


Activity 4

Breaking Point

TEST LEAF TOUGHNESS WITH YOUR OWN PENETROMETER.

Scientists often work closely with engineers to create tools for collecting data. A penetrometer measures the strength of different materials, such as soil or leaves. It can help determine whether the soil in an area is strong enough to support a road. Biologists measure leaf toughness to study the feeding preferences of insects and bugs.



SMART START: Ask girls to collect a variety of natural materials such as leaves, flower petals, and grasses. Fresh natural materials will yield the most accurate results. If this is not possible, gather the man-made materials suggested above and cut them into pieces roughly five inches square.

Make sure you don't pick leaves from poisonous plants.

Here's how:

1. Introduce leaf toughness. Start a discussion about herbivores and what they eat. Pass around or show pictures of different parts of plants—seeds, leaves, stems, fruits, flowers (kidsgrowingstrong.org/PlantParts). Ask girls to brainstorm a list of factors that might affect whether an animal chooses to eat a leaf or not (taste, toughness, color).⁶ Leaf toughness can be measured using a penetrometer, which records the amount of force it takes to push through materials.



You'll Need:

- ♦ Materials to test—a variety of leaves or man-made materials that range from weak (tissue paper, coffee filters, plastic wrap) mid-strength (paper, plastic bags, wax paper) to strong (paper plates, cardstock, manila folders, fabric scraps)

For each small group

- ♦ 1 large paper cup
- ♦ items to add weight (e.g., pennies, beans, or metal washers; use all of the same type of weights)
- ♦ 2 paper clips
- ♦ 1 single hole punch

45 min.

In this experiment, your girls will make their own penetrometer and test the toughness of a variety of materials.

To see how the SciGirls compared trees, watch the *SciGirls Explore* DVD. (Select Habitat Havoc: Test.)



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1-7 See **SciGirls Seven** strategies on page 3.

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2. Build a penetrometer. To prepare the penetrometer, have the girls start by creating a bucket with the paper cup and one paper clip. This bucket will hold the weights. First, the girls will punch two holes on opposite sides of the paper cup, near the rim. Then, they unbend the paper clip to make a handle for the bucket.



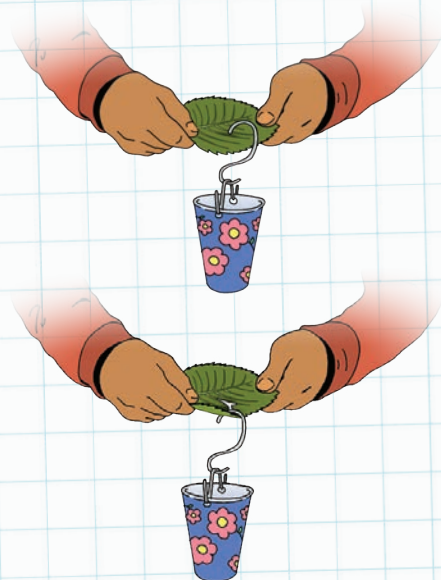
Finally, they'll form an S-shape with the other paper clip and hook one end to the bucket handle. During the testing phase, the girls will put the top part of the S hook on the material and hang the bucket from it, adding weight until the material is punctured.



3. Brainstorm. Deliver the **SciGirls Challenge:** Design an experiment to test the strength of different materials.³ Working in pairs,¹ have your girls consider:

- ★ **Experiment set up** Where will you place the S-hook on the material you are testing? What important factors should you consider when placing the S-hook?
- ★ **Measurement** At what point will you stop adding weights and record your measurement? Who is holding the material to be tested?
- ★ **Number of replications** How many times do you need to repeat the experiment? What factors are important to consider when choosing materials? (If testing leaves, make sure the specimens are approximately the same age and came from the same area on the plant.)

4. Collect data. To test materials, rest the free end of the S-hook on the material. Then, link the other end through the handle of your paper cup "bucket." Add weights to the cup one at a time until the S-hook punctures the material. Predict which materials will be the toughest before you test!



Breaking Point continued

5. Analyze and share. Create a data table and record the number of weights in the cup at the point the material is punctured. Average your results. Which material was the strongest? The weakest? How would the toughness of a leaf affect its use as a food source for insects and bugs? How would you improve this experiment to get more accurate results? ⁶

Watch Theresa show the SciGirls her newest research project on the *SciGirls Explore DVD*. (Select Habitat Havoc: Mentor Moment.) ⁷



Mentor Moment

Dr. Theresa Talley is an ecologist who wants to better understand the varied environments of coastal areas to help solve local conservation problems.

Besides studying topics such as invasive species and climate change, she likes encouraging public participation in these important topics and mentoring students in research. When not working, Theresa loves to explore natural areas with her family and friends!



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¹⁻⁷ See **SciGirls Seven** strategies on page 3.