It's All about Engineering!

Engineering Context Suggestions for TeachEngineering Lessons and Activities

Lessons and activities published on TeachEngineering must include engineering content and/or context. To do this, most lessons employ one or more of the three approaches described below. TeachEngineering curricula reviewers are also open to other creative ways that engineering may be used as the vehicle for teaching science and math fundamentals.

1. Design/Build Activity

One way to provide engineering content and/or context is to include a hands-on activity in which students design and build something that meets a given set of constraints that incorporate scientific and/or technology principles. In some cases, students might create a design but not build it. In either case, students are asked to think like engineers. As an example, in the "Sounds Like Music" lesson, students create musical instruments and in doing so learn about the principles of sound. They apply the science concepts of frequency/pitch to the design of something that performs a particular function. As another example, "Egg-cellent Landing" provides an egg drop activity as a way for students to learn about what is involved in landing a robot on Mars.

2. Design a Part of Something to Fit a Particular Application

Another way to provide engineering content and/or context is to incorporate an activity that teaches a science concept used in an engineering application in which the motivation for learning the science concept is to solve the engineering design problem. For instance, rather than presenting a lesson that teaches students what friction is and how to measure the friction coefficient, the concepts are presented as part of a design problem. In this case, students might act as tire engineers for Goodyear, challenged to design part of a tire: measuring the friction coefficient of various materials to determine the best material for the surface of the tire. By this approach, students are still achieving the same learning, but in the *context* of a design problem. Another good example uses the design of boats to examine buoyancy (see the "What Floats Your Boat?" lesson and its "Clay Boats" activity).

3. Reverse Engineer Something to Learn about What It Does and How It Works

Yet another way to provide engineering content and/or context is to provide students with something that has already been built and challenge them to figure out how it works. To do this, students might take something apart physically in the classroom, or simply examine in detail how something is put together in order to understand why it was designed that way. This approach provides the opportunity for students to think about ways to make it better (improve the design).

Tips to incorporate engineering into your lessons and activities…

1. When suitable for the lesson or activity, introduce the steps of the **engineering design process** at a level of complexity understandable by the target grade level. For example, elementary school-level students might be introduced by the steps delineated in the table below. Also, sometimes it is appropriate to use the engineering design process steps to guide the activity, noting how it is **different from the scientific method**. For examples, see Hot Problem Solving and Modern Day Pyramids.

Scientific Method	Engineering Design Process
Question: **"How can we prove this theory right or wrong?"**	**Challenge:** **"What can we create to solve this?"**
background and research	Brainstorm many different design ideas.
hypothesis	Select a design from your ideas.
describe procedure	Analyze and explain your design.
observation	Build and test your design.
conclusion	Review and decide if your design is the best one possible .
	Redesign (iterate) based on what you learned.

2. As part of the engineering design process, when appropriate, encourage students to cultivate their **engineering teamwork and brainstorming skills**. Remind students that in brainstorming, no idea or suggestion is "silly." All ideas should be respectfully heard and recorded. Take an uncritical position, encourage wild ideas and discourage criticism of ideas. Have students raise their hands to respond. Write their ideas on the board.

Brainstorming Guidelines
No negative comments allowed.
Encourage wild ideas.
Record all ideas.
Build on the ideas of others.
Stay focused on the topic.
Allow only one conversation at a time.

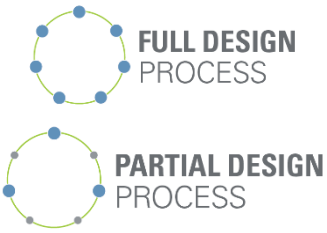
3. As appropriate, include fundamental **engineering vocabulary words and definitions**, suitable for the target grade level. Examples:

Word	Definition
brainstorming (ES)	Thinking of ideas as a group.
brainstorming (MS)	A method of shared problem solving in which all members of a group quickly and spontaneously contribute many ideas.
constraint	A limitation or restriction. For engineers, constraints are the limitations and requirements that must be considered when designing a workable solution to a problem.
design	(verb) To plan out in systematic, often graphic form. To create for a particular purpose or effect. Design a building. (noun) A well thought-out plan documented in detail.
design problem	A challenge to solve by creative ideas, teamwork and critical thought.
engineer	A person who applies his/her understanding of science and math to creating things for the benefit of humanity and our world.

engineering (ES)	Creating new things for the benefit of humanity and our planet.
engineering (MS)	Applying scientific and mathematical principles to practical ends such as the design, manufacture and operation of efficient and economical structures, machines, processes and systems.
engineering design process (ES)	A series of steps used by engineering teams to guide them as they make something that meets a need or solves a problem. Steps: brainstorm, design, plan, analyze, create and improve.
engineering design process (MS and HS)	A series of decision-making steps used by engineering teams to guide them as they develop new solutions, products or systems. The process is cyclical and may begin at, and return to, any step. See more at http://www.teachengineering.org/engrdesignprocess.php
engineering design	The process of devising a system, component or process to meet desired needs. (Source: Accreditation Board for Engineering and Technology, Inc.)
iteration	Doing something again, like starting over at some point in the design process.
mock-up	A layout of printed matter, used for demonstration, study or testing.
model (ES)	(noun) A small but exact copy of something. (verb) To make something to help learn about something else that cannot be directly seen or tested.
model (HS)	(noun) A representation of something for imitation, comparison or analysis, sometimes on a different scale. (verb) To simulate, make or construct something to help visualize or learn about something else (as the living human body, a process or an ecosystem) that cannot be directly observed or experimented upon, often at a smaller scale.
prototype	A first attempt or early model of a new product or creation. May be revised many times.
simulation	Imitating the behavior of some situation or process, especially for the purpose of study or experimental testing.

4. And, take advantage of the **Engineering Connection** component required for every lesson and activity to write a few sentences that clarify and associate the presented science and math material and concepts to real-world engineering relevant to youngsters. Click on any TE activity, lesson or unit to read its "engineering connection" on the first page.

   Note that TeachEngineering also indicates the level of engineering present in its curricular documents by a badge designation of "full" or "partial" design process for those documents that go beyond relating science and/or math concepts to engineering.



Version: July 2014