity. The tube helps achieve the high density needed to prevent settling by packing the insulation throughout the height of the wall.

Retrofit Crawl-Space Insulation

If your home is built over a crawl space, it should be insulated at either 1) the floor above the crawl space, or 2) at the foundation walls around the crawl space.

If you choose to insulate the floor above the crawl space, it should be brought up to least R-11. This can be achieved with a $3^1/_2$-inch un-faced fiberglass batt. Better yet, install a $5^1/_2$-inch batt to achieve R-19. Provide permanent support such as wood strips or wires for this type of overhead installation. Avoid the use of faced batts since they tend to trap moisture.

Insulating the Floor Above Your Crawl Space



There are a number of effective ways to attach and support floor insulation, including twine, wire insulation supports, and wood strips.

In many cases, a better approach to crawl space insulation is to insulate the foundation wall with sheet foam insulation and thereby include the crawl space within the conditioned boundary of the home. Foam insulation can tolerate crawl space moisture better than fiberglass batts, and so is the often the best choice where moisture is present. One-inch extruded polystyrene foam provides about R-5. Spray foam insulation, installed from a truck-mounted machine, is also a good choice for foundation walls, and it has the added benefit of creating a excellent air seal. If you decide to insulate the foundation walls of your crawl space, you should close off the foundation vents—at least during the winter—to avoid heat loss.

For more energy-saving tips, visit the NCC website at www.savemobile.org

The choice of wall vs. floor insulation in a crawl space will often be driven by practical considerations such as the type of foundation (avoid trying to attach insulation to stone walls), the presence of ground water (don't insulate the foundation wall if water drains through it), and the presence of heating and cooling ducts (insulate the foundation wall, not the floor, so the ducts remain within the heated and cooled boundary of the home).

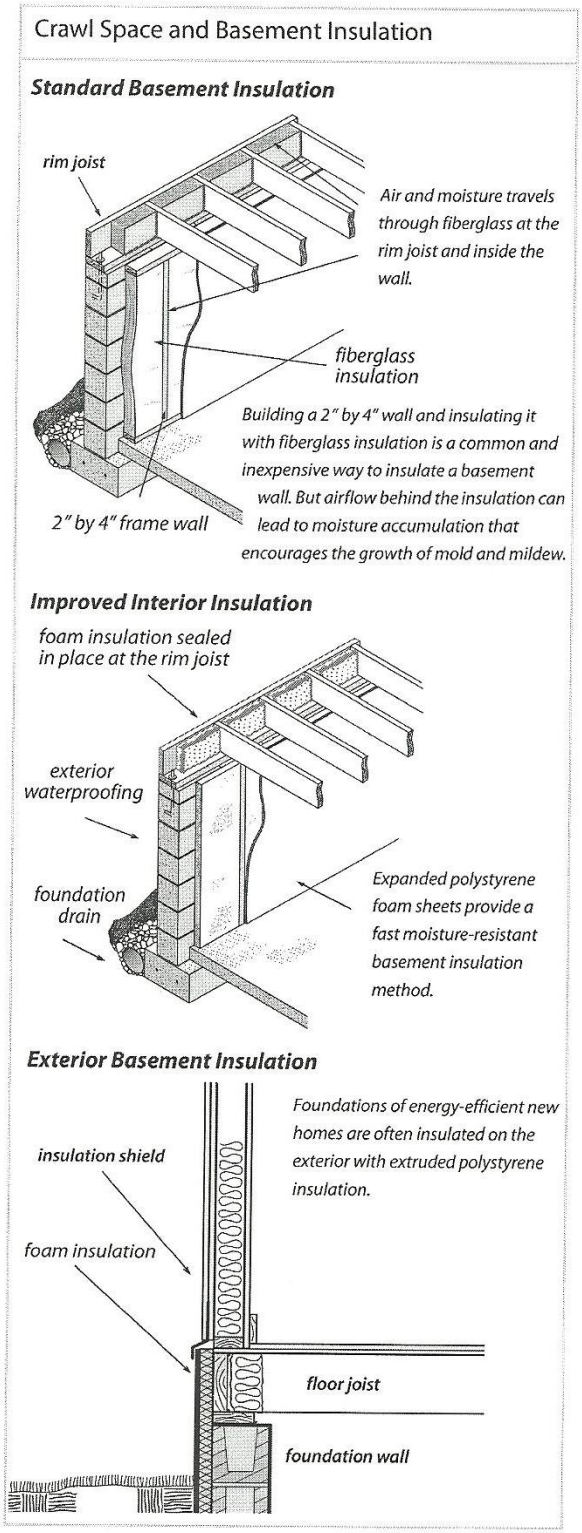
In either case, take steps to control moisture in the crawl space by installing a ground moisture barrier such as polyethylene sheeting over the bare soil, and by sealing the edges and seams with urethane sealant. If moisture is allowed to accumulate in the crawl space or elsewhere in the home, it will encourage the growth of mold, mildew, or rot.

Foundation Insulation

When a house has a heated basement, the basement walls are usually insulated and the floor above the basement isn't insulated. The most common way to insulate basement walls is to build a framed wall against the foundation and fill it with fiberglass batts. The frame is then covered with drywall. This installation creates a moisture trap, however, as moisture can usually find some path into the wall where it can condense into liquid water. This can encourage the growth of mold and mildew.

A better choice for basement wall insulation is polystyrene foam, installed in sheets that are either 1 or 2 inches thick. If installed at the exterior, as during new construction, use durable water-resistant insulation, such as blue or pink extruded polystyrene. You'll also need to provide protection from damage for portions that are exposed above ground level. Sheet metal, fiberglass panels, or troweled-on stucco are usually used to protect this type of installation. If foam board is installed at the interior, as is typical for retrofit applications, the foam is often covered with drywall to provide a finished surface and a fire barrier.

Whether you insulate the floor or foundation wall, you should insulate the rim joist at the same time. Although fiberglass is most commonly used, foam insulation, or a combination of foam insulation and fiberglass, is better because moisture sometimes migrates behind the fiberglass and condenses on the cold rim joist, causing damage from mold or rot. Spraying polyurethane foam in the rim-joist area is now a common practice.



For more energy-saving tips, visit the NCC website at www.savemobile.org

Insulating Values of Construction Materials

Material	Average R-Value
Concrete	0.1 or less
Wood	1.0 to 1.5
Fiberglass batts, standard	3.0
Fiberglass batts, high density	4.0
Fiberglass insulation, blown into open cavity such as an attic	2.3
Fiberglass insulation, blown into closed cavity such as a wall	4.0
Cellulose insulation	3.4
Expanded polystyrene foamboard (white, known as beadboard)	4.1
Extruded polystyrene foamboard (usually blue, yellow, or pink)	5.0
Polyurethane or polyisocyanurate foam (spray application)	4.0 to 7.0

1. Varies according to density.
2. Varies according to density and quality.
3. Varies according to age and formulation.

SEALING YOUR HOME'S AIR LEAKS

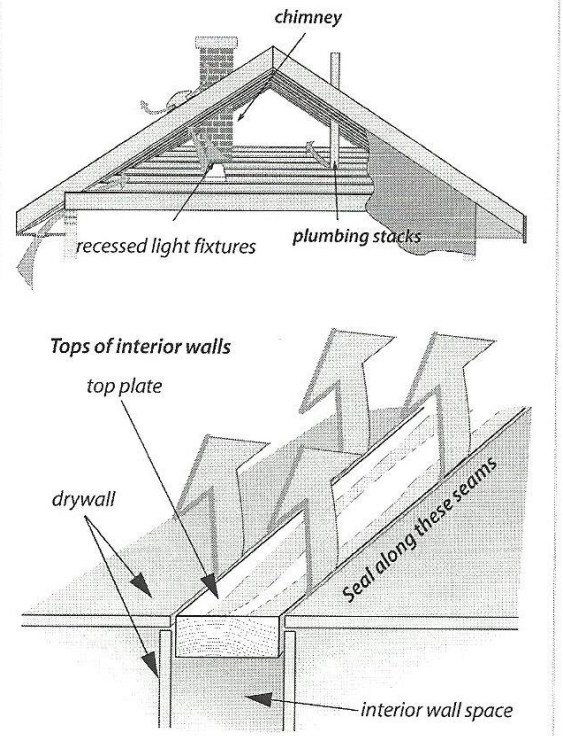
Air leaks in the ceilings, walls, and floors of your home can waste up to 30 percent of the energy consumed by your heating and cooling equipment. Holes and gaps in your home's shell also allow moisture, insects, dust, and pollutants to enter your home. Sealing air leaks reduces this energy loss and also keeps airborne moisture from entering building cavities, where it could encourage the growth of mold and mildew.

The air leakage sites that result in the greatest energy loss often include these locations.

- Recessed light fixtures.
- Penetrations from chimneys, pipes, wires, and electrical boxes through floors and ceilings.
- The perimeter of the floor framing -- rim joist.
- Junctions of exterior walls and floors.
- Gaps between structural framing and door or window frames.
- Leaks into attic through top plates of interior walls.
- Outlets and switches in exterior walls.

You can seal the smallest air leaks with caulking. Moderate size openings are best sealed with one-part canned foam sealants that expand in place. Two-part foams, that are packed in a pair of canisters an furnished with an applicator nozzle, can fill larger gaps. Seal the largest openings, as around plumbing chases in the attic or crawl space, with plywood or rigid-foam insulation.

Sealing Air Leaks in the Attic



Attics harbor a variety of air leaks that draw conditioned air out of your home. The air then passes easily through the fibrous attic insulation. These should be sealed before installing attic insulation to slow heat loss and prevent moisture damage.

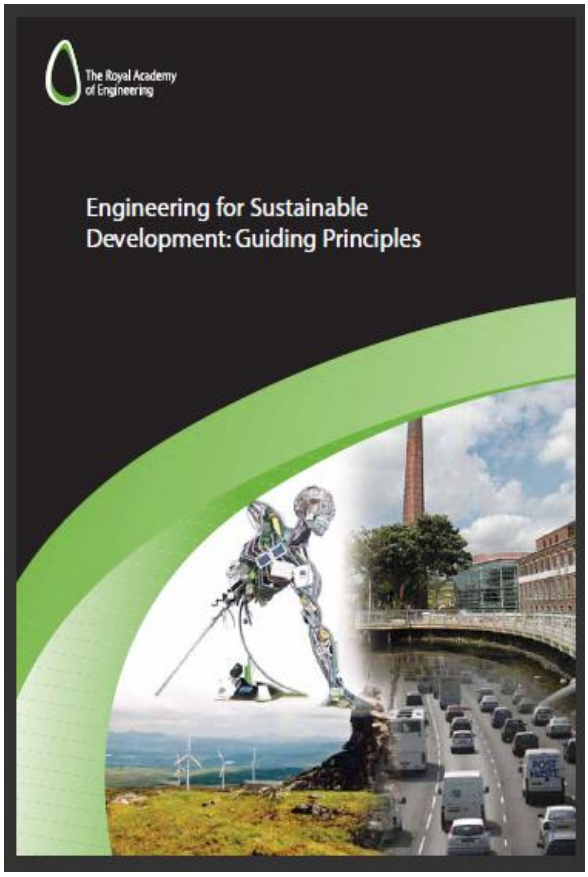
For more energy-saving tips, visit the NCC website at www.savemobile.org

A joint effort of the Alternative Energy Resources Organization (AERO), The S.A.V.E. Foundation, and Saturn Resource Management

11A Relaciones entre distintas partes del texto: Los conectores

Do you know anything about the following concepts? What do you see on the cover of the guide?

- Engineering and sustainabilty
- Sustainable design
- Sustainable development



Retrieved July 29, 2010 from http://www.raeng.org.uk/events/pdf/Engineering_for_Sustainable_Development.pdf

Now read the following definitions connected with sustainability and define the term in Spanish in your own words:

"Sustainability is the optimal balance of natural, economic, and social systems over time."

The Florida Center for Community Design & Research

"A sustainable society is one which satisfies its needs without diminishing the prospects of future generations."

Lester Brown, Founder and President of Worldwatch Institute

Retrieved July 30, 2010 from http://www.cap-lmu.de/fgz/portals/sustainability/definitions.php

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
Page 8, *World Commission on Environment and Development. Our Common Future*. (Oxford, Great Britain: Oxford University Press, 1987). (Frequently referred to as the Brundtland report after Gro Harlem Brundtland, Chairman of the Commission)

Retrieved July 29, 2010 from http://www.sustainablemeasures.com/Sustainability/DefinitionsDevelopment.html

Principles of sustainable development

Economic development is sought by societies not only to satisfy basic material needs, but also to provide the resources to improve the quality of life in other directions, meeting the demand for health care, education and a good environment. Many forms of economic development make demands upon the environment; they use natural resources which are sometimes in limited supply, and generate by-products of pollution and waste.

But there are also many ways in which the right kind of economic activity can protect or enhance the environment. These include energy efficiency measures, improved technology and techniques of management, better product design and marketing, waste minimization, environmentally friendly farming practices, making better use of land and buildings, and improved transport efficiency. The challenge of sustainable development is to promote ways of encouraging this kind of environmentally friendly economic activity, and of discouraging environmentally damaging activities.

Retrieved July 29, 2010 from http://www.ecifm.rdg.ac.uk/sustainable_development.htm

Now, scan the table of contents of the "Engineering for sustainable development: Guiding Principles" Guide and state where you may find the following information:

Information required	**Page number**
What does sustainability mean?	
What are the obstacles connected with sustainability?	
How is sustainability connected with *my* engineering path?	
What are the basic concepts that guide sustainable development?	
Is there information about re-use, recycling and disposal of products?	

Contents

Retrieved July 30, 2010 from http://www.raeng.org.uk/events/pdf/Engineering_for_Sustainable_Development.pdf

Now, this is part of the Introduction section of the "Engineering for sustainable development: Guiding Principles" Guide. Scan the text and identify the information detailed below.

1 Introduction

1.1 Why Engineering for Sustainable Development?

It is increasingly recognised, in public discussion and political discourse, that many of the practices and lifestyles of modern society – particularly **but** not exclusively industrialised society – simply cannot be sustained indefinitely. We are exceeding the capacity of the planet to provide many of the resources we use **and** to accommodate our emissions, **while** many of the planet's inhabitants cannot meet even their most basic needs.

This problem, of recognising the need to live within constraints and to ensure more fairness in access to limited resources, lies at the heart of the concepts of sustainability and sustainable development. It is something new in human history **because** the planet has become full in recent years and we have no new geographical horizons to move to. This Guide is intended to provide an introduction to how sustainability and sustainable development affect the way in which engineering must be practised in future.

Sustainable development is the process of moving human activities to a pattern that can be sustained in perpetuity. It is an approach to environmental and development issues that seeks to reconcile human needs with the capacity of the planet to cope with the consequences of human activities. It is useful to represent the constraints that make sustainable development an imperative in the form of a simple Venn diagram (Figure 2).

