



*Drexel-SDP GK-12 ACTIVITY*

## What is Engineering?

**Subject Area** Science and Technology, Problem Solving

**Associated Unit** Intro to Engineering

**Activity Title** What is Engineering?

**Grade Level** 8 (9-12)

**Time Required** 1 – 30 minute period and 1 or 2 – 60 minute periods

(The first period is required to introduce the activity, then the students will need at least an hour to do their research with supervision, depending on their familiarity with internet searches. They may require additional periods during the week or homework assignments to complete the work. The final one hour period is needed for group presentations.)

**Group Size** 2 - 3

**Expendable Cost per Group** \$0

### Summary

Students will be introduced to the broad field of engineering and all of the associated engineering majors. In this lesson, common misconceptions will be clarified about what engineers are and what they do. Students will discover that engineers solve everyday problems. Students will do their own research. They will identify how engineers use math, science and technology in problem solving.

### Engineering Connection

Engineers are responsible for designing and creating complex projects, products and processes. Engineering is everywhere. There are so many different types of engineering today and interdisciplinary fields that even professionals would have a hard time finding a one size fits all definition. Students will work in teams like engineers to identify some of the creative problem-solving used by engineers. They will identify current engineering projects and jobs in the world around them and correlate math, science and technology to engineering problems.

## Engineering Category

Provides engineering analysis or partial design.

## Keywords

Engineering, Introduction, Problem-solving, Real-world

## Educational Standards

- Science:
- Math:

## Pre-Requisite Knowledge

Students may use Microsoft PowerPoint to present the findings of their research, but this is not required.

## Learning Objectives

After this lesson, students should be able to:

- **Identify three different types of engineering and describe the responsibilities of each type.**
- **Explain that engineers use math and science to solve real-world problems, help the environment, help people and create things for the benefit of society.**

## Materials List

Each group needs:

- Access to a computer for research.
- Hand-outs on different engineering majors or magazine like “Go For It Engineering”
- Poster of flipchart paper to present findings or make props for skits

## Introduction / Motivation

## Vocabulary / Definitions

Word	Definition
engineering	See below
discipline	See below
art	See below
profession	See below

## Procedure

### Background

When I ask “what is an engineer?” or “what does an engineer do?” I get a variety of responses including \_\_\_\_\_ (i.e. “fixes things like cars and trains”, “repairs buildings”, “build things”, etc.) These responses do not describe the engineering profession.

One of the reasons you may be confused about this is because the word is used to describe other jobs like train drivers, or building maintenance professionals. This is not uncommon in other fields that you are aware of too. People who have doctorate degrees (i.e. PhD, EdD, etc.) are called “Dr.” but they are not medical doctors and if you are sick, they wouldn’t be the person to

help you. In the same way, lawyers provide legal guidance or counsel and are often called counselors, but if you have a behavioral or emotional problem, they are probably not qualified to help you. You would want to see a psychologist. So let's talk about what engineers really do and what the engineering profession really is.  
[Put this on the board.]

**“Engineering** is the discipline, art and profession of acquiring and applying technical, scientific and mathematical knowledge to design and implement materials, structures, machines, devices, systems, and processes that safely realize a desired objective or inventions.” (Wikipedia 2009)  
That was a big sentence, so let's break it down. [Have students give examples of each item discussed. Some are provided. Perhaps they have seen some of the commercials promoting research instead of products that you can call to mind.]

1. **Engineering** is the discipline – It requires training or special knowledge, skills and rules.
2. art - the principles or methods governing any craft or branch of learning: *the art of baking; the art of selling.*
3. profession - a vocation requiring knowledge of some department of learning or science: *the profession of teaching or medical profession*
4. acquiring and applying technical, scientific and mathematical knowledge – Engineers use math, science and technology to solve problems. Explain that sometimes engineers do research when a readily available solution is not present or can not be borrowed from another application. [Give an example.]
5. to design and implement materials, structures, machines, devices, systems, and processes that safely realize a desired objective or inventions – Engineers solve all types of problems using all types of solutions that is why there are many different specialties or sub-disciplines. Make a comparison with different types of doctors – pediatricians, oncologists, neurologists, allergists, etc. Some are internist, some are surgeons, etc. One might require several types of doctors to solve a particular medical issue, like having a baby.
6. that safely realize a desired objective or inventions – Engineers work within a framework starting with a problem. There may be many possible solutions, but they are charged with finding one that meets all the required constraints or goals.  
Engineers are involved in all stages of the life cycle of their solutions or inventions including initial development, design, building, and operation.

[Show the video – “Ask An Engineer” downloadable for free at:  
<http://www.teachersdomain.org/resource/eng06.sci.engin.design.askengineer/>]  
Ask the investigating questions after the video.

Now let's investigate different types of engineering individually. I will provide you with a handout that contains information about all of the engineering majors, then assign your group 1 or 2 of the majors. You will be given time to do some research on this type of engineer, find out what they do, identify a problem they would solve and how they use math and science to solve the problem. When you are finished you will present your findings to the class either in a PowerPoint presentation, poster or by a skit.

### **Before the Activity**

Do pre-assessment survey.

Create matching game - Print and tape the types of engineering disciplines and the problems to index cards. Make enough sets so that groups of 4 students can work on them all at once. You may substitute the problems below for current events or topics you know your class is familiar with.

