National Center for
Technological Literacy

Museum of Science, Boston

Engineering the Future:

Designing the World of the 21st Century™

Engineering the Future: Designing the World of the 21st Century™ is a full-year, introductory engineering course, suitable for students in grades 9-12. The course provides a strong foundation in physics and offers students an opportunity to explore the social, historical, and environmental contexts of emerging technologies. A central goal of the course is to build technological literacy for every student. Throughout the course, students develop a practical understanding of how we all are influenced by technology, and how we all influence future technological development by the choices we make as workers, consumers, and citizens. The course is *not* intended exclusively for pre-engineering students or students who wish to enter technical trades.

This course is currently being field tested in over 100 classrooms throughout Massachusetts, New Hampshire, Maine, Vermont, Pennsylvania, New York, New Jersey, and Michigan. Educators who are interested in considering this course for the 2006-2007 school year are urged to send an email message to **etf@mos.org**.

Course Goals

The course is aimed specifically at seven standards in technology and engineering: Engineering Design, Manufacturing, Construction, Communication, and Energy Systems: Fluid, Thermal, and Electrical. The course is consistent with the *National Standards for Technological Literacy* (ITEA 2000). The major goal of the course is to give students opportunities to develop increasingly complex answers to the following essential questions:

What is technology?

Throughout the course, students will build a deep and rich understanding of the term "technology", including the earliest technologies invented by humans, the evolution of technologies for food, shelter, and clothing, the technologies of the modern world, and appropriate technologies for developing nations.

What do engineers do?

Students will learn about many different kinds of engineers, the type of work that engineers do, and who engineers are as people through first-person textbook chapters written by a diverse cadre of working engineers. In class, the students will be the engineers themselves, applying the engineering design process to design and build their own technologies.

What are the implications of new technologies?

Every day, as workers and consumers in modern society, we collectively influence how new technologies are developed and introduced—whether we realize it or not. Students will be encouraged to analyze their roles in the designed world—as well as the effects of technological revolutions of the past—as they consider how they wish to affect the world of the future.

Course Outline

Engineering the Future is broken into four “Projects,” that reflect seven technology/engineering standards. Each Project includes both hands-on activities and related textbook chapters.

Project 1: Engineering Design and Manufacturing

Project 1 begins with an engaging individual task to design a new kind of cell phone holder. Students sketch their design ideas and construct mock-ups with simple materials. The students then learn the basics of engineering drawing, and how important teamwork and planning is in the completion of a project. The major focus of the project is to follow the steps of the engineering design process as a team with the task to design an organizer that meet the needs of a specific audience.

Project 2: Construction and Integrated Systems

In Project 2, students explore the problem of urban sprawl and how certain construction techniques can lead to more sustainable urban development. The students learn about various forces that act on structures by designing a backyard deck and analyzing structural failures. Through text readings and activities, the students learn about material properties of common construction materials as well as some basic concepts related to energy transfers and climate control systems. They experiment with different materials in an effort to design structures well suited for a range of environmental conditions. The culminating goal is to present a design and a model of a multi-functional, energy-efficient structure.

Project 3: Fluid and Thermal Systems

A primary goal of Project 3 is for students to understand the interplay between science and engineering as they investigate the topics of thermodynamics, energy transfer, fluid dynamics, work, and motion. Students build a "putt-putt boat" that runs using a fluid/thermal engine. Their challenge is to redesign the boat. To do that, students learn key scientific concepts that help explain how the boat operates so that they have a better idea of how to redesign it. As students build knowledge, they take on the role of working engineers, applying science to the redesign of a system. The students test their redesign ideas to see if those ideas meet their own criteria for improvement. Finally, students prepare patent applications to protect their creative ideas from exploitation by others.

Project 4: Electricity and Communication

In Project 4, students work with Snap Circuits, an electronics kit in which components can be "snapped" together. Using switches, motors, speakers, resistors, light bulbs, and LEDs, they will explore how electricity flows through different circuit arrangements and apply their understanding to a series of small design projects, including a burglar alarm and a multi-speed fan. Once students learn how a multimeter works, they study energy output from generators and solar cells. Project 4 concludes with an exploration of electronic circuits useful for communication.

Instructional Materials

The textbook for this course is written in the first-person by practicing engineers. Men and women, from various ethnic and cultural backgrounds, tell what it is like to practice their professions and how they came to do what they do.

The Engineer’s Notebook mimics the way engineers and designers record their research, designs and conclusions. The Notebook aids in the illustration of background science and math connections to each design challenge. This engineering workbook lays out the design process for each challenge and provides ample space for students to brainstorm and design.

The Teacher's Guide is divided into four Projects. Most of the major projects are developed by teams of students in a manner parallel to the way that engineers work in industry. Concepts and skills build on one another, and those learned in a prior project are further elaborated and practiced in those that follow.

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