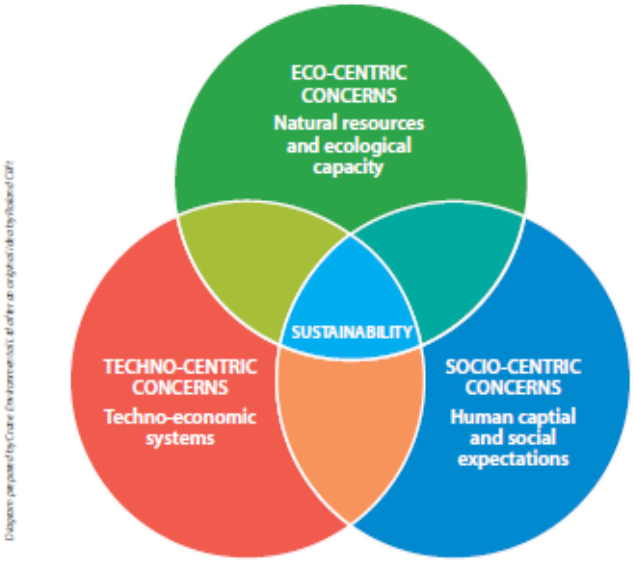
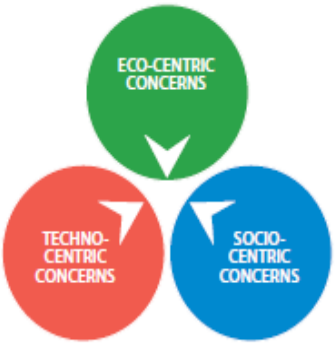


Figure 2a:Three dimensions of sustainability

In the first place, 'Techno-centric concerns', which encompass techno-economic systems, represent human skills and ingenuity – the skills that engineers must continue to deploy – and the economic system within which we deploy them. **Secondly**, 'Eco-centric concerns' represent the ability of the planet to sustain us – ***both*** by providing material ***and*** energy resources and by accommodating us and our emissions and wastes. **Finally**, 'Socio-centric concerns' represent human expectations and aspirations – the needs of human beings to live worthwhile lives, summed up by the phrase in the UK Government's interpretation of sustainable development as 'a better quality of life for everyone, now and in the future'.



Sustainability can be thought of as the region in the centre of Figure 2a where all three sets of constraints are satisfied, **whereas** sustainable development is the process of moving to that region. **As well as this**, sustainable development can be thought of as the process of moving the circles together in a way that they almost completely overlap but with the societal and techno-economic circles within the environmental circle, at which point all human activity is sustainable – see Figure 2b.

Although Figure 2 is simplistic, it reminds us that sustainability means living within all three types of long-term constraint: technology cannot be deployed **as though** it has no environmental or societal implications. **Therefore**, engineers must be key players in sustainable development, and have an obligation as citizens not just to act as isolated technical experts. Achieving sustainability through sustainable development will require some significant shifts in behaviour and consumption patterns. Often it will be – and should be – engineers who lead processes of making decisions about the use of material, energy and water resources, the development of infrastructure, the design of new products and so on. **Consequently**, engineers must recognise and exercise their responsibility to society as a whole, which may sometimes conflict with their responsibility to the immediate client or customer.

Engineers will still be called on to design and manage complex systems, or simple systems to meet complex sets of demands. **However**, sustainable development redefines the contexts within which these skills must be deployed. It is a new integrative principle, not a new set of tools, **so that** the concept cannot simply be regarded as an 'add-on' to existing engineering skills and educational programmes. This Guide is aimed at providing a set of Guiding Principles and understanding to help promote more-sustainable design and guide their application in the practice of engineering, illustrated through summaries of selected real-life examples.

a- Reason for the need of sustainable development.
b- Purpose of the Guide.
c- Definition of sustainable development.
d- Three areas involved in the concept of sustainability.
e- The role of engineers within sustainable development.

Now, using the list of connectors in APPENDIX 3 and APPENDIX12 state the general meaning of the connectors highlighted in the text and comment on the relationship based on the contents.

Connector	**Line #**	**Adición**	**Contraste**	**Resultado/ consecuencia**	**Propósito/ Finalidad**	**Causa/ Razon**	**Manera / Compa-ración**	**Tiempo/ Secuen-cia**	**Relación entre las partes unidas**
but	2								
and	4								
while	5								
because	9								
In the first place	18								
Secondly	21								
both…and	22								
Finally	23								
whereas	30								
As well as this	31								
Although	36								
as though	38								
therefore	39								
Consequentl y	46								
However	50								
so that	53								

Los conectores

Los conectores son palabras que cumplen la función de conectar distintas partes del texto para que el mismo sea cohesivo y coherente. Estas palabras que facilitan la transición de una idea a la otra, pueden conectar ideas dentro de una misma oración o ideas en oraciones separadas. Para ejemplificar:

- Conectores uniendo ideas dentro una misma oración:

We are exceeding the capacity of the planet to provide many of the resources we use **and** to accommodate our emissions, **while** many of the planet's inhabitants cannot meet even their most basic needs. (linea 3)

- Conector uniendo ideas en oraciones separadas:

Often it will be – and should be – engineers who lead processes of making decisions about the use of material, energy and water resources, the development of infrastructure, the design of new products and so on. **Consequently**, engineers must recognise and exercise their responsibility to society as a whole, which may sometimes conflict with their responsibility to the immediate client or customer. (linea 43)

Aunque la ocurrencia no está ejemplificada en el texto de arriba, hay conectores que van más allá de los límites de las oraciones y tienden a unir distintas partes -párrafos- del texto para darle una organización lógica al mismo. Cuando éste es el caso, se utilizan expresiones que claramente marcan la secuencia de cada parte del texto como por ejemplo cuando decimos *Por un lado,….. Por otro lado,…. En conclusión, …..* con cada una de estas frases introduciendo párrafos que apuntan a un cierto momento de la discusión.

Si bien los conectores en el APÉNDICE 3 están agrupados de acuerdo con el significado que expresan, cabe aclarar que se podrían separar en las dos categorías expresadas anteriormente: los que unen ideas dentro de una misma oración y los que unen ideas en oraciones separadas. Para el alumno de lectura en lengua extranjera, es suficiente con reconocer el significado de estas expresiones y darle el valor correspondiente en castellano sin preocuparse por esta diferenciación.

Para repasar: ¿Qué conector podría reemplazar al que está en la oración original?

1- We are exceeding the capacity of the planet to provide many of the resources we use and to accommodate our emissions, **whereas/when/because** many of the planet's inhabitants cannot meet even their most basic needs. (linea 3)
2- It is something new in human history **while/since/whereas** the planet has become full in recent years and we have no new geographical horizons to move to. (linea 9)
3- …process of moving to that region. **Firstly/ However/ Moreover**, sustainable development can be thought of as the process of moving the circles together in…. (linea 31)
4- **Even though/When/If** Figure 2 is simplistic, it reminds us that sustainability means living within all three types of long-term constraint… (linea 36)
5- ….simple systems to meet complex sets of demands. **Moreover/Nevertheless/Finally**, sustainable development redefines the contexts….. (linea 50)

11B Over to your Career Path

Activity 1: Read the title and look at the pictures. What is this text about?

Activity 2: Match the heading to a part in the text.

a- Passive cooling
b- Natural ventilation
c- Rainwater catchment
d- Renewable energy
e- Sewage recycling
f- Green roofs and façades

ECOHOUSE BRAZIL

by Sarah Rich, 12/23/05
filed under: Architecture, Sustainable Building

In the Urca neighborhood near the base of Sugarloaf mountain and the shores of Rio de Janeiro, architect Alexandra Lichtenberg carried out a remodeling project that demonstrates that being green isn't the exclusive domain of high-cost, luxury residences and backwoods. A good green remodel is within reach of the average well-intentioned homeowner in the average urban neighborhood anywhere in the world, and the EcoHouse proves it.

The EcoHouse Project was intended to provide not only a more eco friendly environment for its inhabitants, but also a tool for evaluating comfort levels within ecologically-enhanced and highly efficient thermal, water and lighting systems. The architect's goal was to create comparable or better amenities in the home while improving the ecological impact. In the hot, humid climate of Rio, the house served as a case example for similar climates worldwide.

Below is an overview of the various aspects of the remodel. Any one of these is available to homeowners at minimal cost, and most are just as easily implemented in an existing building as in a new home.

1._____

This is one of the most sensible things that can be done to increase home water efficiency as well as to reduce water pollution and store rainwater in neighborhoods. Most rainfall runs over impermeable urban surfaces straight into storm drains without ever being used, which – given the ease and benefits of collecting it – is an unnecessary waste.

In the EcoHouse, a concrete cistern collects rain from the roof and patio, which flows through a gravity-driven mechanical filter. It is then pumped to the recycled water tank located on the highest green roof, and distributed by gravity to toilets, garden irrigation system, and faucets used for non-potable water. In the first year, the system accounted for 28% of the total water use of the house.

2. _____

Even the most hardcore environmentalists sometimes do not want to deal with grey water and sewage. However, there are a number of well-designed compact sewage treatment systems that make residential water reuse easy and clean. A Brazilian company called Mizumo provided a test system for the Ecohouse Urca Project. Intended for small urban lots, it measures 1.20m x 2.60m x 2.10m. The system is meant to provide water for the same non-potable uses as the rainwater system. Before it is pumped to the water tank on the green roof, the water undergoes sand and UV light filtration to eliminate any remaining impurities.

3. _____

The best way of achieving passive heating and cooling is through well-planned orientation of a house on its site. Nevertheless, with existing buildings, there are other ways to make use of passive technologies, such as strategic placement of shade trees, extension of eaves and overhanging roofing, and window glazing. Keeping the walls, windows and roof of the house cool by deflecting or avoiding direct sunlight, the inside stays cooler, as well, without A/C or other high-energy systems.

4._____

Green roofs enhance passive cooling capacities, absorb rainwater, and offer another usable outdoor space for residents – a perfect spot for cultivating a garden. The EcoHouse's old ceramic tile roof was replaced by green roofs, using mostly grass and cooking herbs. Moreover, all northwest-facing facades were fitted with an aluminum trellis in order to protect the outside walls from sun exposure. A vigorous vine will climb the trellis and create a shield to absorb most of the direct radiation that would hit the walls.

5. _____

Natural ventilation is another component that is often best installed during the initial building process of the home, when operable skylights and windows can be designed into the building. For the EcoHouse remodel, the architect did a reconfiguration of the internal layout to allow for natural ventilation because air circulation is vitally important, not only to reduce heating and cooling costs, but for the health of the inhabitants. Keeping a good inflow of fresh air enhances the interior atmosphere so that it never feels stuffy or stagnant.

6._____

Two solar systems heat all the hot water in the house, both working in a passive thermosiphon system, which takes advantage of gravity and eliminates the need to pump liquids around the house. Normally, solar panels mounted on the roof heat water in a tank several floors below, which means that the liquid needs to

be pumped to the roof for heating. On the other hand, in a thermosiphon system, the tank is on the roof, placed above the solar collector.

As the temperature of the heat-transfer fluid increases, its density decreases. The fluid rises, causing natural convection, which permits passive circulation in the pipes. In the EcoHouse, one of the two solar systems has an electrical backup source. The other functions completely on solar.

Retrieved and adapted from

Activity 3: Choose the idea that matches the original one in the text.

a- ….Lichtenberg carried out a remodeling project that demonstrates that being green isn't the exclusive domain of high-cost, luxury residences and backwoods off-grid dwellings. (line 2)

1- The project is important **since** it shows that you can build green without being rich.
2- The project is important to the building industry. **However**, it is impossible to carry it out.

b- The EcoHouse Project was intended to provide not only a more eco friendly environment for its inhabitants, but also a tool for evaluating comfort levels within ecologically-enhanced and highly efficient thermal, water and lighting systems. (line 6)

1- The project was intended to provide a better environment for its inhabitants with ecologically-enhanced and highly efficient thermal, water and lighting systems.
2- The project was intended to provide **both** a better environment for its inhabitants **and** a tool for evaluating comfort levels.

c- Most rainfall runs over impermeable urban surfaces straight into storm drains without ever being used, which-given the ease and benefits of collecting it- is an unnecessary waste. (line 14)

1- It is easy to collect rainwater and it presents many benefits. **Nevertheless**, most rainfall runs over impermeable urban surfaces straight into storm drains without ever being used.
2- It is easy to collect rainwater **when** it runs over impermeable urban surfaces straight into storm drains.

d- Before it is pumped to the water tank on the green roof, the water undergoes sand and UV light filtration to eliminate any remaining impurities. (line 25)

1- **First**, the water is pumped to the water tank on the green roof. **Then**, it undergoes sand and UV light filtration to eliminate any remaining impurities.
2- **First**, the water undergoes sand and UV light filtration to eliminate any remaining impurities. **Then**, it is pumped to the water tank on the green roof.

e- The best way of achieving passive heating and cooling is through well-planned orientation of a house on its site. Nevertheless, with existing buildings, there are other ways to make use of passive technologies…(line 27)

1- **Although** the best way of achieving passive heating and cooling is through well-planned orientation of a house on its site, there are other ways to make use of passive technologies…
2- The best way of achieving passive heating and cooling is through well-planned orientation of a house on its site. **According to this**, with existing buildings, there are other ways to make use of passive technologies…

f- … all northwest-facing facades were fitted with an aluminum trellis in order to protect the outside walls from sun exposure (line 34)
   1- …. all northwest-facing facades were fitted with an aluminum trellis **when** they protected the outside walls from sun exposure
   2- ….all northwest-facing facades were fitted with an aluminum trellis **so as to** protect the outside walls from sun exposure

g- Keeping a good inflow of fresh air enhances the interior atmosphere ….(line 41)
   1- **If** a good inflow of fresh air is kept, the interior atmosphere is enhanced.
   2- **Even though** a good inflow of fresh air is kept, the interior atmosphere is enhanced.

h- Normally, solar panels mounted on the roof heat water in a tank several floors below, which means that the liquid needs to be pumped to the roof for heating. On the other hand, in a thermosiphon system, the tank is on the roof, placed above the solar collector. (line 45)
   1- **Whereas** most usually solar panels mounted on the roof heat water in a tank several floors below, in a thermosiphon system, the tank is on the roof, placed above the solar collector.
   2- Normally, solar panels mounted on the roof heat water in a tank several floors below, which means that the liquid needs to be pumped to the roof for heating. **As well as this**, in a thermosiphon system, the tank is on the roof, placed above the solar collector.

Activity 4: State the general meaning of the highlighted linking expressions in 3. Choose from the following categories:

ADICIÓN
CONTRASTE
CONDICIÓN
TIEMPO Y SECUENCIA
CAUSA/RAZON
PROPÓSITO/FINALIDAD
RELACIÓN

Activity 5: Complete the following ideas with information from the text.

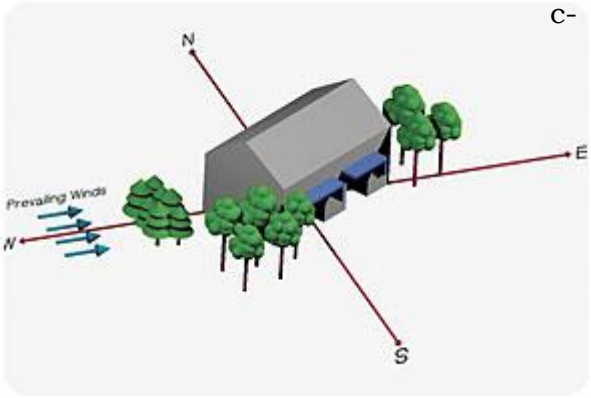
a- Al trabajar en el proyecto, la arquitecta tenía como objetivo……
b- La recuperación de agua de lluvia resulta positivo porque….
c- El agua que proviene del alcantarillado pasa por un proceso en el que….
d- Para obtener confort termal en casa ya construidas se puede…
e- Para calentar el agua se utiliza….

Review Section 5

Activity 1: Look at the following pictures. What do they show? Match the headings to the pictures. Comment on what you know about them.

