

Perfectly Effortless Programs: Easy Engineering

Activity Overview

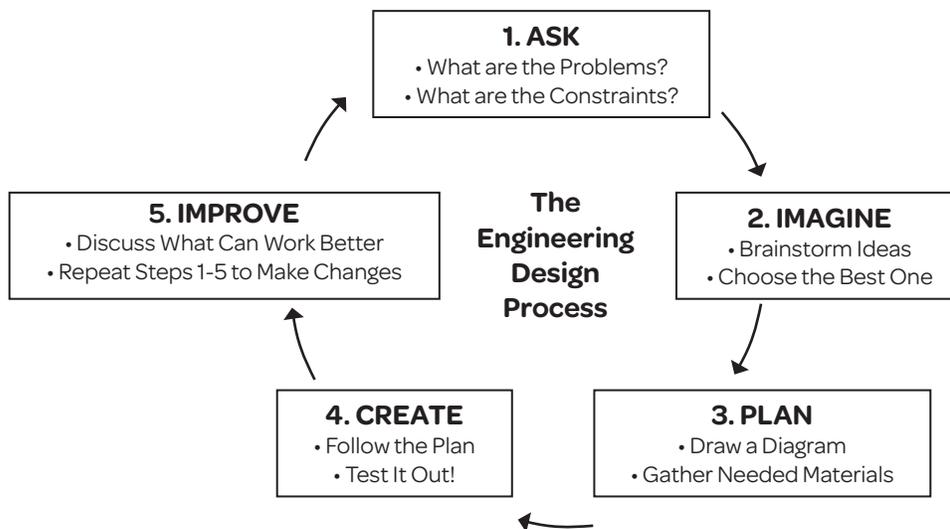
Many people don't realize that engineers are leaders, innovative problems solvers, and team players who make a difference in the world. Sounds a lot like a Girl Scout—yet women are dramatically underrepresented in the world of engineering. This PEP teaches girls that engineering can be fun!

Discussion

Ask the girls, "What do engineers do?"

Engineers are problem-solvers who use every resource possible to bring into existence the things and ideas that they imagine. Engineering involves the application of creativity in partnership with math, science, social studies, language arts, and fine arts to search for quicker, better, and less expensive ways meet to challenges.

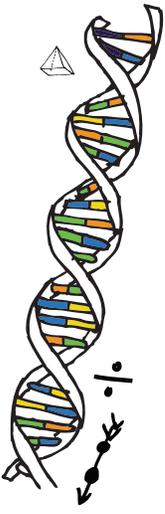
Scientists use the Scientific Method in their work. Engineers use the Engineering Design Process.



So many different kinds of engineers!

Engineering offers many career options. It's a profession that can take you from the depths of the ocean to the far reaches of outer space! Here are some of the most popular engineering fields.

Aerospace Engineers design and develop aircrafts, from planes to space shuttles. They also develop items used in space, such as telescopes. What they design can also help things that stay on the earth, like race cars and golf balls.



Agricultural Engineers not only figure out ways to help crops grow efficiently and full of nutrients, they also design farming equipment and ways to make sure farming is friendly to the environment.

Architectural Engineers work alongside architects to design buildings that are safe and efficient. They work on the structure, lighting, and ventilation of buildings to make sure they are safe.

Biomedical Engineers work with biologists and medical doctors to develop medical instruments, artificial organs, and prosthetic devices.

Chemical Engineers take raw materials and turn them into products that we use every day such as pharmaceuticals and make up.

Civil Engineers work in one of the largest branches of engineering, and deal with buildings, bridges, dams, roads, and other structures like airports and high-rises.

Computer/software Engineers deal with all aspects of computer systems including design, construction, and operation.

Electrical Engineers take energy from fuel cells, hydroelectric plants, turbines, and solar panels and move it into homes and businesses. They also move information from place to place, such as in televisions, satellite transmissions, and cellphones.

Environmental Engineers prevent environmental damage and fix existing problems. They help with water distribution systems, recycling methods, and pollution prevention.

Materials Engineers turn raw materials into useful substances like plastics, metal, and ceramic. They work to create stronger materials.

Mechanical Engineers design and develop everything you think of as a machine – from fighter jets to toasters to bicycles.

Nuclear Engineers research and develop methods and instruments that use nuclear energy and radiation to benefit humanity.

Challenge Activities

Let your girls practice being engineers with these fun challenges. Girls can work individually or with a buddy. Have the girls practice the engineering design process by imagining and planning before they start to create. After each challenge is complete, have girls discuss what they made. Were there designs that were more successful than others? Why? How could they improve the design in the future?

Design and build a paper airplane .

