

Women in Engineering Badge

For Girl Scout Juniors

Purpose: This badge was created in collaboration with the Society of Women Engineers from Worcester Polytechnic Institute to introduce girls to the field of engineering.

To earn this badge, complete three activities from the Discover section, including the starred activity; two activities from Connect and one Take Action project.



Discover:

*What's an Engineer?

Find the definition of "engineer" and then create a list of at least 3 kinds of engineers. Select one and find out the primary things those engineers build or design.

Technology

Make a list of 10 items in your home or school that didn't exist 10 years ago. Discuss your list with others. Discuss how the advancement of technology has affected your life.

Trial and Error

What does trial-and-error mean? Can you think of some examples when you have used the trial-and-error method (maze, puzzles, etc.)? One example of trial-and-error in history is the building of the pyramids. Archaeologists have found the remains of different shaped pyramids that collapsed over time. But there are later ones which are still standing after thousands of years. The ancient designers used trial-and-error to find just the right design to hold up to the test of time. Think of some situations when someone wouldn't want to use trial-and-error (diffusing a bomb, surgery, etc.).

Try your hand at trial-and-error by putting together a puzzle picture-side down. You don't have the image to help you!

Design a Structure

Using toothpicks and packing peanuts (or gumdrops, mini marshmallows, Styrofoam balls, etc.), design a structure strong enough to hold a can of soda or a soup can. Work on your design for 10 minutes and then test your structure to see if it will hold the can. Discuss what worked best and try to think of how you could have made your structure stronger. Try again using your new ideas!

Design

Make a scale drawing of a three-dimensional object. Show a side view, a top view, and a front view on the same piece of paper. Or design your "dream home" by drawing an aerial view of the building and grounds. Indoor swimming pool? Amusement park in your back yard? The sky's the limit!

Create

Create an artistic and sturdy structure from construction materials of your choice. Tell how you used your knowledge of art and science to build your structure.

Connect:

Connect With Others

Visit a laboratory, manufacturing plant or factory and study machine design, robot uses, or other appropriate features. Or attend an engineering program event sponsored by your Girl Scout council, the Society of Women Engineers group from a local college, your school, or other venue to learn more about engineering.

Construction Materials Hunt

Go on a "construction materials hunt" in your neighborhood. Locate something made out of each of the following materials: brick, paper, cement, plastic, wood, metal, stone, cinder block, sheetrock, concrete, stone, marble. For each thing you found, discuss why that particular material was probably chosen for the constructed item.

Learn from an Expert

Have a practicing engineer show and explain about the tools s/he uses. Look at a blueprint of something s/he is working on. Learn about projects or products engineers are working on to make a better future.

Take Action:

Team Challenge

Using the attached suggestions, work with a group of girls to take on one of the challenges, or design one of your own. If your group is big enough, consider making it a contest between two or more teams! When you're done, talk about what you could have done differently to make your construction better, bigger or stronger. Once you've identified some things you'd like to try, do it again! Consider changing a variable (one thing to change) and make a prediction. Then give it a try (for example, change the material used, add in another material like tape, staples or string).

Take Action

Design your own Take Action Project centered on engineering and what you've learned while earning this badge. You could lead a group of younger girls in some of the fun challenges you learned, use your knowledge to "study" a public building such as a library or town hall and make suggestions to the directors, create a display or activity sheets to help others learn about engineering, etc.



Team Engineering Challenges

These challenges are good team building activities and also good activities to practice engineering and problem solving skills. The girls will work in teams to complete the challenge they choose, while using a limited amount of materials.

If working as competing teams, think about adding points for cooperation, creativity and communication as well as bonus points for completing the tasks.

What's the Engineering Scoop?

How can you make a weak material like newspaper strong enough to stand up? One way is to change its shape, like rolling it into a tube, crumpling it, or pleating it with folds. You also need to think about the different forces that are acting on your structure. The structure's weight is pulling it down while the surface it is resting on is pushing it back up. Small air movements are also pushing from the side and can blow it over. If you build a wide base at the bottom, this distributes the weight over a wider area and makes your structure more stable.

Grand Spans

Materials needed (per team):

- 5 unopened cans (soup, soda, etc.)
- 5 plastic drinking straws
- 6" length of masking tape
- 2 paper clips
- 12" length of string
- 1 pipe cleaner
- 1 elastic band
- 1 pair of scissors
- 1 ruler

Procedure:

- Have each team place their cans in a row on the floor, so that there is a 20" space between each can. Gather the rest of the materials and place them nearby. Read the team instructions aloud to the teams.
- Instructions: Engineers use steel to span the distance between strong towers. Each of these cans represent a tower of a bridge. Your task is to span the distance across, using the cans as your tower supports. You don't have steel, but you do have some different materials to work with to span the cans you see in front of you. Your challenge is to span as many cans as possible using this odd assortment of materials. Each span must reach from one can to another without touching the floor. You may not change the distance between cans, or otherwise move the cans from their positions in any way. You may not use the ruler or scissors in your design. You have 5 minutes to complete this challenge.

Straw Tower Building Project

Materials needed (per team):

- 20 drinking straws
- 1 yard of masking tape
- 1 pair scissors

Procedure:

- Pass out materials to all groups and give instructions so that everyone starts at the same time.
- Instructions: Using twenty straws and the 1-yard strip of masking tape, construct the tallest tower you can that will stand unsupported for at least 5 seconds. You may not use the scissors in the construction, but if the straws come in wrappers, you can use the wrappers. You cannot get additional or replacement materials.

Paper Tower Challenge

Materials needed (per team):

- 4 sheets of newspaper
- Ruler
- Optional: 12 inches of tape

Instructions:

Build the tallest tower you can. You can bend, tear, crumple, or roll the newspaper. Try to make the tower taller. Keep redesigning it until you can't go any higher. Use the ruler to measure the height of your tower. It must stand for at least 30 seconds without falling over. The ruler may not be used as part of your structure.

Construction Materials Hunt

Go on a "construction materials hunt" in your neighborhood. Locate something made out of each of the following materials. For each thing you find, discuss why that particular material was probably chosen for the constructed item. Consider cost, strength, availability, etc.

Brick _____

Paper _____

Cement _____

Plastic _____

Wood _____

Metal _____

Stone _____

Cinder block _____

Sheetrock _____

Concrete _____

Stone _____

Marble _____