1- Green roofs
2- Grey water systems
3- Green buildings
4- The siting of a building

a-

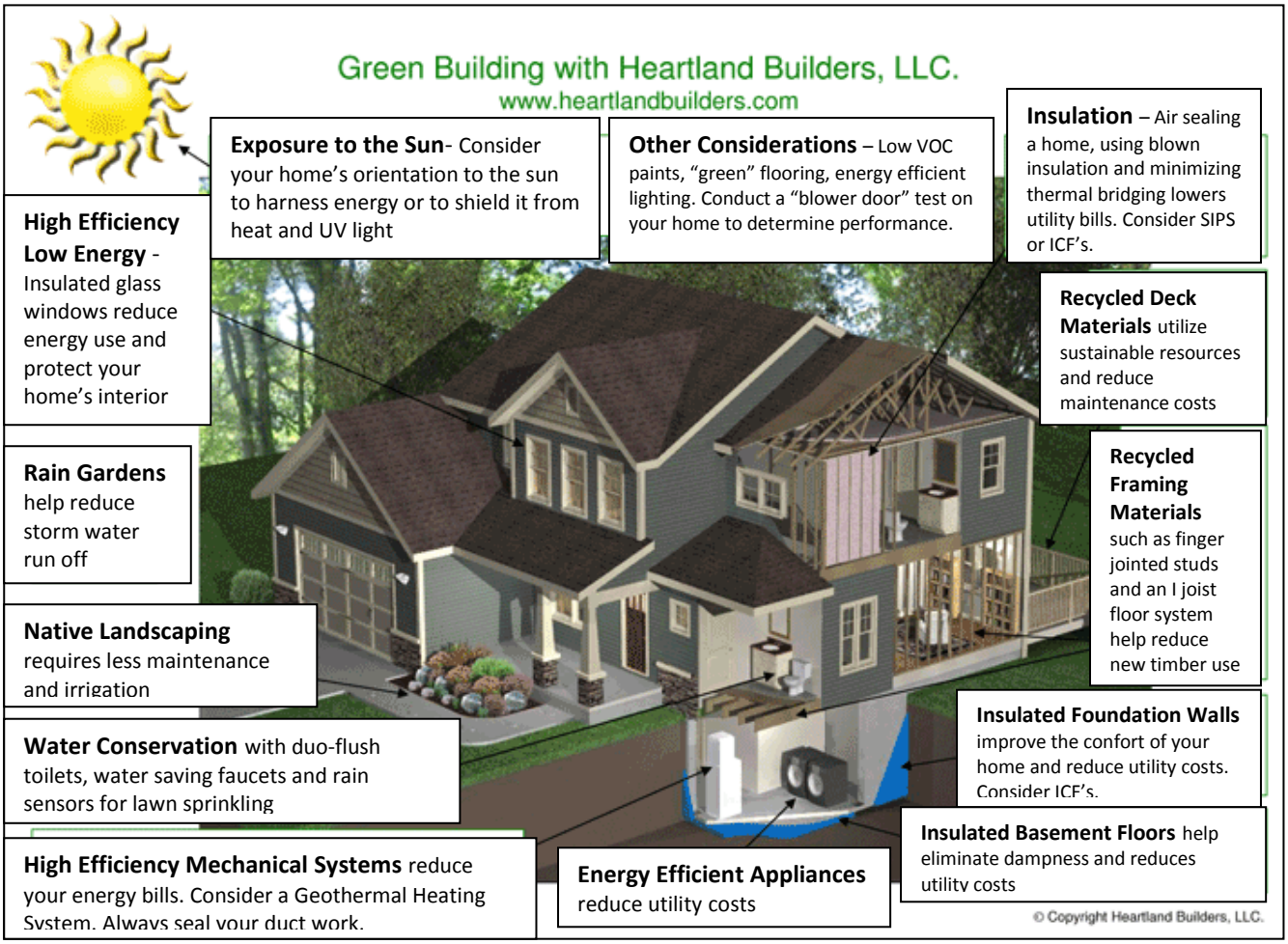


c-

b-

d-

Activity 2: Look at the following picture and comment on it.



Retrieved and adapted January 21, 2011 from http://www.heartlandbuildersllc.com/green_building.htm

Activity 3: Scan the text and choose the best title for it.

a. Green efficiency and energy building
b. Green building and energy efficiency
c. Building efficiency and green energy

Title: _____

Green building (also known as **green construction** or **sustainable building**) is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. **P1**

Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by: **P2**

- Efficiently using energy, water, and other resources **P3**
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environmental degradation

A similar concept is natural building, which is usually on a smaller scale and tends to focus on the use of natural materials that are available locally. Other related topics include sustainable design and green architecture. Green building does not specifically address the issue of retrofitting existing homes such as the *Epositivehome* project. **P4**

Green buildings often include measures to reduce energy use. To increase the efficiency of the building envelope, (the barrier between conditioned and unconditioned space), they may use high-efficiency windows and insulation in walls, ceilings, and floors. Another strategy, passive solar building design, is often implemented in low-energy homes. Designers orient windows and walls and place awnings, porches, and trees to shade windows and roofs during the summer while maximizing solar gain in the winter. In addition, effective window placement (daylighting) can provide more natural light and lessen the need for electric lighting during the day. Solar water heating further reduces energy loads. **P5**

On-site generation of renewable energy through solar power, wind power, hydro power, or biomass can significantly reduce the environmental impact of the building. Power generation is generally the most expensive feature to add to a building. **P6**

Retrieved September 2, 2010 from http://en.wikipedia.org/wiki/Green_building

Activity 4: Where are the following topics discussed?

	Topic	**Paragraph**
a-	Definition of green building	
b-	Actions that can be taken to reduce the impact of construction on people and the planet	
c-	The stages in a building's cycle of life	
d-	Possible actions that can be taken to reduce the use of energy	
e-	Definition of natural building	

Activity 5: Focus on the following topics and comment on them in a paragraph in Spanish.

a- What is green building?

b- What are the stages involved in a building's cycle of life?

c- What is natural building?

Activity 6: Choose the best option:

a- "This practice" on line 4 refers to
   1. creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle.
   2. creating structures
   3. using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle

b- Green buildings are designed to obtain
   1. a reduction in the built-environment impact on people and the planet.
   2. environmental impact on people and the planet.
   3. environmentally friendly people.

c- Natural building is
   1. not very different from green building.
   2. exactly the same as green building.
   3. totally different from green building.

d- Many people use high-efficiency windows and insulation in walls, ceilings and floors.
   1. However, the building envelope is improved.
   2. In this way, the building envelope is improved.
   3. Nevertheless, the building envelope is improved.

e- The orientation of windows and walls brings thermal comfort
   1. in the summer.
   2. in the winter.
   3. in summer as well as winter.

Activity 7: Choose the best option.

a- **If/However/Although** buildings make efficient use of energy, water and other resources, they help reduce the impact of the built-environment on the planet.
b- The planet is **also/firstly/however** helped when there is a reduction in waste, pollution and environmental degradation.
c- Renewable energy generation in a building helps reduce the environmental impact of the building. **However,/Moreover,/Finally,** its installation is not cost-effective.
d- Effective window placement can provide more natural light **but/or/as well as** reduce the need for electric lighting during the day.

Activity 8: Answer these questions in Spanish.

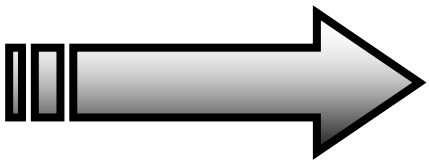
a- How can energy be reduced in green buildings?

b- What does “passive solar building design” mean (line 17)? What is it used for?

Activity 9: Choose the best option.

1	placement (sust – línea 24)	***colocación / ubicación/ localización***
2	address (verbo – l. 17)	tratar /direccionar /comentar
3	awning (sust – l. 22)	***techo/alero/toldo***
4	building envelope (frase sust – l. 19)	sobre de construcción /sobre del edificio/envolvente del edificio
5	concern (sust – l. 5)	***cuestión, dilema/inquietud, interés, preocupación / valoración, apreciación***
6	conditioned (adj – l. 19)	diseñado/acondicionado/restaurado
7	current (adj – l. 7)	de actualidad, vigente / corriente, común / corriente eléctrica

8	deconstruction (sust – l. 4)	diseño/deconstrucción/adecuación
9	measure (sust – l. 18)	detalle / medida / cinta
10	green building (frase sust – l.1)	construcción ecologica / construcción verde / construcción artificial
11	high efficiency window (frase sust- l. 20)	ventana de alta eficiencia / ventana altamente eficiente / alta eficiencia de ventana
12	issue (sust – l. 17)	dilema, problema/asunto, tema, cuestión / apreciación, valoración
13	low energy home (frase sust – l. 21)	***hogar de baja o poca energía / hogar energéticamente bajo / hogar con poca energía***
14	natural building (frase sust – l. 14)	edificio natural/construyendo naturalmente/construcción natural
15	on-site generation (frase sust – l. 27)	***generación lugareña/generación in-situ / generación de sitio***
16	passive solar building design (frase sust – l. 21)	***diseño*** de ***construcción solar pasiva / construyendo diseños solares pasivos/ diseño de construcción pasivamente solar***
17	resource efficient (adj – l. 3)	***recurso eficiente/eficiente en el uso de recursos/ eficiente en el suministro***
18	retrofit (verbo – l. 17)	modernizar, reconstruir/destruir, derrumbar/diseñar, planificar
19	shade (verbo – l. 23)	***proteger de la luz solar /sombrear/ proteger de la sombra***
20	siting (sust –l. 3)	***emplazamiento/situación/yacimiento***
21	solar water heating (frase sust – l. 25)	calentando el agua solarmente/calentamiento solar del agua/calentando agua solar



APÉNDICE 1

Referencia: Unidad 2A, sección *Falsos cognados*

Glosario de falsos cognados en material para la ingeniería

1	actual	real, verdadero, genuino
1	actually	en realidad,
2	alteration	ajuste, modificación, arreglo
3	apparent	obvio, evidente
4	argue	discutir, argumentar
5	argument	discusión
6	approve	estar de acuerdo, aprobar
7	brave	valeroso
8	cargo	carga (transporte)
9	college	universidad
10	comprehensive	integral
11	design	diseño
12	dispose	desechar
13	disposable	desechable
14	editor	corrector de estilo
15	educated	culto
16	education	estudios
17	equipment	equipo
18	elaborate	explicar con detalles
19	exciting	emocionante
20	expedient	oportuno
21	fabric	tela
22	facilities	instalaciones
23	figures	cifras
24	foundation	basamento
25	fund	financiar
26	grass	pasto
27	guard	proteger,
28	habitation	vivienda
29	idiom	expression idiomática
30	import	importación
31	labor	trabajo
32	major	importante
33	peculiar	raro, extraño
34	presume	suponer
35	presently	actualmente
36	promotion	ascenso
37	qualification	capacidad, antecedentes
38	realize	darse cuenta
39	record	registro, registrar, grabar
40	relate	relacionar
41	remark	hacer un comentario, comentar, mencionar
42	revise	modificar, actualizar
43	revision	modificación
44	summary	resumen
45	ultimately	a la larga, con el tiempo
46	utilities	servicios esenciales (public utilities)

APÉNDICE 2

Referencia: Unidad 3A, sección *La morfología del sustantivo*

Procesos de formación de palabras

Toda lengua incorpora nuevas palabras a medida que surge la necesidad de comunicar nuevos conceptos. La formación de palabras a través de prefijos y sufijos (la derivación) es sólo uno de los procesos posibles para generar nuevas incorporaciones en la lengua. A continuación se detallan otros procesos:

1- **Recorte**: una palabra larga es recortada, manteniendo el significado de la palabra original: *Mathematics, Math* (BrE)/*Maths* (AmE).

2- **Incorporación**: este proceso se refiere a la incorporación de palabras provenientes de otras lenguas, resultando en la aparición de cognados: *Alegbra, Geometry, Physics*.

3- **Creación**: este proceso se manifiesta de manera espontánea cuando se necesita crear una palabra que describa un nuevo concepto: *Internet*.

4- **Recorte y Combinación**: a través de este proceso dos palabras son recortadas y combinadas para dar lugar a una nueva palabra que combina los significados de los dos elementos en cuestión: pixel (picture-element. Nota: la grafía de *pix* hace referencia al recorte de la palabra *pictures* a *pics*, comúnmente usada en inglés).

5- **Formación de acrónimos**: estas palabras se forman utilizando la primera letra (a veces primeras letras) de una expresión larga para formar una sola palabra: HTML /ˌeitʃˌti:ˌemˌel/, URL /ɜ:rl/, JPEG /ˈʤeipəg/. La pronunciación de estas palabras puede varias puesto que hay veces que se pronuncian como una sola palabra, haciendo sonar cada letra o de las dos maneras, como es el caso de URL.

6- **Composición**: este proceso hace referencia a la unión de dos (o más) palabras para formar una palabra compuesta. El significado de la misma usualmente guarda estrecha relación de significado con las palabras por separado, pero algunas veces se hace difícil interpretarlo. Distintas clases de palabras pueden formar estas palabras compuestas (sustantivo + sustantivo, adjetivo + sustantivo, adverbio + adjetivo, adverbio + verbo, sustantivo + verbo) y su función variará de acuerdo con la posición en la oración (adjetivo, sustantivo, verbo). Una característica común de estos compuestos es que suelen estar unidos por un guión (-), especialmente cuando cumplen la función de modificadores del sustantivo. Entonces tenemos:

   - The *air conditioner* is on. (sustantivo + sustantivo en función de sustantivo)
   - They sell *central heating* devices (adjetivo + sustantivo en función de adjetivo = modificador del sustantivo)
   - It is a *year-long* project. (sustantivo + adjetivo en función de adjetivo)
   - They *mass-produce* fly ash concrete for the construction of …. (sustantivo + verbo en función de verbo)

   Aunque las palabras compuestas son expresiones fijas, hay multiplicidad de posibles combinaciones y, dada la naturaleza productiva de este aspecto de la lengua inglesa, se crean nuevos términos constantemente.

APÉNDICE 3

Referencia: Unidad 3A, sección *La frase nominal*

Clases de Palabras[1]

Sustantivo

Clase de palabra con género inherente que puede funcionar sola, o con algún determinante, como sujeto de la oración.

Sustantivos				
Comunes				Propios
Contables		Incontables		
Concretos	Abstractos	Concretos	Abstractos	
Dog Box	Difficulty Worry Fear	Iron Steel Bread	Music Homework Love	John Paris London Argentina

Adjetivo

Que califica o determina al sustantivo.

En inglés, no podemos determinar si una palabra es un adjetivo si se nos presenta en forma aislada, ya que la forma de la palabra no necesariamente indica su función. Sin embargo, hay cuatro aspectos que caracterizan al adjetivo. Ellos son:

(1) Puede premodificar a un sustantivo.
Ej.: *flexible materials*. (materiales **flexibles**)

(2) Puede aparecer en el predicado.
Ej.: *These new sources of energy are beneficial***.** (Estas nuevas fuentes de energía son **beneficiosas**.)

(3) Puede estar premodificado por un intensificador.
Ej.: *These components are* ***very cost-effective***. (Estos componentes son ***muy rentables***.)

(4) Puede aparecer en sus formas compartiva y superlativa.
Ej.: *Some materials are stronger than others.* (Algunos materiales son ***más resistentes*** que otros)
These components are the strongest of all. (Estos comoponentes son los **más resistentes** de todos.)