**With the Students**

1. Give students handouts of engineering majors.
2. Assign engineering major to each group of two students. (There are a total of 22. Depending on the size of the class and time constraints you may assign 2 majors instead of 1.)
3. Give the students at least 60 minutes to use the internet to come up with a current problem that their assigned engineering type might solve. They may use news sites, encyclopedia sites, job postings, etc.
4. Ask them to identify how math and science might be applied to the problem. Students should only use vocabulary that they understand.
5. Have each team (group of two) give a 2 minute presentation of their findings.
6. As a final assessment, have each team work with another team (so break into groups of 4) and do the “Engineering Matching Game”. Match a problem to a type of engineer.

- Aerospace	- Design a new military fighter jet to fly farther while using less energy.
- Agricultural	- If we could design a way to grow plants in fluids, we could use less space to grow food and ensure proper nutrients.
- Architectural	- We need to find the most efficient way to heat a new skyscraper.
- Bioengineering/Biomedical	- The development of an adjustable prosthetic device would make it more affordable for children who are constantly growing.
- Chemical/Biological	- How can we take raw materials like petroleum and make new plastics?
- Civil	- Planning, design and construction are needed for a new airport in Philadelphia because the existing one is too small for the current population.
- Computer	- A computer small enough and heat resistant enough to put in a new toaster is necessary to automatically stop when the toast is burning.

- Electrical	- Cleaner and cheaper fuel alternatives are required to supply electrical energy to homes and businesses in our society.
- Engineering management	- Someone is needed to manage the cost of a large scale project.
- Engineering science/physics	- An applied physicist is needed for an optics project.
- Environmental	- Chemicals from a dry cleaning plant have leaked into the ground and threaten the water supply in a nearby stream.
- General Engineering	- This is an engineering “wild card”
- Industrial	- Streamlining operation and emergency rooms in a hospital
- Manufacturing	- A process is needed to manufacture T-shirts out of corn or bamboo.
- Mechanical	- Elderly people who want to be independent could benefit from a friendly robot to help stimulate conversation to keep their minds sharp.
- Materials	- A coating to make light weight, warm clothing water resistant is needed by the U.S. Ski team.
- Mining	- Extracting and processing minerals from the natural environment.
- Naval Architectural	- The U.S. Navy needs to design and construct new marine vehicles to meet damage control and safety regulations.
- Nuclear	- A community is interested in obtaining a nuclear power plant to supply electricity in a clean efficient way with minimal pollution or waste.
- Petroleum	- A plan is needed to extract oil from an extremely difficult location because all of the easily accessible oil deposits have been depleted.
- Software	- A complex software system is required to manage the timing of all

	the traffic signals in a city.
- Systems	- Many different types of engineers are required to work on a problem. Help is needed to make sure they all work together to meet their goals and schedule.
- Ocean	- Beach erosion is destroying the shoreline at Cape May, NJ and we fear that many historic landmarks will be lost forever.

### Attachments

Go For It Engineering - handout

### Safety Issues

- None

### Troubleshooting Tips

- None

### Investigating Questions

These questions are from the “Questions for Discussion” part of the “ Ask an Engineer” video site. (see URL above)

- One of the engineers in this video says she liked to solve puzzles when she was young. What is one problem or puzzle that the engineers in this video solved?
- Why can't aquariums use water from right outside their doors in their exhibit tanks? How did the engineers in this video solve this problem?
- Think of a problem or puzzle in your home that engineers had to solve. How did they solve it? For example, how did engineers get safe drinking water to your home? How do you keep your home a healthy temperature?
- What do you want to know about? Do you know an engineer whom you could ask about it?

### Assessment

#### Pre-Activity Assessment

*Provide the students with an open-ended survey to find out what they know about engineering and what engineers do.*

#### Activity Embedded Assessment

*Use the following rubric to grade the team presentations:*

1. *Worked in an effective team (i.e. all members participated) (20%)*
2. *Clearly defines type of engineering (20%)*
3. *Clearly demonstrates what that type of engineer does (20%)*

4. *Provides a clear example of a real world problem that their type of engineer solves (20%)*
5. *Demonstrates a math and/or science principle that can be used by the engineer to solve the problem (can be as simple as a single equation.) (20%)*

### **Post-Activity Assessment**

*Play a matching game within each group using index cards. Put one type of engineering on each card and write an engineering problem that may be solved by each type of engineer on a corresponding card. Shuffle the cards. Match a card with a real world engineering problem on it with a type of engineering. Give each group an appropriate time limit. Go over the answers with the class. Repeat game with a shorter time limit.*

### **Activity Extensions**

Have students independently write an essay about a problem they see in their community, or envision how they would like to see something changed in the world. Identify how engineering would contribute to finding a solution to the problem.

### **Activity Scaling**

Provide students with more or less assistance in the research part of the activity depending on their abilities.

### **References**

Engineering. (2009, November 3). In *Wikipedia, The Free Encyclopedia*. Retrieved 18:01, November 4, 2009, from <http://en.wikipedia.org/w/index.php?title=Engineering&oldid=323635838>

### **Owner**

Drexel University GK-12 Program

### **Contributors**

Jade Mitchell-Blackwood and Donna Barreca

### **Copyright**

Copyright 2010 Drexel University GK-12 Program. Reproduction permission is granted for non-profit educational use.