

Chemical Engineering

Have you ever wondered what was in your laundry detergent or how the fabric of your athletic shirt was made? Or who designs batteries to be used in space? Those are just a few examples of items that were probably impacted by chemical engineers. Chemical engineers solve problems to create products that people depend on every day and to improve the products and processes of tomorrow. And they do it by applying knowledge of disciplines from physics, chemistry, and mathematics to microbiology, biochemistry, and economics.

CATEGORY

- Engineering

OBJECTIVES

By the end of this session, participants will be able to:

- Understand what chemical engineers do.
- Demonstrate key engineering concepts.

SUPPLIES

- Various kitchen ingredients (see Introduction)
- A large collection of pennies
- For each team of three Explorers, provide the following:
 - 20 to 30 dull pennies
 - 1/4 cup white vinegar
 - 1 teaspoon salt (NaCl)
 - One shallow, clear glass or plastic bowl (not metal)
 - One to two clean steel screws or nails
- Water
- Measuring spoons
- Paper towels

ADVISOR NOTE: Text in italics should be read aloud to participants. As you engage your post in activities each week, please include comments, discussions, and feedback to the group relating to **Character**, **Leadership**, and **Ethics**. These are important attributes that make a difference in the success of youth in the workplace and life.

ACTIVITY 1

Discussion

Ask: *How do you think the following disciplines are connected?*

- *Bioinformatics*
- *Biotechnology*
- *Cheminformatics*
- *Environmental engineering*
- *Fluid dynamics*
- *Molecular engineering*
- *Nanotechnology*
- *Polymer and plastics engineering*

- *Textile engineering*

Explain that all of the disciplines on that list are supported by the work of chemical engineers.

This description of the field of chemical engineering is from Columbia University: “Chemical engineering includes creating ultra-strong fibers, fabrics, adhesives, and composites for vehicles; bio-compatible materials for implants and prosthetics; gels for medical applications; and pharmaceuticals. In addition, chemical engineers now play key roles in a wide variety of industries in the development and production of systems and devices that rely on special chemistries or material response for their function.” (Source: Columbia University Chemical Engineering, <http://cheme.columbia.edu/chemical-engineering-columbia>, accessed February 22, 2016)

ACTIVITY 2

Introduction

Ask: What do you think pennies are made of?

Explain that, while pennies were once made entirely of copper, they are now mostly made of zinc, with a small amount of copper plating—which gives them the copper color we see.

Assemble in advance items such as the following: ketchup, pickle juice, laundry detergent, hand soap, fruit juice, soda, vinegar, and baking soda. Explain to Explorers that you will be examining how a variety of basic kitchen ingredients react with the copper from a penny. Have them predict what will happen when pennies are coated with each item. Will the ingredients clean the pennies? Will they change their color?

Have Explorers try the different ingredients and observe the results. Discuss with participants what has happened and why.

Make Your Pennies Shine

In the next activities, participants will submerge pennies in vinegar to investigate several reactions. If possible, group Explorers in teams of three.

Visit www.exploratorium.edu/science_explorer/copper_caper.html for directions and an explanation of the science behind the reactions you will see.

ADVISOR NOTE

Some sample questions are below to help the participants get the most out of the session and make them think. The questions are designed to help the participants apply what they have learned to their own interests. You are welcome to use these questions or develop your own questions that relate to your post or specific focus area.

REFLECTION

Focusing Questions

- *What was the purpose of these activities? Why did we do them?*

- *Can you think of other things chemical engineers might do?*
- Analysis Questions
 - *What type of engineering was used in each activity?*
- Generalization Questions
 - *Is this a career you might be interested in? What about chemical engineering appeals to you?*
 - *What types of engineering would you like to learn more about?*
 - *What subjects in school do you believe you will need for this type of engineering?*

RESOURCES

The following websites describe the paths taken by two chemical engineers working for NASA:

<http://www.nasa.gov/audience/foreducators/9-12/features/unlikely-chemical-engineer.html>

<https://www.nasa.gov/content/nasa-engineer-pioneering-research-for-future-deep-space-explorers>