

# Insulator Innovator

## IMPROVE YOUR FAVORITE WATER BOTTLE

NASA employs many materials engineers to develop and test every piece of equipment (including spacesuits) that astronauts use. These engineers carry out tests for each piece of equipment, devising new ways to use existing materials, or developing new materials.

### SMART START:

- ★ Bring in, or ask girls to bring in, reusable water bottles so that you have a variety of shapes and sizes.
- ★ If it's a fairly humid day, before the activity fill a bottle with ice water and set it on a sheet of construction paper to demonstrate the mess that water bottles can make.
- ★ Set up four stations around the room to test for durability (sandpaper), water resistance (spray bottle), protection (washers or marbles), and elasticity (rulers).

## HERE'S HOW:

### Part 1: Testing Materials

**1. Introduce materials engineering.** Have the girls get into small groups<sup>1</sup>. Ask them to list the most common materials (plastic, metal, wood, etc.) and the best ways to use them. For example, concrete is rigid so is good for buildings and sidewalks, rubber is soft and flexible so is good for shoes and bouncing balls, plastic is strong but light so is good for car bodies. Share a couple of examples with the whole group. Talk about the drawbacks of some of the materials. For instance, plastic can become brittle in very cold temperatures.

## You'll need:



### For each pair:

- 2 spray bottles
- washers or marbles
- meter stick
- tape (duct, masking)
- 2 blocks (5in. x 5in. x 10in.) of wet floral foam in gallon-sized Ziploc bags
- ping pong ball
- rubber bands
- sandpaper
- construction paper
- reusable water bottles (various styles)
- rulers

### For each group:

- 4 samples (6in. x 5in.) of each of these materials: bubble wrap, felt, T-shirt, aluminum foil, wax paper, paper towel, cling wrap
- blank paper

Watch Alma Stephanie Tapia's Role Model profile to learn what a materials engineer does.<sup>7</sup>



**2. Introduce the problem.** Reusable water bottles are great for the environment and come in all shapes and sizes, but they have room for improvement. Ask girls to share problems they have had with water bottles<sup>2</sup> (breaking, denting, leaking). Introduce the **SciGirls Challenge**: Create a holder that addresses some of the problems of reusable water bottles.

**POINTER:** If your girls don't have experience with reusable water bottles, you can present the list of problems.



**3. Brainstorm.** Present the different materials available. Each group can decide what materials they want to test<sup>3</sup>. Before testing, girls should examine the materials and predict what they think each would do best.



Watch the SciGirls test the materials for their water bottle holders in **Escuadrón Espacial | Space Squad (Test Materials)**.

**4. Test.** Introduce the girls to the four testing stations set up around the room.

★ **Durability:** Wrap a sample of the material around the ping pong ball and secure it with a rubber band. Rub the sample along the piece of sandpaper for 5 seconds. Measure the size of the hole that formed.

★ **Water resistance:** Place a piece of construction paper under the material sample and spray with 5 squirts of water. Measure the diameter of any water spots that formed on the construction paper.

★ **Protection:** Place the material sample over the piece of foam. Drop the washers or marble from 1 meter above the block. Measure the size of the divot created in the foam.

★ **Elasticity (tensile strength):** Test along two different sides of the material sample. Record the length of the fabric when it is unstretched, then record the length when it is stretched as far as it will go.

**5. Analyze.** In small groups, compare the results for different materials. Did any materials do really well on all the tests? Materials engineers test materials to understand their strengths and weaknesses and will often combine different ones to create a product that has the strengths of them all.

## Part 2: Create a Waterbottle Holder

**6. Design.** Each small group should decide what materials they are going to combine to make their final product. Sketch out a design for the water bottle holder. Consider how to attach the layers together and how the water bottle will fit into the holder. What order will the layers go in?<sup>6</sup>

**7. Build.** Create the water bottle holder following the design. Problem solve and modify the design when issues arise.<sup>3</sup>

**8. Share.** Have each small group display their finished water bottle holder with their design sketches. Give each girl a pad of sticky notes and allow them to examine each design and write a constructive comment, a suggestion, or question<sup>5</sup>. As a large group debrief about the process. What went well? Where did they struggle? Talk about what they might change based on the feedback they received<sup>6</sup>.

**POINTER:** Before having the girls comment on designs, discuss the purpose and importance of being respectful to others.



**9. Extension.** If time allows, have groups field test their water bottle holders. Take a trip to the park, drop them from the top of a slide, or test them out at school for a day. Groups can also have time to decorate their holder.

## Mentor Moment

Alma Stephanie Tapia is a materials engineer who works at NASA specializing in materials used in space equipment. Two things she likes about her job: each day is different and she is always solving problems.

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