[1] Las definiciones de este apéndice fueron extraídas de http://buscon.rae.es/draeI/ en abril de 2010.

Verbo

Clase de palabras que expresa una acción y puede tener variación de persona, número, tiempo, modo y aspecto.

Adverbio

Palabra invariable cuya función consiste en complementar la significación del verbo, de un adjetivo, de otro adverbio y de ciertas secuencias. Hay adverbios:

- de lugar, como *aquí, delante, lejos;*
- de tiempo, como *hoy, mientras, nunca;*
- de modo, como *bien, despacio, fácilmente;*
- de cantidad o grado, como *bastante, mucho, muy;*
- de orden, como *primeramente;*
- de afirmación, como *sí;*
- de negación, como *no;*
- de duda o dubitativos, como *acaso;*
- de adición, como *además, incluso, también;*
- de exclusión, como *salvo, tampoco.*

Algunos pertenecen a varias clases.

Conjunción o conector

Palabra invariable que encabeza diversos tipos de oraciones subordinadas o que une vocablos o secuencias sintácticamente equivalentes. Elemento que pone en conexión diferentes partes de un texto o diferentes textos (ver APÉNDICE 12 para trabajar sobre el significado de los conectores que se presentan debajo)

Algunos Conectores en Inglés

ADICIÓN (utilizados para unir dos o más ideas dentro de una oración o dos oraciones)

also
and
as well
as well as
besides
furthermore
in addition
moreover
not only ...but also
too
similarly
or
either…or…
neither….nor…

CONTRASTE (para expresar que la información que se presenta se contrapone con otra idea expresada anteriormente)

although, though
but
even so
however
nevertheless
on the contrary
on the other hand
whereas
despite
while, whilst

TIEMPO y SECUENCIA

afterwards
at the same time
beforehand
ever since

finally
finally, lastly, at last
first, firstly
meanwhile
then, after that

CONDICIÓN (de condición):

if
unless
as long as
in that case
otherwise

PROPÓSITO, FINALIDAD

in order that
in order to
so that
to
to that end

CAUSA/RAZON

accordingly
as
as a result of
because
because of
due to, owing to
hence
since
thereby
therefore
thus
for

RESULTADO

so
so that
consequently
thus
as a result of
therefore

MANERA/COMPARACIÓN

as
as if
as though
like
likewise
thus

EXPLICATIVOS, EJEMPLIFICATIVOS

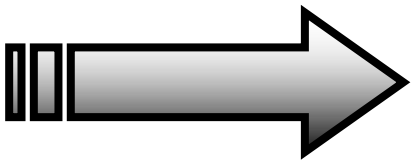
in other words
that is (i.e.)
for example (e.g.)
for instance
according to this

Preposición

Palabra invariable que introduce elementos nominales u oraciones subordinadas sustantivas haciéndolos depender de alguna palabra anterior.

Algunas Preposiciones en Inglés

about : acerca de **above :** por encima de according to **across** : a través de, enfrente de , de un lado a otro **across from** : en frente de **after :** despues **against :** contra **ahead of** : delante de **along :** a lo largo de **alongside** a lo largo **along with:** junto con **among** entre, en medio de **apart from :** aparte de **around** : alrededor **as :** como, a medida que **as for :** en cuanto a **aside:** aparte, al margen **aside from :** lejos de, aparte **as to** : en cuanto a, respecto a **at** : en , a **away from**: lejos de , aparte **because of** : por , debido a **before :** ante **behind** : detrás **below** : debajo de **beheath** debajo de, inferior a **beside :** al lado **besides** : además **between** : entre **but** : pero **by:** por, de, a, junto a **by means of :** mediante, por medio de **contrary to:** en oposición a, en contra de **despite :** a pesar de **down** : abajo **due to** : debido a	**during:** durante **except for:** si no fuera por, a no ser por, **excepting:** a excepción de, **excluding** excepto **following** siguiente **for :** por , para **from :** desde **in :** en **in between** : entre medio **in favour of** : a favor de **in front of :** delante de **inside:** dentro de **in spite of :** a pesar de **instead of :** en vez de **into :** en **like:** como, a manera de **minus:** menos **near :** cerca **near to** : cerca de **next to** : al lado de **of** : de **off:** de, desde, a, lejos de **on account of:** debido a, por **onto** : sobre **on top of :** sobre **opposite** : enfrente de **opposite to :** contrario a , opuesto a **other than :** aparte de **out of:** fuera de **outside**: fuera, afuera **outside of:** fuera de **over :** por encima de **owing to** : debido a	**per** : por **plus** : más **prior to** : previo a **regarding** respecto a r**egardless of** sin importar **save for:** excepto, salvo por **since** : desde ,ya que **than:** que (comparación) **thanks to:** gracias a **till :** hasta **through:** a través, de un lado a otro **throughout:** durante todo **together with**: junto con **toward** : hacia **towards** : hacia **under** : abajo **underneath** : debajo de **unlike** : a diferencia de **until** : hasta **unto** **up :** hacia arriba **up to** : hasta **up and down:** de un lado a otro **with** : con **within** : dentro de, adentro de, al alcance de **without** : sin. fuera de, afuera, de, más allá de

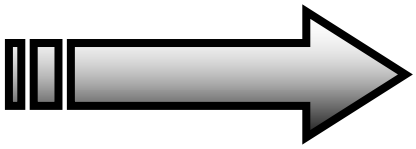


APÉNDICE 4

Referencia:
Unidad 3A

Modificadores del sustantivo: Determinantes

1	a kind of	un tipo de
2	a piece of	un pedazo/ porción/ trozo de
3	a sort of	una clase/tipo de
4	a type of	una tipo de de
5	all	todo/a, todos/as
6	another	otro/a
7	any	alguna, ninguno/ ninguna (al negar)
8	both	ambos, los dos, ya sea uno y el otro
9	each	cada (tomados en particular)
10	either	cualquiera (de dos), ninguno (al negar)
11	every	cada (significando todos)
12	few	pocos (plural)
13	little	poco
14	most	la mayoría, la mayor parte de
15	neither	ninguno de los dos, ni el uno ni el otro
16	not many	no muchos
17	not much	no mucho
18	other	otro/a, otros/as
19	several	varios
20	some	algo de (singular)
21	some	algunos / algunas (plural)
22	such	tal
23	such	tal, tales
24	that	ese, esa, eso; aquel, aquella/o (singular)
25	these	estos, estas (plural)
26	this	este, esta, esto (singular)
27	those	esos, esas; aquellas/os (plural)
28	various	varios



APÉNDICE 5

Referencia: Unidad 3A, sección *La morfología del sustantivo*

La formación de sustantivos en plural

Aunque la formación de sustantivos en plural es un proceso simple, hay ciertas variaciones a tener en cuenta. En la clase de Inglés I se espera que el alumno pueda reconocerlas para facilitar su interpretación como así también la búsqueda de palabras en el diccionario.

1- Generalmente, el plural se forma agregando el sufijo **–s** a la palabra:
metal –metal**s**
computer – computer**s**

2- Si la palabra termina en *'sh', 'x', 'ch'* o 's' el sufijo es **–es**:
brush – brush**es**
glass – glass**es**
box – box**es**
church - church**es**
bus – bus**es**

3- En los sustantivos que terminan en consonante seguida de una 'y', se elimina la 'y' y el sufijo se vuelve **–ies**:
country – countr**ies**
story – stor**ies**

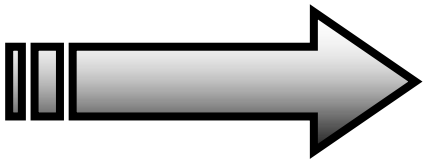
4- Los sustantivos que terminan en vocal seguida de una 'y' sólo agregan el sufijo **–s**:
alloy – alloy**s**
buoy – buoy**s**

5- Los sustantivos terminados en 'f' o en 'fe' al pasar al plural se cambia la 'f' o la 'fe' por el sufijo **–ves**:
half – hal**ves**
turf – tur**ves**
life – li**ves**

6- Algunos sustantivos terminados en 'o' agregan el sufijo **–es**:
echo – echo**es** *pero decimos* photo - photo**s**
embargo – embargo**es** radio – radio**s**

7- Hay algunos sustantivos que tienen plurales irregulares:
man – **men**
datum – **data**
axis – **axes**
phenomenon – **phenomena**
criterion - **criteria**

Información obtenida de *Collins Cobuild English Grammar*. (1994). London: Harper Collins Publishers.



APÉNDICE 6

Referencia: Unidad 4A, sección *Los afijos y sufijos*

Adjetivos Comparativos y Superlativos

En la lengua inglesa, los adjetivos calificativos no tienen plural ni género, y se colocan siempre delante del sustantivo. Los adjetivos, y también es el caso de los adverbios, pueden agregar sufijos (en el caso de ser cortos) o more/most (en el caso de ser largos) para indicar comparación. Esta comparación se puede dar de dos maneras, ya sea a través de lo que llamamos comparativos o de los denominados superlativos.

Comparativos en adjetivos largos

Utilizamos estas estructuras cuando la cualidad de una cosa es mayor o menor que la de la otra. Es decir, que la comparación se establece entre dos entidades.

Para formar un adjetivo comparativo con un ADJETIVO LARGO (de dos o mas sílabas) se antepone al adjetivo la palabra ***more*** , en el caso de una comparación que indique un nivel/cantidad/cualidad/etc. mayor o de superioridad, o la palabra ***less*** cuando la comparación indica algo de menor nivel/cantidad/cualidad/etc. Este comparativo puede estar seguido por la palabra **"than"**, la cual establece la comparación con otro elemento**.** Por ejemplo:

These notes are *more difficult than* the ones in the handout. (Estas notas son *más difíciles que* las del cuadernillo)

Superlativos en adjetivos largos

Utilizamos estas estructuras cuando la cualidad de una cosa es mayor o menor a las del resto. Es decir, las utilizamos para decir *el más/menos + cualidad*.

Con los adjetivos largos se antepone al adjetivo la frase

the most (el más) o
the least (el menos)

Por ejemplo:

This is *the most eco-friendly material of all*. (Este es el material *más ecológico de todos*)

Ejemplos de comparativos y superlativos en adjetivos largos:

POSITIVE	COMPARATIVE	SUPERLATIVE
modern	more modern…than (+)	the most modern
modern	less modern (-)…than	the least modern
functional	more functional….than (+)	the most functional
functional	less functional (-)…than	the least functional

advanced	more advanced ….than (+)	the most advanced
advanced	less advanced (-)…than	the least advanced
protected	more protected (+)	the most protected
protected	less protected (-)….than	the least protected

Comparativos en adjetivos cortos

Para formar el adjetivo comparativo con un ADJETIVO CORTO (de una sola o dos sílabas) se añade al adjetivo el sufijo **"er"** para formar el comparativo de superioridad. Este comparativo puede estar seguido por la palabra **"than".** Por ejemplo:

There are *cheaper materials than* cement that can be used. (Hay materials *más baratos que* el cement que pueden ser usados.)

These notes are *easier than* the ones in the book. (Estas notas son *más fáciles que* las del libro)

Superlativos en adjetivos cortos

Para formar un adjetivos superlativo con un adjetivo corto, se antepone el artículo "**the"** y se añade el sufijo (terminación) **"est"** al adjetivo. Por ejemplo:

This is *the cheapest building material of all*. (este es *el material de construcción más barato de todos*.)

Ejemplos de comparativos y superlativos en adjetivos cortos:

ADJECTIVO	**COMPARATIVO**	**SUPERLATIVO**
fast	faster…than (+)	the fastest
slow	slower …than (+)	the slowest
high	higher ….than (+)	the highest
low	lower …than (+)	the lowest
big	bigger …than (+)	the biggest
small	smaller…than (+)	the smallest
long	longer…than (+)	the longest
large	larger…than (+)	the largest
short	shorter …than (+)	the shortest

Nota Importante: en muchos de los casos, la comparación ya sea por medio de comparativos o superlativos no se encuentra expresada con la totalidad de la frase que se presenta en el cuadro de arriba. Puede suceder que una parte de la comparación sea información compartida entre los participantes por lo que no se expresa o que la referencia faltante de la comparación haya sido mencionada en otra parte del texto. Por ejemplo: There will be greater changes in the future. (= Habrá cambios más grandes/importantes en el futuro.) Entonces aquí nos podemos preguntar ¿más importantes que qué? Y la respuesta sería "más importantes que los cambios que estamos experimentando ahora". En este caso, el agregado de esta información podría resultar redundante para el lector.

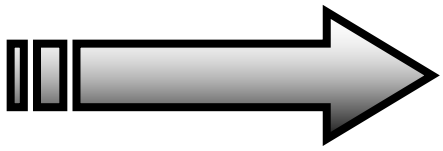
Comparativos y superlativos irregulares

Algunos adjetivos forman el comparativo de manera irregular

	POSITIVE	**COMPARATIVE**	**SUPERLATIVE**
bueno	good	better	the best
malo	bad	worse	the worst
poco	little	less	the least
mucho	much	more	the most

Examples:

1. According to their findings, homes made of concrete are *much more storm-resistant than* homes constructed of wood and steel. (De acuerdo con los resultados, los hogares hechos con cemento son *mucho más resistentes a las tormentas que* los hogares construidos de madera o de acero. Retrieved March 3, 2012 from http://architecture.about.com/cs/buildyourhouse/a/concretehomes.htm)
2. Highly durable wood framed windows are cheaper thatn uPVC… (Las ventanas de marcos de madera altamente durables/de alta duración son *más baratas que* las de uPVC. Retrieved March 3, 2012 from http://www.bioregional.com/news-views/publications/bedzed-toolkit-for-carbon-neutral-developments-part-1-construction-materials-report/)
3. However, *the greatest impacts* will be felt by people in developing countries… (Sin embargo, *los impactos más grandes* serán percibidos por la gente de los países en desarrollo… Retrieved March 3, 2012 from http://www.forestry.gov.uk/pdf/Carbonbenefitsoftimberinconstruction.pdf/$FILE/Carbonbenefitsoftimberinconstruction.pdf)
4. As new buildings become *more energy efficient*, the emissions associated with materials make up *a greater proportion* of their total climate change impact. (A medida que los edificios nuevos se vuelven más eficientes con la energía, las emisiones asociadas con los materiales componer una mayor proporción de su impacto en el cambio climático total. Retrieved March 3, 2012 from http://www.forestry.gov.uk/pdf/Carbonbenefitsoftimberinconstruction.pdf/$FILE/Carbonbenefitsoftimberinconstruction.pdf)



APÉNDICE 7

Referencia: Unidad 3A, sección *La morfología del sustantivo y* Unidad 4A

Listado de Algunos Sufijos Según su Función

Función Sustantivo

SUFIJO	SIGNIFICADO	FUNCIÓN	EJEMPLOS
IST	persona que practica una ciencia	sustantivo	scientist botanist analyst physicist percussionist pianist cellist
ER / OR	persona o cosa que realiza acción	sustantivo	transducer operator inventor insulator driver
ENT/ ANT			student assistant attendant
IAN	persona que practica una ciencia	sustantivo	physician optician mathematician technician obstetrician
ANCE	la acción o resultado de	sustantivo	impendance defiance disturbance importance
ENCE			preference dependence interferente presence
NESS	estado o condición de	sustantivo	brightness goodness darkness toughnness
SHIP			friendship leadership citizenship
MENT	la acción o resultado de ..	sustantivo	shipment pavement payment
AL			denial proposal refusal proposal
ITY	el estado o calidad de	sustantivo	stability identity electricity malleability conductivity
CY			urgency frequency efficiency
ATION	la acción de..	sustantivo	approximation explanation
TION			invention function
SION			expansion admission inclusion transmission

AGE	la calidad o acción de..	sustantivo	mileage shortage percentage packaged drainage
RY	lugar para o práctica de	sustantivo	bribery robbery misery refinery

Función Adjetivo

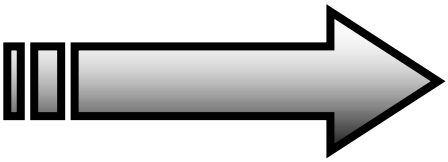
SUFIJO	SIGNIFICADO	FUNCIÓN	EJEMPLOS
FUL	calidad de	adjetivo	powerful careful beautiful helpful
LESS	carente o falto de	adjetivo	numberless hopeless endless doubtless
AL	la condición de	adjetivo	technical visual digital principal academical accidental thermal
IC **ENT**	la condición de	adjetivo	energetic systematic electric different dependent excellent
IVE **OUS**	La condición de	adjetivo	productive creative dangerous continuous - curious spacious
ABLE	que se puede	adjetivo	reliable dettachable visible
Y	que está constituido de	adjetivo	rocky stony sandy

Función Adverbio

SUFIJO	SIGNIFICADO	FUNCIÓN	EJEMPLOS
LY	terminación -mente	adverbio	traditionally technically

Función Verbo

SUFIJO	SIGNIFICADO	FUNCIÓN	EJEMPLOS
UCE	Significados varios	verbo	produce induce
EN			broaden fasten shorten
ISE - IZE			stabilise visualise symbolise
ATE			create vibrate separate
FY			quantify electrify
UCE			produce induce



APÉNDICE 8

Referencia:
Unidad 5A, 8A y 9A

Más acerca de los verbos

Verbos lexicales: estos verbos son los que representan el núcleo de la frase verbal y no pueden actuar como verbos auxiliares. Los verbos lexicales son los que contienen el mayor significado verbal en la oración. Por ejemplo: research (investigar), develop (desarrollar), arise (surgir), etc.