Items needed:

- Paper
- Tape measure

The challenge: Build a paper airplane that will fly at least five feet. Let each girl make a paper airplane. They can follow directions for making planes or try to create their own. Let each girl fly her plane and record how far it goes. Keep a chart to see which plane flies the farthest. Have the girls discuss why they think that is.

Design and build a card house.

Items needed:

- Decks of playing cards
- A flat surface

The challenge: Working individually or in pairs, have the girls build a house made of playing cards by leaning the cards together. See who can build the tallest or biggest house.



Design and build a straw bridge.

Items needed:

- Drinking straws
- Paper clips
- Pennies

The challenge: Construct bridges using only straws and paperclips that are at least 12 inches long and can support weight. After each bridge is built, see how many pennies it can support. If girls have trouble, give them this hint: triangles are very strong.

Design and build a catapult.

Items needed:

- Plastic spoons
- A ruler
- Masking tape
- 2 rubber bands
- Cotton balls

The challenge: Design and build a catapult capable of flinging a cotton ball. Using any of the first four items, girls will build a catapult. See what catapult design makes the ball go the farthest.

Design and build a tall, sturdy building .

Items needed:

- Spaghetti
- Stale mini-marshmallows (left out overnight)
- A tiny stuffed animal or similar item

The challenge: Build the tallest building possible that will support the weight of a stuffed animal. Have the girls discuss their design and then build it using the spaghetti and marshmallows. After the girls construct their tower, see how well the building supports a stuffed animal. Who built the tallest tower that could support an animal? Why do the girls think it worked? If the girls are having problems, remind them that triangles are strong.

Add a twist: Tell the builders that each team has a building budget of \$400. Each piece of spaghetti costs \$5 and each marshmallow costs \$10. If the building can't support weight, you can give the girls an extra \$200 for more building materials.

Design and build a boat

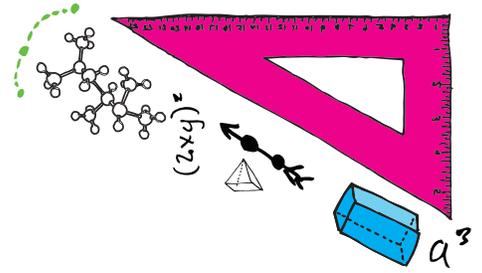
Items needed:

- 6 inch squares of tinfoil
- Pennies
- Container, half-filled with water

The challenge: Design and build a boat that will support the weight of the pennies without sinking.

Why boats float: when a boat floats, it settles into the water, pushing the water aside to make room for it. But it is a two-way pushing match-the water pushes back on the bottom and sides of the boat. This force is called buoyancy and it holds the boat up.

Girls will create their boats by bending the tinfoil. Once it's done, float the boat. Add pennies one at a time until the boat sinks. Count how many pennies the boat could hold (don't count the last one, because it made the boat sink.) If the boat was not successful, have the girls redesign their boat.



Turn raw materials into glue.

Items needed:

- Skim milk
- Baking soda
- Vinegar
- Measuring cup
- Measuring spoons
- Paper towels
- Rubber band

The challenge: Make glue from vinegar and milk.

1. Add 2 tablespoons of vinegar to $\frac{1}{2}$ cup of skim milk. Stir together and let sit for two minutes. The vinegar will make the protein in the milk stick together to form small white lumps called curds. The leftover liquid is called whey.
2. You will need to strain the curds since you won't need the whey to make glue. To make a strainer, put a folded paper towel over an empty cup. Push it down in the center so it forms a bowl shape. Put a rubber band around the top of the cup to hold the paper towel in place. Pour the curds and whey into the cup. The whey will go through the paper towel and the curds will stay on top. Wait about five minutes for the whey to drain through the paper towel.
3. Use a spoon to carefully scoop out the curds. Put them between two dry paper towels and press down to get all the whey out.
4. Put the curds into another cup, stir in two teaspoons of water, and then add one teaspoon of baking soda. The baking soda reacts with the vinegar that is in the curds, producing carbon dioxide. If you hold the mixture up to your ear, you can hear tiny bubbles popping. If the mixture doesn't look like glue, just add some water.
5. Try out your glue by gluing some paper together.

Build an electromagnet.

Items needed:

- 1.5-volt battery
- 2-inch nail
- 1 yard of thin insulated wire
- Box of paper clips

The challenge: Use everyday items to create an electromagnet strong enough to pick up paperclips.

1. Wind the wire tightly around the nail, 25 times leaving enough wire free at the end to connect to the battery.
2. Connect the wire to the negative (-) end of the battery terminal.
3. See how many paperclips you can pick up with the nail. Record the number.
4. Now wrap the wire around five more times and see how many paperclips you can pick up. Record the number.
5. Continue to wrap the wire around in intervals of five until you get to 50. Test the number of paperclips with each increase.