Verbos auxiliares: los verbos auxiliares son los verbos utilizados para negar los verbos lexicales y para hacer preguntas. Estos verbos se clasifican en verbos auxiliares primarios y verbos auxiliares modales.

Verbos auxiliares primarios: estos verbos son BE, HAVE, DO. Los mismos no tienen un significado específico, por lo que se dice que su función es estrictamente marcar cuestiones gramaticales en la frase verbal tales como aspecto (simple, perfecto, continuo), voz (pasiva, activa), persona, interrogación, negación. Entonces, en la pregunta *Have researchers collected the data?* cuya interpretación sería *Han los investigadores recolectado los datos?*, el verbo auxiliar HAVE cumple la función de, en primer lugar indicar que lo que se va a decir es una pregunta. Asimismo, este verbo describe el hecho de que la acción denotada por el verbo lexical (research o investigar) es una acción que se comenzó en el pasado y se extiende en el tiempo presente. Asimismo, el hecho de contar con la palabra HAVE y no HAS nos indica que estamos hablando ya sea de I, YOU, WE o THEY. En este caso se trata de THEY = researchers. Estos verbos auxiliares, verbos auxiliares primarios, presentan la particularidad de poder funcionar como verbos lexicales y como verbos auxiliares, aún dentro de la misma frase. Para ejemplificar:

Verbo BE:

The researchers **are** at the university campus at the moment.	Verbo BE utilizado como verbo lexical expresando la idea de ESTAR
The researchers **are** working on new solutions to the problem.	Verbo BE utilizado como verbo auxiliar para formar el aspecto progresivo junto con la forma –ing en el verbo lexical.
New possibilities **are being** studied by researchers to solve the problem.	Verbo BE utilizado en el primer caso como verbo auxiliar que marca el aspecto (continuo) y, en el segundo caso, la voz pasiva + la parte –ing que llevaría el verbo lexical en voz activa.

Sus distintas formas son:

BE	**Tiempo Presente**	**Pasado**	**Pasado Participio**
I	am	was	Auxiliar + been
He/She/ It	is	was	
We/You/They	are	were	

Verbo DO:

They **do** research projects connected with improving energy collection.	DO utilizado como verbo lexical.
They **don't do** research projects connected with carbon dioxide emissions.	Primer DO utilizado como auxiliar para formar la negación del verbo lexical, en este caso, (segundo) DO.

Sus distintas formas son:

DO	**Tiempo Presente**	**Pasado**	**Pasado Participio**
I	do	did	Auxiliar + done
He/She/ It	does		
We/You/They	do		

Verbo HAVE:

The university **has** a group of researchers working on solar energy.	HAVE utilizado como verbo lexical.
The researchers **have had** several problems lately.	Primer HAVE utilizado como auxiliary marcando el aspect perfecto y el Segundo HAVE utilizado como verbo lexical.

Sus distintas formas son:

HAVE	**Tiempo Presente**	**Pasado**	**Pasado Participio**
I	have	had	Auxiliar + had
He/She/ It	has		
We/You/They	have		

Verbos conjugados: Toda oración en inglés debe contar con al menos una frase verbal conjugada. La misma puede contar con un solo verbo o con la combinación de verbo(s) auxiliar(es) + verbo lexical para formar una frase verbal compuesta. Por ejemplo:

The researchers **are working** on possible solutions. (verbo auxiliar + verbo lexical)

They **have been researching** this issue for two decades now. (verbo auxiliar 1 [representa el aspecto perfecto] + auxiliar 2 [representa el aspecto progresivo] + verbo lexical [en la forma –ing para completar la idea del aspecto progresivo]).

New systems **are being researched** at the moment. (verbo auxiliar 1 [representa parte necesaria para conformar el aspecto progresivo] + verbo auxiliar 2 [se incorpora para formar la voz pasiva con el sufijo del aspecto progresivo] + verbo lexical [en la forma necesaria para formar la voz pasiva- pasado participio]).

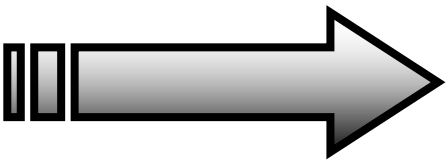
Ahora veamos cómo se puede conjugar un verbo en tiempo presente haciendo combinaciones con los *aspectos simple*, *progresivo* y *perfecto* tanto en voz activa como en voz pasiva. Cabe destacar que cuando hablamos de *tiempo* nos referimos a un punto particular en la línea temporal ya sea, pasado, presente o futuro. Cuando nos referimos a la categoría gramatical de *aspecto* de un verbo queremos representar una cierta característica de la acción a la que se hace referencia. Por ejemplo: si la acción, ya sea en tiempo presente o pasado, es descripta en progreso o no (aspecto progresivo) o si la acción denotada por el verbo se extiende de un tiempo a otro (aspecto perfecto) o si la acción denota la idea de rutina, hechos habituales o verdades eternas (aspecto simple).

Voz Activa

Tiempo Presente	Aspecto Simple (=Presente Simple)	Aspecto Progresivo (=Presente Progresivo)	Aspecto Perfecto (=Presente Perfecto)	Perfecto + Progresivo (=Presente Perfecto Progresivo)
Oraciones afirmativas	I/We/You/They **work** on a new project every year. He/She/It **represents** a major step in the project.	I **am working** on a new project now. He/She/It **is working** on a new project now. We/You/ They **are working** on a new project now.	I/We/You/They **have worked** on this project since September. He/She/It **has worked** on this project since Spetember.	I/You/We/They **have been working** on this project for many years. He/She/It **has been working** on this project for many years.
Oraciones negativas	I/We/You/They **don't (do not) work** on a new project. He/She/It **doesn't (does not) represent** a major obstacle to the project.	I **am not ('m not) working** on a new project now. He/She/It **is not (isn't) working** on a new project now. We/You/ They **are not (aren't) working** on a new project now.	I/We/You/They **have not (haven't) worked** on a new project since 2009. He/She/It **has not (hasn't) worked** on this project since 2009.	I/You/We/They **have not (haven't) been working** on this project for many years. He/She/It **has not (hasn't) been working** on this project for many years.
Preguntas	What **do** I/we/you/they **research** in connection with sustainability? **Do** I/we/you/they **research** anything connected with sustainability? What **does** he/she/it **research** in general lines? **Does** he/she/it **research** anything connected with sustainability?	What **am** I **focusing** on here? **Am** I **focusing** on the findings? What **is** he/she/it **working** on? **Is** he/she/it **developing** a new kind of energy? What **are** you/we/they **working** on at this moment? **Are** you/we/they **working** on a new kind of energy?	What **have** I/you/we/they **researched** in the last few years? **Have** I/you/we/they **worked** on a new kind of energy in the last few years? What **has** he/she/it **researched** in the last few years? **Has** he/she/it **worked** on a new kind of energy in the last few years?	How long **have** I/you/we/they **been working** on this project? **Have** I/you/we/they **been working** many weeks on this project? How long **has** he/she/it **been working** on this project? **Has** he/she/it **been working** many weeks on this project?

Voz Pasiva

Tiempo Presente	**Aspecto Simple** (=Presente Simple)	**Aspecto Progresivo** (=Presente Progresivo)	**Aspecto Perfecto** (=Presente Perfecto)	**Perfecto + Progresivo** (=Presente Perfecto Progresivo)
Oraciones afirmativas	First, the research area **is narrowed down** to a specific topic (by me/you/him/her/it/us/ them). Second, the research questions **are posed** (by + persona).	The new project **is being developed** at the University of Cambridge (by + persona). The projects **are being developed** at the University of Cambridge (by + persona).	The project **has been developed** by a group of MIT researchers. The projects **have been developed** by a group of researchers.	No se utiliza esta combinación.
Oraciones negativas	That research question **is not (isn't) included** in this project (by + person). Those research questions **are not (aren't) included** in the project (by + persona).	The new project **is not (isn't) being developed** at the University of Cambridge (by + persona). The projects **are not (aren't) being developed** at the University of Cambridge (by + persona).	The project **has not (hasn't been) developed** by a group of MIT researchers. The projects **have not (haven't) been developed** by a group of MIT researchers.	No se utiliza esta combinación.
Preguntas	What aspect of energy **is developed** (by + persona) at this research center? **Is** this aspect of energy **researched** here? Which **are** the energy systems **developed** (by + person) at this research center? **Are** the energy systems **developed** here?	Where **is** the project **being developed**? **Is** the project **being developed** at the University of Cambridge? Where **are** the projects **being developed**? **Are** the projects **being developed** at the University of Cambridge?	Who **has** the project **been developed** by? **Has** the project **been developed** at the University of Cambridge? Who **have** the projects **been developed** by? **Have** the projects **been developed** by the students?	No se utiliza esta combinación.



APÉNDICE 9

Referencia: Unidad 6A, sección *La frase nominal compleja*

Interpretación y Traducción de la Frase Nominal Compleja

Una correcta y adecuada traducción es una consecuencia lógica de una correcta interpretación del texto fuente.

Las ideas no se estructuran de la misma manera en un idioma que en otro, por lo tanto, lo primero a tener en cuenta es que se debe abandonar la tendencia a traducir palabra por palabra. Debemos buscar las ideas contenidas en los diferentes segmentos del texto y la oración, como por ejemplo las frases nominales, para traducir ideas completas y no palabras aisladas. No obstante, cuando la frase nominal es un tanto compleja o muy larga, al traducirla podemos segmentarla en fracciones significativas, interpretando la función que cada segmento cumple en la unidad toda, para luego unir los fragmentos en una unidad mayor con valor propio. Para ello debemos, primeramente, entender el valor de la frase en la lengua fuente, que es inglés en nuestro caso. Así, podremos obtener un equivalente coherente, cohesivo y que refleje fielmente este valor en la lengua meta, que es español en nuestro caso. Veamos el ejemplo siguiente:

The molecules in a gas in continuous random motion making collisions with each other …

En este ejemplo vemos el núcleo (*molecules*) que tiene un solo pre-modificador *(the*) y tres post-modificadores a saber:

in a gas
in continuous random motion
making collisions with each other

Al traducir estos segmentos obtenemos gran parte de la traducción deseada:

de un gas
en movimiento aleatorio continuo
que colisionan una con otras

Luego sólo resta unir las partes en forma coherente y cohesiva para obtener lo siguiente:

Las moléculas de un gas que colisionan una con otras en movimiento aleatorio continuo…

La mayor dificultad como puede verse no está puntualmente en la transferencia de la lengua extranjera a la lengua castellana sino en la correcta interpretación de la frase nominal en inglés. Interpretar correctamente el significado del texto original nos permite realizar una traducción más funcional que transmite el valor de la frase sin que necesariamente se haga una traducción literal (palabra por palabra). Por ejemplo la frase:

The basic engineering materials

Admite las siguientes traducciones conservando el valor de la frase:

(a) *los materiales básicos de ingeniería*
(b) *los materiales ingenieriles básicos*

Reconocimiento y traducción de los pre-modificadores

El sustantivo núcleo de la frase nominal puede estar pre-modificado por un artículo, un determinante, un adjetivo, un genitivo u otro sustantivo. Nuevamente, para poder realizar una correcta traducción debemos, en primer lugar, determinar cuál es el sustantivo núcleo y luego "leer hacia atrás" para identificar los pre-modificadores.

En caso de que haya una sucesión de sustantivos aparentemente inconexos, debemos saber que el último es el núcleo y por lo tanto los anteriores lo pre-modifican. En el ejemplo[2]:

America's growing energy demands

El núcleo es:

demands

Pre-modificado por:

America's (genitivo)
growing (forma *ing* en función de adjetivo)
energy (sustantivo)

La correcta traducción final sería:

Las crecientes demandas de energía de Estados Unidos

Frases nominales de mayor complejidad

En el inglés técnico las frases nominales complejas son muy frecuentes y por ello es muy importante aprender a identificarlas y traducirlas. En ellas encontramos pre-modificadores y post-modificadores que se combinan para brindar la mayor cantidad de información de la forma más eficiente posible. La cuestión es, entonces, cómo identificar los diferentes segmentos significativos para llegar a una correcta traducción.

Nuevamente, lo primero es identificar el núcleo. Para ello debemos recorrer la frase atendiendo a la clase de palabras que la componen. Como estamos buscando un sustantivo núcleo nos detendremos en los sustantivos que encontremos y observaremos qué palabra le sigue. Si le sigue otro sustantivo, no se trata del núcleo sino de un pre-modificador. Si le sigue:

- una frase preposicional (que comienza con una preposición)
- una oración introducida por *which* o *that*
- una oración introducida por un verbo no conjugado en la forma –ing
- una oración introducida por un verbo no conjugado en la forma *–ed*
- una oración introducida por un verbo no conjugado en *to-infinitive*
-

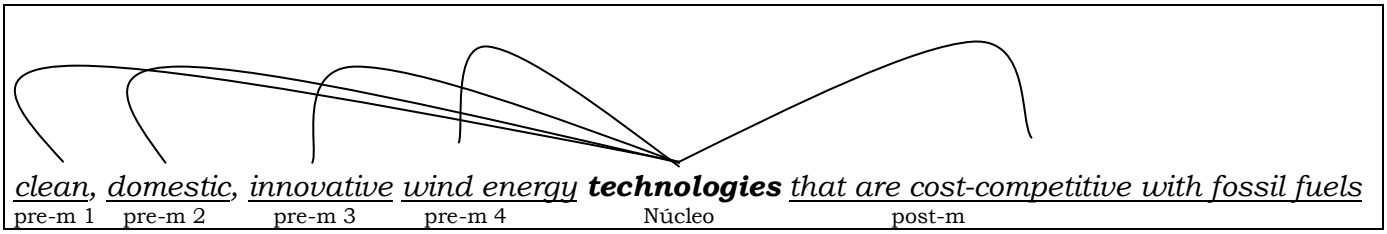
estaremos en presencia de un post-modificador. Entonces, sabremos que ese sustantivo es el núcleo y "leeremos hacia atrás" para interpretar los premodificadores y "hacia adelante" para interpretar los post-modificadores.

[2] Los ejemplos que siguen en el texto fueron tomados de la página de Internet http://www.energy.gov/energysources/wind.htm

Veamos el siguiente ejemplo:

clean, domestic, innovative wind energy ***technologies*** *that are cost-competitive with fossil fuels*

Las relaciones entre **núcleo** y **modificadores** pueden graficarse así:



Aquí nos encontramos primeramente con tres adjetivos (*clean, domestic, innovative*) y luego con el sustantivo *wind* seguido del sustantivo *energy (que constituyen una frase nominal premodificadora del núcleo principal)*, seguido del sustantivo *technologies*, seguido de una oración introducida por *that*. Si usamos las estrategias descriptas en el párrafo anterior podemos identificar el núcleo *technologies*, sus cuatro pre-modificadores y su post-modificador. Luego de interpretar estos segmentos y traducirlos, los combinamos para obtener la versión final en L2:

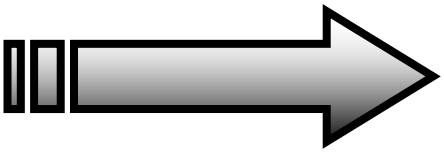
tecnologías de energía eólica innovadoras, domésticas y limpias con combustibles fósiles y competitivas en cuanto a los costos (*)

(*) Esta última frase admite otras posibles traducciones. Por Ej.:
económicamente competitivas
muy rentables

Como se puede observar, la versión en castellano no necesariamente sigue el mismo orden que el original en inglés. No obstante, se ha mantenido el valor y la función de las expresiones en esta última.

Frase nominal sin post-modificadores

También puede suceder que la frase no tenga post-modificadores, por lo que la última palabra será el núcleo. En este caso es probable que después del núcleo encontremos: un verbo conjugado, un conector, un punto y coma (;) o un punto (.). Estos deben ser interpretados como marcadores de que la frase nominal termina ahí.



APÉNDICE 10

Referencia:
Unidad 7A

Pronombres Personales y Otras Palabras de Referencia

Los pronombres personales son elementos que pertenecen a una clase cerrada de palabras- es decir que no se pueden crear nuevas entradas en la lista- y que básicamente hacen referencia a un sustantivo. Dentro de la oración los pronombres pueden cumplir la función de sujeto y de objeto (estructura que completa el significado expresado por el verbo). Los pronombres usualmente hacen referencia a un concepto expresado en el texto con anterioridad a su uso (referencia anafórica), pero pueden también hacer referencia a algo que está por ser presentado más adelante (referencia catafórica). Asimismo, los pronombres I, YOU, WE hacen referencia a una entidad que puede estar fuera del texto, que pertenece al contexto como puede ser el autor del trabajo, el lector o a los lectores o la gente en general (referencia exofórica). La tarea del lector de lengua extranjera es ir recuperando y tejiendo las referencias de estas palabras para así poder dar sentido y continuidad a lo que se está tratando de comprender.

Pronombres personales en función de sujeto:

Pronombre	Ejemplo	Comentario
I	**I** am responsible for the project. (***Yo*** soy responsable de este proyecto.)	En el tipo de texto expositivo-argumentativo, cuando el pronombre *I* es usado, el mismo hace referencia al autor del trabajo. Su referencia es exofórica, es decir, que se encuentra fuera del texto en sí.
YOU	***You*** can find more information about this issue at www.energysolutions.com. (***Usted/Tú*** puede/puedes encontrar más información acerca de esta cuestión en www.energysolutions.com.)	El pronombre YOU hace referencia al lector. Su referencia es exofórica también. La única manera de saber si se trata de you singular (usted/tú) o plural (ustedes) es a través del contexto.
HE	William Schreiber wrote "Solving the energy problem" in 2007. ***He*** addresses the issue of finding alternative ways of producing energy. (William Schreiber escribió "Solucionando/La solución al problema de energía" en 2007. ***Él*** trata la cuestión de encontrar formas alternativas para producir energía)	En el primer ejemplo, el pronombre tiene referencia anafórica.

	When ***he*** wrote the article "Solving the energy problem", William Schreiber's main aim was to propose a feasible plan to solve the energy problem. (Cuando ***él*** escribió el artículo "Solucionando/La solución al problema de energía", el objetivo más importante de William Schreiber era proponer un factible para resolver el problema de la energía.)	En el segundo, HE hace referencia al nombre que aparece en la segunda parte de la oración (referencia catafórica)
SHE	Elsa Garmire is a Professor of Engineering Sciences at Dartmouth College. ***She*** made advances in optical devices and quantum electronics that made the commercial use of lasers feasible. (Elsa Garmire es una profesora de Ciencias de la Ingeniería en el Colegio Universitario de Dartmouth. Ella hizo avances en dispositivos ópticos y electrónica cuántica que hicieron posible el uso comercial de los lasers.)	SHE hace referencia Elsa Garmire.
IT	What is the energy problem? ***It*** has several parts. (¿Cuál es el problema de la energía? ***Éste*** tiene varias partes.)	IT hace referencia a *the energy problem*. Notar que el equivalente propuesto en este caso es ESTE y no ÉL, que gramaticalmente sería posible pero no es lo que se usa usualmente.
WE	***We*** propose in this paper a new vision to solve the problem. (***Nosotros*** proponemos en este trabajo una nueva visión para resolver el problema.) There are many measures ***we*** can take to solve the energy problem. (Hay muchas medidas que ***nosotros*** podemos tomar para resolver el problema de la energía.)	En el primer ejemplo, WE hace referencia al autor y su equipo. En el segundo, el autor usa WE con referencia genérica en la que se incluye a él mismo, al lector, y la gente en general.
YOU	There are many measures **you** can take to solve the energy problem. (Hay muchas medidas que ***ustedes/tú*** pueden/puedes tomar para solucionar el problema de la energía)	Aunque este ejemplo es usado para referirse al YOU plural, podría ser un caso de YOU singular. Su significado es genérico, no hace referencia a una persona en particular.
THEY	The researchers collected data for more than 10 months. ***They*** used materials of different nature and origin for the experiments. (Los investigadores recabaron datos por más de 10 años. ***Ellos*** usaron materiales de diversa naturaleza y origen para los experimentos.) Renewable sources of energy are not cost-free. Although ***they*** are found in nature, there is cost involved in the production of energy coming from them. (Las fuentes renovables de energía no están exentas de costos. Aunque se ***las*** encuentra ***(a ellas)*** en la naturaleza, hay un costo involucrado en la producción de energía que proviene de ellas.)	En el primer ejemplo THEY hace referencia a personas y en el segundo a fuentes renovables de energía.

Pronombres personales en función de objeto:

Pronombre	Ejemplo	Comentario
ME	Many people have asked ***me*** how to solve the energy problem. (Mucha gente ***me*** ha preguntado ***(a mi)*** como solucionar el problema de energía) The university gave ***me*** the funds to do the research. (La Universidad ***me*** dió ***(a mi)*** los fondos para hacer la investigación.)	En los dos ejemplos hay un verbo seguido de pronombre objeto.
YOU	There are several options for **you** at UTN. (Hay muchas opciones para ***usted/tí*** en la UTN.) The university offered ***you*** a new position. (La Universidad ***te*** ofreció ***(a ti)*** un nuevo puesto.)	En el primer ejemplo tenemos una preposición seguida de pronombre objeto. En el segundo ejemplo hay un verbo seguido de un pronombre objeto.
HIM	William F. Schreiber, a professor emeritus in electrical engineering, died suddenly at his home in Cambridge on Monday, Sept. 21, 2009, at the age of 84. He was an inventive, energetic, generous teacher, fighting for causes that make the world around ***him*** a better place. (from MIT EECS) (William F. Schreiber, un profesor emérito en ingeniería electrónica, murió repentinamente en su hogar en Cambridge el lunes, 21 de septiembre de 2009, a la edad de 84 años. Él era un docente inventivo, energético y generoso, que luchaba por causas que hacían el mundo alrededor de ***él*** un mejor lugar.)	Preposición + pronombre objeto
HER	Elsa Garmire is a Professor of Engineering Sciences at Dartmouth College. Advances in optical devices and quantum electronics that made the commercial use of lasers feasible are attributed to ***her***. (Elsa Garmire es una profesora de Ciencias de la Ingeniería en el Colegio Universitario de Dartmouth. Los avances en dispositivos ópticos y electrónica cuántica que hicieron posible el uso comercial de los lasers ***le*** son atribuidos a ***ella***.)	Preposición + pronombre objeto
IT	How do we solve the energy problem? There are several solutions to deal with ***it***. (¿Cómo resolvemos el problem de la energía? Hay muchas soluciones para tratar***lo (a él)***)	Preposición + pronombre objeto
US	A reasonable use of energy sources will impact ***us***, our way of life, for the better. (Un razonable uso de las Fuentes de energía ***nos*** impactarán/impactarán sobre ***nosotros***, nuestra forma de vida, para bien.	Verbo + pronombre objeto
YOU	The changes will affect ***you*** and future generations. (Los cambios ***los*** afectarán ***a ustedes*** y a futuras generaciones.)	Verbo + pronombre objeto
THEM	The children of today are in a world characterized by constant changes. These changes will affect ***them*** and future generations. (Los niños del presente están en un mundo caracterizado por cambios constantes. Estos cambios ***los*** afectarán ***a ellos*** y a futuras generaciones.)	Verbo + pronombre objeto

Pronombres posesivos:

Pronombre	**Ejemplo**	**Comentario**
MINE	This project is ***mine***. (Este proyecto es ***mío***.)	Los pronombres posesivos reemplazan la combinación de adjetivo posesivo + sustantivo o la combinación de sustantivo en caso genitivo + sustantivo (Elsa Garmire's idea = her idea = hers). = This project is *my project*.
YOURS	My project is financed by the university. ***Yours*** is financed by the Ministry of Science and Technology. (Mi proyecto está financiado por la Universidad. El ***tuyo*** por el Ministerio de Ciencia y Tecnología.)	= *Your project* is sponsored by … (en este caso se refiere a *tu proyecto*)
HIS	William F. Schreiber always respected other people's ideas although ***his*** were many times attacked. (William F. Schreiber siempre respetaba las ideas de otras personas aunque las ***suyas*** eran muchas veces atacadas.)	= WFS always respected other people's ideas but *his ideas* were many times attacked. / …..but *WFS's ideas* were many times attacked.
HERS	Elsa Garmire has published in this journal several times but the article about quantum electronics in this issue is not ***hers***. (Elsa Garmire ha publicado en esta revista especializada muchas veces pero el artículo acerca de electrónica cuántica en este número no es ***de ella***.)	=…is not *her article*. / ….is not *Elsa Garmire's article*
-----	-----	El pronombre personal IT no posee equivalente dentro de los pronombres posesivos.
OURS	We can use the resources nature gives us but they are not ***ours***. We have to use them conscientiously to protect humanity's future. (Nosotros podemos usar los recursos que la naturaleza nos da pero no son ***nuestros***. Nosotros tenemos que usarlos cuidadosamente para proteger el futuro de la humanidad.)	= the resources are not *our resources* (se refiere a que no somos dueños de los recursos)
YOURS	This project idea is not mine. It is ***yours***. (Esta idea de proyecto no es mía. Es ***de ustedes***.)	= It is *your idea*. (en este caso se refiere a *la idea de ustedes y no tuya* – sólo el contexto puede establecer esto)
THEIRS	The Materials Engineers at the MIT want to execute the research project themselves because the idea was ***theirs***. They do not want help from other universities. (Los Ingenieros en Materiales del MIT quieren ejecutar el proyecto ellos mismos de investigación porque la idea es ***de ellos***. Ellos no quieren ayuda de otras universidades.)	=…their idea / …*the Materials Engineers at the MIT's idea*

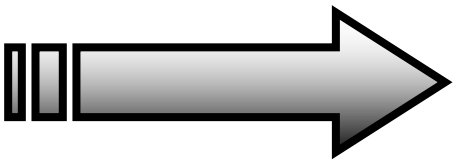
(Los pronombres reflexivos, presentados en la unidad 7A, no serán descriptos en detalle puesto que su recurrencia en textos científico-académicos no es muy alta).

Pronombres y adjetivos demostrativos

Pronombre	Ejemplo	Comentario
THIS	…we have no choice but to act now. ***This*** involves providing new options to old problems. (…nosotros no tenemos otra alternativa más que actuar ahora. ***Esto*** involucra proveer nuevas opciones para problemas viejos.)	THIS en este caso no hace referencia a una cosa/elemento/ objeto en particular pero a toda una idea (*actuar ahora*).
THAT	Some changes are needed in the research group. ***That*** will involve assigning new positions to each member. (Se necesitan algunos cambios en el grupo de investigación. ***Eso*** involucrará asignar nuevos puestos a cada integrante.)	THAT se refiere a la idea de hacer cambios en el grupo de investigación, en este caso. THAT es in palabra que puede ocasionar confusión puesto que tiene muchas funciones. Ver cuadro debajo.
THESE	The solar panels are a solution. ***These*** are installed on roofs and on flat surfaces. (Los paneles solares son una solución. ***Éstos*** son colocados sobre techos y superficies planas.)	THESE hace referencia a *the solar panels*. El pronombre THEY también podría ser utilizado para expresar lo mismo.
THOSE	There are many projects which are funded by international corporations. ***Those*** are given top priority. (Hay muchos proyectos que son financiados por corporaciones internacionales. ***Esos*** reciben máxima prioridad.	THOSE en este caso hace referencia a los proyectos que son subvencionados por corporaciones internacionales.

Usos de THAT	Ejemplo	Comentario
Como pronombre demostrativo	Some changes are needed in the research group. ***That*** will involve assigning new positions to each member. (Se necesitan algunos cambios en el grupo de investigación. ***Eso*** involucrará asignar nuevos puestos a cada integrante.)	THAT reemplaza a la idea de reestructuración del grupo de investigación.
Como adjetivo demostrativo	***That*** project was developed in the year 2009. (***Ese*** proyecto fue desarrollado en el año 2009.)	THAT actúa como modificador del sustantivo *project*.
Como pronombre relativo	It is a problem ***that*** requires immediate attention. (Es un problema ***que*** requiere de atención inmediata.)	THAT introduce una oración que postmodifica al sustantivo *problem*. En este uso también se puede utilizar el pronombre relativo *which*.

Como relativizador para introducir una construcción nominal (sustantiva).	Many of us believe ***that*** this energy plan is viable. (Muchos de nosotros creemos ***que*** este plan de energía es viable.) **That** this energy plan is viable is an issue that we have to discuss. (***Que*** este plan de energía es viable es un asunto que tenemos que tratar.)	THAT introduce una idea que podría ser reemplazada por los pronombres *IT o THIS: Many of us believe it/this (= that this energy plan is viable).*
Como parte de un conector	Renewable energy sources have to be used so ***that*** the environment can be protected. (Fuentes de energía renovables tienen que ser usadas ***para que*** el medioambiente pueda ser protegido.)	Este conector expresa resultado en este caso.



APÉNDICE 11

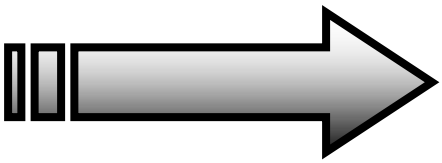
Referencia: Unidad 8A, *la frase verbal en tiempo pasado.*

Verbos irregulares con alta frecuencia de uso en el inglés coloquial y neutro

Infinitive	Simple Past	Past Participle	Spanish
arise	arose	arisen	surgir
be	was / were	been	ser
beat	beat	beaten	golpear
become	became	become	convertirse
begin	began	begun	comenzar
bet	bet/betted	bet/betted	apostar
bite	bit	bitten	morder
bleed	bled	bled	sangrar
blow	blew	blown	soplar
break	broke	broken	romper
bring	brought	brought	traer
build	built	built	construir
buy	bought	bought	comprar
catch	caught	caught	atrapar
choose	chose	chosen	elegir
come	came	come	venir
cost	cost	cost	costar
creep	crept	crept	arrastrarse, moverse en silencio
cut	cut	cut	cortar
deal	dealt	dealt	dar, repartir
do	did	done	hacer
draw	drew	drawn	dibujar
dream	dreamt/dreamed	dreamt/dreamed	soñar
drink	drank	drunk	beber
drive	drove	driven	conducir
eat	ate	eaten	comer
fall	fell	fallen	caer
feed	fed	fed	alimentar
feel	felt	felt	sentir
fight	fought	fought	pelear
find	found	found	encontrar
flee	fled	fled	huir
fly	flew	flown	volar
forget	forgot	forgotten	olvidar
forgive	forgave	forgiven	perdonar
freeze	froze	frozen	congelar
get	got	got	tener, obtener
give	gave	given	dar
go	went	gone	ir
grind	ground	ground	moler
grow	grew	grown	crecer
hang	hung	hung	colgar
have	had	had	tener
hear	heard	heard	oír
hide	hid	hidden	esconderse
hit	hit	hit	golpear
hold	held	held	tener, mantener
hurt	hurt	hurt	herir, doler
keep	kept	kept	guardar
kneel	knelt	knelt	arrodillarse
know	knew	known	saber
lay	laid	laid	poner, preparar
lead	led	led	encabezar
learn	learnt/learned	learnt/learned	aprender
leave	left	left	dejar
lend	lent	lent	prestar
let	let	let	dejar
lie	lay	lain	yacer
lie	lied	lied	mentir
lose	lost	lost	perder
make	made	made	hacer
mean	meant	meant	significar
meet	met	met	conocer, encontrar
pay	paid	paid	pagar
put	put	put	poner
quit	quit/quitted	quit/quitted	abandonar

read	read	read	leer
ride	rode	ridden	montar, ir
ring	rang	rung	llamar por teléfono
rise	rose	risen	elevar
run	ran	run	correr
say	said	said	decir
see	saw	seen	ver
sell	sold	sold	vender
send	sent	sent	enviar
set	set	set	fijar, establecer
sew	sewed	sewn/sewed	coser
shake	shook	shaken	sacudir
shine	shone	shone	brillar
shoot	shot	shot	disparar
show	showed	shown/showed	mostrar
shrink	shrank/shrunk	shrunk	encoger
shut	shut	shut	cerrar
sing	sang	sung	cantar
sink	sank	sunk	hundir
sit	sat	sat	sentarse
sleep	slept	slept	dormir
slide	slid	slid	deslizar
sow	sowed	sown/sowed	sembrar
speak	spoke	spoken	hablar
spell	spelt/spelled	spelt/spelled	deletrear
spend	spent	spent	gastar

spill	spilt/spilled	spilt/spilled	derramar
split	split	split	partir
spoil	spoilt/spoiled	spoilt/spoiled	estropear
spread	spread	spread	extenderse
stand	stood	stood	estar de pie
steal	stole	stolen	robar
sting	stung	stung	picar
stink	stank/stunk	stunk	apestar
strike	struck	struck	golpear
swear	swore	sworn	jurar
sweep	swept	swept	barrer
swim	swam	swum	nadar
take	took	taken	tomar
teach	taught	taught	enseñar
tear	tore	torn	romper
tell	told	told	decir
think	thought	thought	pensar
throw	threw	thrown	lanzar
tread	trode	trodden/trod	pisar
wake	woke	woken	despertarse
wear	wore	worn	llevar puesto
weave	wove	woven	tejer
weep	wept	wept	llorar
win	won	won	ganar
wring	wrung	wrung	retorcer
write	wrote	written	escribir



APÉNDICE 12

Referencia:
Unidad 8A

Verbos en Pasado

Los verbos detallados en los cuadros debajo hacen referencia al tiempo pasado tomando en consideración los distintos aspectos con los que se puede combinar dando como resultado lo siguiente:

Pasado + Aspecto Simple: representa una acción que ocurrió (terminó) en un momento determinado o que se realizaba con frecuencia en el pasado: They *researched* the atom at the University of Cambridge (= *Investigaron/Investigaban* el átomo en la Universidad de Cambridge).

Pasado + Aspecto Progresivo o Continuo: representa una acción que estaba en evolución/desarrollándose en un punto o período del pasado. Se focaliza la idea de "en evolución" y no interesa hacer referencia a cuándo comenzó o terminó dicha acción: They *were researching* the atom when the lab exploded (= *Estaban investigando* el átomo cuando el laboratorio explotó).

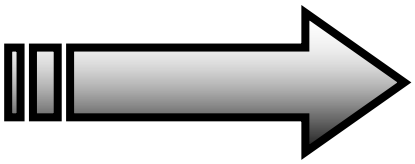
Pasado + Aspecto Perfecto: representa una acción que tomó lugar antes que otra acción en el pasado. Es decir que el pasado perfecto es el pasado del pasado y siempre debe ser utilizado tomando un momento del pasado como punto de referencia: They *had finished* the project before the lab exploded. (= *Habían terminado* el proyecto antes de que el laboratorio explotara).

Pasado + Aspecto Perfecto + Aspecto Progresivo: representa una acción que estaba en desarrollo antes que otro momento del pasado: They *had been working* on the Project for several weeks when the lab exploded. (=*Habían estado trabajando* en el proyecto por varias semanas cuando el laboratorio explotó).

Voz Activa	Tiempo Pasado	Aspecto Simple (= Pasado Simple)	Aspecto Continuo (=Pasado Progresivo)	Aspecto Perfecto (=Pasado Perfecto)	Perfecto + Progresivo (=Pasado Perfecto Progresivo)
	Oraciones afirmativas	I/We/You/They **worked** on a new project last year. He/She/It **represented** a major step in the project.	I/He/She/It **was working** on a new project two weeks ago. We/You/ They **were working** on a new project two weeks ago.	I/He/She/ItWe/You/ They **had worked** on this project before the lab exploded.	I/He/She/It/You/We/ They **had been working** on this project before the lab exploded.
	Oraciones negativas	I/He/She/It/We/You/They **did not (didn't) work** on a new project that day.	I/He/She/It **was not (wasn't) working** on a new project that day. We/You/ They **weren't (were not) working** on a new project that day.	I/He/She/It/We/You /They **had not (hadn't) worked** on a new project since 2003.	I/He/She/It/You/We/ They **had not (hadn't) been working** on a project for many years.
	Preguntas	What **did** I/ he/she/it/ we/you/they **research** in connection with sustainability? **Did** I/ he/she/it/we / you/ they **research** anything connected with sustainability?	What **was** I/he/she/it **doing** at that time? **Was** I/he/she/it **reviewing** the findings? What **were** you/we/they **working** on at that moment? **Were** you/we/they **working** on a new kind of energy?	What **had** I/ he/she/it you/we/they **researched** before they discovered the atom? **Had** I/ he/she/it /you/we/they **worked** on a new kind of energy before they created this engine?	How long **had** I/ he/she/it/ you/we/they **been working** on this project before it was cancelled? **Had** I/ he/she/it/ you/we/they **been working** for many weeks when the project was cancelled?

Voz Pasiva

Tiempo Pasado	Aspecto Simple (=Pasado Simple)	Aspecto Progresivo (=Pasado Progresivo)	Aspecto Perfecto (=Pasado Perfecto)	Perfecto + Progresivo (=Pasado Perfecto Progresivo)
Oraciones afirmativas	First, the research area **was narrowed down** to a specific topic (by me/you/him/her/it/us/them). Second, the research questions **were posed** (by + persona).	The new project **was being developed** at the University of Cambridge (by + persona). The projects **were being developed** at the University of Cambridge (by + persona).	The project **had been developed** by a group of MIT researchers.	No se utiliza esta combinación.
Oraciones negativas	That research question **was not (wasn't) included** in this project (by + person). Those research questions **were not (weren't) included** in the project (by + persona).	The new project **was not (wasn't) being developed** at the University of Cambridge (by + persona). The projects **were not (weren't) being developed** at the University of Cambridge (by + persona).	The project(s) **had not (hadn't been) developed** by a group of MIT researchers.	No se utiliza esta combinación.
Preguntas	What aspect of energy **was developed** (by + persona) at this research center? **Was** this aspect of energy **developed** here? Which **were** the energy systems **developed** (by + person) at this research center? **Were** the energy systems **developed** here?	Where **was** the project **being developed**? **Was** the project **being developed** at the University of Cambridge? Where **were** the projects **being developed**? **Were** the projects **being developed** at the University of Cambridge?	Who **had** the project(s) **been developed** by? **Had** they **been developing** the project when the lab exploded?	No se utiliza esta combinación.



APÉNDICE 13

Referencia: Unidad 9A, sección *Los verbos y la voz pasiva*

Modales:

Reconozcamos los verbos modales en los textos en inglés para lograr una mejor comprensión de los mismos.

1. Su forma es única para todas las personas: I *can*, it *will*, they *should* …
2. Se usan con el infinitivo sin '*to*' (a excepción de *ought*)
3. No utilizan ningún auxiliar adicional para expresar formas interrogativas o negativas

CAN

FUNCION	CASTELLANO	EJEMPLOS
CAN Expresa habilidad para realizar alguna cosa	poder	➢ The energy dissipated **can be compared** to an electric current ➢ the interaction between the thermal quantities **can be described** as a corollary to Ohm's Law ➢ we **can split** the thermal resistance into two parts ➢ it **can only dissipate** its heat to the atmosphere by radiation and convection ➢ Supplier catalogs **can help** to get the best possible choice

COULD

FUNCION	CASTELLANO	EJEMPLOS
COULD	poder/posibilidad en pasado (podía)	➢ With EPROM, however, Intel **could offer** customers chips that **could be erased**. ➢ the researchers tested out how well it **could recognize** words. ➢ These PCs were not very configurable and the user **could not easily modify** them.
COULD (60% probabilidad)	Podría (referencia al futuro)	➢ Samsung **could release** a new set of tablets based on Windows 8. ➢ Intel's new 22-nanometer, tri-gate transistor **could greatly boost** performance

MAY

FUNCION	CASTELLANO	EJEMPLOS
MAY Expresa posibilidad o probabilidad	poder	➢ The impact of Japan's quake **may constrain** the semiconductor sector ➢ semiconductors **may fail** after one very high discharge ➢ the index **may not be** as strong as it appears on the screen ➢ This **may be** due to the variation of the sensitivity….. ➢ The examples and perspective in this article **may not represent** a worldwide view ➢ You **may need** to upgrade your Flash player by visiting this link

MIGHT

FUNCION	CASTELLANO	EJEMPLOS
MIGHT (pasado de may) Expresa menor probabilidad o posibilidad	podría	➢ Why **might** an upstanding firm like Intel **do** this? ➢ How you **might go** about testing the mechanical television monitor? ➢ Manufacturers test their engines and different parts of the engine but the tests **might not be** extensive.

WILL

FUNCION	CASTELLANO	EJEMPLOS
WILL forma el futuro	will indicate indicará	➢ Massively multicore processors **will enable** smarter computers ➢ The pressure **will increase** when the engine rpm is increased ➢ **Will** Intel's Ultrabook **replace** the netbook? ➢ The circuit of a homemade room temperature monitor presented in this article **will accurately display** the temperature variations ➢ IBM plans to create more energy-efficient supercomputers that **will shrink** processors to the size of a sugar cube

WOULD

FUNCION	CASTELLANO	EJEMPLOS
WOULD Pasado de will Se utiliza para formar el condicional en inglés	Would indicate indicaría	➢ Without computers weather forecasting as we know it today **would not be** possible ➢ calculations in quantum physics, molecular modeling and nuclear weapon detonation simulations **would need** a supercomputer ➢ The ultra-pure water used to clean semiconductors and make microchips **would suck** vital minerals right out of your body

SHOULD

FUNCION	CASTELLANO	EJEMPLOS
SHOULD recomendación, consejo	should debería	➢ The maximum temperature **should not exceed** 30 degrees C. ➢ Which heatsink **should** you **use**? ➢ the heatsink **should** be mounted on a vertical panel ➢ heatsinks **should be designed** to have a large surface ➢ Instructions show you how you **should install** a heat sink and fan in your own computer

OUGHT TO

FUNCION	CASTELLANO	EJEMPLOS
OUGHT TO recomendación, consejo	ought to debería	➢ The designer of integrated circuits **ought to be** familiar with these processes. ➢ **Ought** these frequencies **to be** quite precise? ➢ The number of transistors that are fitted into an integrated circuit **ought to double** after a couple of years like clockwork. ➢ MEMS, which are made from silicon wafers, **ought to conform** to the successful IC industry model. ➢ Analysis **ought to be** short, quick and straight to the target.

MUST

FUNCION	CASTELLANO	EJEMPLOS
MUST deber obligación	must deber	➢ all PMOS transistors **must have** either an input from the voltage source or from another PMOS transistor ➢ the voltage relationships **must also be reversed**. ➢ The following guidelines **must be followed.** ➢ This device **must perfectly fit** the space

APÉNDICE 14

Referencia:
Unidad 3A, 6A, 8A, 10A

Más Ejemplos de la Forma -ING

Repasemos aquí las funciones principales que puede cumplir una palabra en **–ing.**

1. sustantivo (reemplazable por *esto*)	the materials used in Engineer**ing** (los materiales usados en la Ingeniería/en *esto*)
2. –ar, -er, -ir o sustantivo cuando es sujeto/objeto en la oración	**Allowing the adhesive to cure for 24 hours before using it** is recommended. (*Esto* (Permitir que el adhesivo se cure por 24 horas antes de usarlo) es recomendado)
3. adjetivo (premodificación de sustantivo)	determin**ing** properties (propiedades *determinantes*)
4. frase verbal conjugada	Materials engineers are develop**ing** a new kind of building material. (Los ingenieros en materiales *están desarrollando* un Nuevo tipo de material para la construcción.
5. QUE (postmodificación de sustantivo)	Today we are able to build mega structures using light-weight, resistant materials. (Hoy podemos construir mega estructuras *que utilizan* materiales livianos y resistentes.)
6. preposición + -ar, -er, -ir	The table shown is useful for estimat**ing** the amount of aggregates needed. (La tabla mostrada es útil *para calcular* la cantidad de agregados necesaria.)
7. verbo no conjugado (ando – endo – información adicional acerca de una idea completa)	The properties of materials are discussed, giv**ing** details of their commonalities. (Las propiedades de los materiales son discutidas, *dando* detalles de sus particularidades.)

Función sustantivo (esto)

SIGNIFICADO	FUNCIÓN	EJEMPLOS
Cuando las formas –ing cumplen la función de sustantivo, se pueden reemplazar por la palabra *esto* (ésta, éstos, éstas). Para su interpretación usamos un	Sustantivo	• Large pores of the POA and RHA pastes were increased indicating *coarsening* of pores owing to possible attack on CSH (Los grandes poros de las pastas POA y RHA fueron incrementados indicando *engrosamiento* de los poros debido al possible ataque a los CSH)

equivalente en castellano y su lugar en la frase nominal es: **(artículo) + (adjetivo) + -ing** En algunos casos también la podemos reemplazar por una construcción que empieza con una forma–ar, -er, -ir		• the *manufacturing* of these devices in factories (la *fabricación/ manufactura* de estos dispositivos en fábricas) • Global *warming* is now almost universally accepted (el *calentamiento* global está universalmente aceptado ahora) • Some is used for domestic hot water and some for space *heating* (Algo es usado para agua caliente doméstica/en el hogar y un poco para *calentamiento* de espacios) • a rapid expansion of wood frame *buildings* (una rápida expansion de *construcciones/edificios* de marcos de madera) • the first reinforced concrete *building* constructed in the United States. (el primer *edificio* de hormigón reforzado construido en los EEUU) • The *building* introduced the practicability of reinforced concrete as a building material (El *edificio* introdujo la practicidad del hormigón reforzado como un material de construcción. – el primer "building" funciona como sustantivo y el segundo como adjetivo)

Función –ar, -er, -ir (sujeto/objeto - reemplazable por esto)

SIGNIFICADO	FUNCIÓN	EJEMPLOS
En algunos casos una construcción que empieza con una forma –ing forma una estructura que es el sujeto o el objeto de la oración. En dicho caso la forma –ing se interpreta usando un sustantivo o una forma terminada en –ar, -er, -ir	Sujeto -ar, -er, -ir (o un sustantivo) Objeto	• *Finding the aggregate for the dam, and transporting it and the cement to the dam site* are important factors. (*Encontrar* el agregado para el dique y transportarlo a él y al cemento al sitio del dique son factores importantes. – en este caso resulta dificil encontrar un equivalente en sustantivo para "encontrar") • *Dealing with spent nuclear fuel* is as problematic as greenhouse gases (*Encargarse de* combustible nuclear utilizado es tan problemático como los gases de efecto invernadero) • *Cleaning carbon dioxide from the Earth's atmosphere* is not one of my fields of expertise (Limpiar/La limpieza del dióxido de carbono de la atmósfera de la Tierra no es uno de mis campos de experticia.) • *Relying on the Sun rather than petroleum* would also allow us to cut down on carbon dioxide. (*Depender del/La dependencia en el* sol en vez del petróleo nos permitiría reducir el dióxido de carbono.) • *Heating of swimming pools* seems to be the largest application. (La *calefacción* de las piletas de natación parece ser la aplicación más grande.)

	-ar, -er, -ir (o un sustantivo)	• The process of cement elaboration involves *mixing ingredients carefully*. (El proceso de elaboración del cemento involucra *mezclar* cuidadosamente/*la mezcla* cuidadosa de los ingredientes.)

Función adjetivo

SIGNIFICADO	FUNCIÓN	EJEMPLOS
Las formas ING pueden modificar a los sustantivos, en cuyo caso su posición **dentro de la frase nominal** sería: ***(artículo) + -ing + Noun***	adjetivo	• a step in the *manufacturing* process (un paso en el proceso *de manufactura*) • a flat *insulating* surface (una superficie *de aislación*) • the fastest *selling* retail object of the time (el objeto de venta por menor de más rápida *venta* de la época) • engineers worked out new designs and *manufacturing* techniques (los ingenieros lograron hacer nuevos diseños y técnicas *de fabricación*.) • A lot of time is required to refine *manufacturing* processes (Se require mucho tiempo para refinar los procesos *de fabricación*.) • its *corresponding* strain value (su valor de tension *correspondiente*) • the influence of the *manufacturing* process on these mechanical properties (la influencia del proceso *de fabricación* sobre estas propiedades mecánicas) • A very *promising* battery project is underway at MIT (Un projecto de batería muy *prometedor* está en ejecución en el MIT.) • the *existing* unwanted gases will slowly dissipate (los gases indeseados *existentes* se disiparán lentamente) • a conventional *manufacturing* process (un proceso *de fabricación* convencional) • accelerated *aging* test equipment were built (instrumental de testeo de *envejecimiento* acelerado fue construido) • *rising* sea levels problems. (problemas de los niveles del mar *ascendientes*) • The cement used in concrete is not used as a *building* material (El cemento utilizado en el hormigón no es usado como un material *de construcción*.) • When I began my *engineering* education long ago… (Cuando comencé mi educación *en la ingeniería* mucho tiempo atrás…) • Selection of a w/c ratio gives the engineer control over two *opposing*, yet desirable properties (La selección de la proporción de a/c le da al ingeniero un control sobre dos propiedades *opuestas*, pero deseadas.) • The receptors would be located near *existing* hydroelectric plants (Los receptores serían ubicados cerca de plantas hidroeléctricas *existentes*.) • The *orbiting* mirrors would be, perhaps, a mile in diameter. (Los espejos *en órbita* serían, tal vez, de una milla de diámetro).

		• It is important to incorporate sufficiently accurate *measuring* mechanisms. (Es importante incorporar mecanismos *de medición* suficiente precisos.) • *incoming* solar radiation in clear weather • the *incoming* power (la energía *que entra/ de entrada/ entrante*) • carbon-*containing* fuels (combustibles *que contienen* carbono) • national and international *engineering* projects (proyectos *de ingeniería/ ingenieriles* nacionales e internacionales) • a unique or significant construction or *engineering* technique (una única o significativa técnica *de ingeniería* o construcción) • …to meet the City's *growing* demand for water (para alcanzar la demanda *creciente* de agua de la ciudad) • the use of concrete as a *building* material (el uso del hormigón como un material *de construcción*)

Función frase verbal conjugada

SIGNIFICADO	FUNCIÓN	EJEMPLOS
Las formas (ING) pueden formar parte de una frase verbal conjugada, en cuyo caso su posición **dentro de la frase verbal** sería: ***Be + Ving***	frase verbal conjugada	• Adhesives *are being* increasingly *used* in civil engineering applications (Los adhesivos están *siendo* usados cada vez más en aplicaciones de ingeniería civil.) • Different analytical approaches and methods *are being used* to investigate this. (Diferentes enfoques y métodos analíticos están *siendo* usados para investigar esto.) • …the rock that *is being bound* by the hardened cement.(…la roca que está *siendo* unida por el cement endurecido) • solar panels *are not producing* energy for your home (paneles solares están *produciendo* energía para su hogar) • When I *was teaching* in India in the '60s… (Cuando yo *estaba enseñando* en India en los 60…)

Función QUE

Las formas -ing pueden postmodificar un sustantivo, acompañadas de otras palabras, y aportar	QUE	• The resistance of a material to a force *tending to tear it apart…* (La Resistencia de un material a una fuerza *que tiende a* separarlo…) • the relative influence of factors

información adicional acerca del sustantivo núcleo. Entonces obtenemos la siguiente fórmula: ***art + adj + noun + -ing*** Al interpretar la frase, comúnmente se utiliza la partícula "que"		*affecting the shrinkage of foam concrete... (*la influencia relativa de factores *que afectan* el encogimiento del hormigón aireado... • Solar energy *coming from solar panels* produces electricity very quietly. (La energía solar *que proviene/proveniente* de paneles solares produce electricidad de modo muy silencioso – hay casos en los que encontramos un adjetivo que pueda reemplazar la estructura encabezada por QUE) • a major disadvantage for businesses or industry *wishing to install solar panels*... (una desventaja importante para los negocios y las industrias *que desean* instalar paneles solares...) • the steering mechanism of the satellite *carrying the mirror...* (...el mecanismo de giro del satellite *que soporta/que lleva* el espejo...) • the light energy *appearing as heat* (la energía de la luz *que aparece* como calor)

Función Preposición + -ar, -er, -ir

SIGNIFICADO	FUNCIÓN	EJEMPLOS
Las palabras en –ing (solas o introduciendo una estructura más larga) pueden seguir a una preposición ***Prep + ing***	-ing + preposición (Interpretado como –ar,-er, -ir o como un sustantivo)	• Concrete is formed from *combining water, a special cement and rock* (El concreto se forma *de la combinación del/al combinar el* agua, un cemento especial y roca. • a means of *bonding together similar or dissimilar materials* (una manera *de combinar* materiales similares o disímiles) • the maximum tension the material can withstand without *tearing*. (la tension maxima el material puede resitir *sin romperse*) • The first step in *developing a test method and model* for *predicting the environmental fracture data* (el primer paso *para desarrollar/para el desarrollo* de un método de prueba y modelo *para predecir* la data de ruptura medioambiental) • Solar power at present is faulted for *being available only during clear days* (La energía solar en el presente tiene el defecto *de estar* disponible sólo en los días soleados) • This proposal concentrates on *dealing with these issues.* (Esta propuesta se centra *en tratar* estos asuntos.) • Solar panels can be installed on top of many rooftops, which eliminates the problem of *finding the required space for solar panel placement.* (Los paneles solares pueden ser instalados en los techos, lo que elimina el problema *de encontrar* el espacio requerido para la instalación del panel solar.) • The indispensable first step in *devising a solution in the real world* was to define the

	-ando, -endo cuando la preposición es BY (denota la manera/forma en que algo es realizado)	problem. (El primer paso indispensable *para idear* una solución en el mundo real fue definir el problema.) • We still have a lot of competence in *developing new technology.* (Todavía tenemos mucha capacidad *para desarrollar* nueva tecnología.) • …in spite of *losing a good part of our manufacturing skills*. (…a pesar *de perder* gran parte de nuestras habilidades de manufactura.) • I learned that some irrigation pumps were solar-powered without *using any electrical components.* (Yo aprendí que algunas bombas de irrigación eran impulsadas por energía solar *sin usar* ningún componente eléctrico.) • …the business of *making and selling the collectors and the receptors for the various applications.* (…el negocio *de hacer y vender* los colectores y los receptores para las variadas aplicaciones.) • Solar electric cells, besides *being* expensive, are not very efficient in *converting* light into electricity. (Las celdas eléctricas solares, *además de ser* caras, no son muy eficientes *para convertir* la luz en electricidad.) • This is preferably done by *using feedback from small sensors*. (Esto es preferentemente hecho *usando* retroalimentación de pequeños sensores.) • It is produced by *burning fossil fuels.* (Es producido quemando combustibles fósiles.) • It produces an effect on volume stability indirectly by *allowing some shrinkage*. (Produce un efecto en la estabilidad del volumen indirectamente permitiendo algo de encogimiento.) • A measurement of elasticity obtained by *dividing stress* (una medición de elasticidad obtenida dividiendo la fatiga)

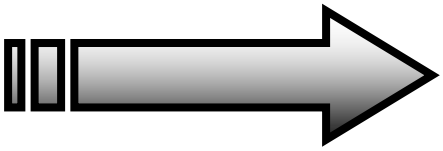
Recordemos algunas preposiciones y sus significados:

about	*alrededor de, sobre*	**above**	*por encima de*
after	*detrás de, después de*	**among**	*entre (tres o más)*
at	*en, junto a*	**before**	*antes de, delante de*
behind	*detrás de*	**for**	*para, por, durante, desde hace*
beneath	*debajo de*	**in**	*en, dentro de*
between	*entre (dos o más)*	**like**	*como, igual a*
by	*por, junto a*	**of**	*de*
except	*excepto*	**on**	*en, sobre*
from	*de, desde*	**to**	*a, hasta, hacia*
over	*por encima de, al otro lado*	**up**	*hacia arriba*
through	*a través de*	**with**	*con*
till = until	*hasta*		
under	*por debajo de*		
without	*sin*		

Función frase verbal no conjugada –ando, -endo (agregando información adicional acerca de toda una idea)

SIGNIFICADO	FUNCIÓN	EJEMPLOS
Las formas ING pueden además formar parte de una **frase verbal no conjugada**, cuya interpretación se formula con una palabra que termina en *endo - ando*	frase verbal no conjugada	• the presence of water from data obtained *using double-torsion mild steel adhesive joints* (la presencia de agua en datos obtenidos usando juntas adhesivas de acero suave de doble torsión) • possible attack on calcium silicate hydrate (CSH) *depending on the type of pozzolan used* (possible ataque al hidrato de silicato cálcico dependiendo del tipo de puzolana usada) • Large pores of the POA and RHA pastes were increased *indicating coarsening of pores owing to possible attack on CSH* (Grandes poros de POA y de pastas RHA fueron incrementadas indicando engrosamiento de los poros debido a posible al CSH) • Properties of the cement will vary *depending on the relative amounts of these compounds.* (Las propiedades del cement variarán dependiendo de las relativas cantidades de estos componenetes.) • If an engineer designs a dam *assuming a certain concrete strength*, …. (Si un ingeniero diseña un dique asumiendo una cierta Resistencia del cement, …) • A way to do this is to move to an electrical economy, *producing electricity from sunlight* (Una manera de hacer estos es movernonos a una econocmía eléctrica, produciendo electricidad del sol)

Nota: Muchos de los ejemplos presentados en este apéndice son del texto “Solving the energy problem” por el Profesor William Schreiber del MIT. El texto se encuentra disponible en el campus virtual de la UTN FRP en la unidad de Práctica Complementaria.



APÉNDICE 15

Referencia:
Unidad 11A

Conectores en la lengua inglesa

1	after	después
2	also, too	también, además
3	although	aunque
4	apart from	aparte de
5	as a result	como resultado
6	as if	como si
7	as soon as	en cuanto, tan pronto como
8	as well as	así como también
9	at the beginning	en el principio
10	because of	debido a
11	before	antes
12	both…and	ambos; ya sea x como y
13	but	pero
14	consequently	consecuentemente
15	due to	debido a
16	eventually	eventualmente
17	even though	aunque
18	finally	finalmente
19	firstly	en primer lugar
20	for example	por ejemplo
21	for instance	por ejemplo
22	furthermore	además, es más
23	however	sin embargo
24	if	si
25	in addition	además
26	in case	en caso
27	in order (not) to	para (no)
28	in spite of	a pesar de
29	in spite of… the fact that	a pesar del hecho que…
30	in the end	finalmente
31	like	similar, como
32	likewise	de la misma manera o forma
33	moreover	es más, además
34	neither…nor	(1) ningún; (2) ni x ni y
35	nevertheless	sin embargo, no obstante
36	on the other hand	por otra parte, por otro lado
37	on the contrary	por el contrario
38	otherwise	si no, de otro modo
39	since	(1) desde (tiempo) (2) ya que, puesto que
40	such as	tal como, tales como
41	so	por lo tanto, por consiguiente
42	then	entonces
43	therefore	por lo tanto, por ello
44	though	aunque
45	to	para
46	to begin with	para empezar
47	thus	por lo tanto, por consiguiente
48	until , till	hasta
49	while	(1) mientras (2) mientras que (contraste)
50	where	donde
51	whereas	mientras que, aunque
52	whether	si

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