Structured for Strength

When held one way, a yardstick is very flimsy and bendable, but when held in another way, it can be very rigid and strong, like a beam in a building. This is similar to an egg shell. When used in one way, it is very fragile, but when used in another way, it can be surprisingly strong, like a dome.

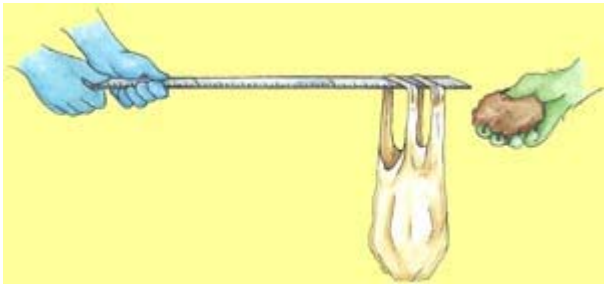
PART 1

Materials

- Wooden meter stick
- Plastic shopping bag
- 1 or 2 potatoes

Procedure

1. Hold one end of a meter stick so that the flat side with the numbers is facing up. Have your partner place a shopping bag about 10 – 15 centimeters from the other end of the meter stick as shown.



2. Hold on tightly with both hands as your partner places 1 or 2 potatoes in the bag. What do you notice about the stick?
3. This time, turn the stick so that the side with the numbers is facing sideways. Place an empty bag on the stick at the same distance from the end as before.
4. Hold on tightly with both hands as your partner places the same potatoes in the bag as before. How did the bending of the stick this time compare with how much it bent before?

PART 2

Materials

- 4 egg shell halves
- Square piece of stiff cardboard (about 20 cm x 20 cm)
- Magazines or thin books
- Paper towel

Procedure

1. Arrange the 4 egg shell domes in a square on the paper towel. Place the cardboard on the egg shells so that the cardboard sticks out beyond the egg shells by about 3 centimeters.

2. Start placing magazines or thin books on the cardboard. How many do you think you can stack before the domes will break? Keep stacking until you hear the domes cracking!

Think about this...

The beam and the dome are so strong that examples of them have lasted thousands of years. The Greeks built many buildings, such as the famous Parthenon, using columns with beams going from one column to the next. The famous Roman building, the Pantheon is an example of a dome with a hole cut through the top at the very center.

Where's the Chemistry?

In Part 1, when you turned the meter stick on its edge, you were using the meter stick like a beam. Some materials work better than others but any rectangular shaped object like a piece of wood can be used as a beam. When placed on its edge and used as a beam, a piece of wood can hold up a lot of weight. That's because there is a lot more material to resist bending when the beam is oriented in this way. In fact, the taller the beam, the more weight it can handle without bending and eventually breaking.

In Part 2, the egg shells were able to hold up a fair amount of weight because each one was acting like a dome. The shape of a dome gives it a lot of strength. When weight is placed on the top of a dome, the force is spread out away from the center along the curved surface of the dome in all directions so the dome can handle a lot of weight. Also, in this case, the weight was shared evenly among 4 egg shell domes.

The American Chemical Society develops materials for elementary school age children to spark their interest in science and teach developmentally appropriate chemistry concepts. The *Activities for Children* collection includes hands-on activities, articles, puzzles, and games on topics related to children's everyday experiences.

The collection can be used to supplement the science curriculum, celebrate National Chemistry Week, develop Chemists Celebrate Earth Day events, invite children to give science a try at a large event, or to explore just for fun at home.

Find more activities, articles, puzzles and games at www.acs.org/kids.

Safety Tips

This activity is intended for elementary school children under the direct supervision of an adult. The American Chemical Society cannot be responsible for any accidents or injuries that may result from conducting the activities without proper supervision, from not specifically following directions, or from ignoring the cautions contained in the text.

Always:

- Work with an adult.
- Read and follow all directions for the activity.
- Read all warning labels on all materials being used.
- Wear eye protection.
- Follow safety warnings or precautions, such as wearing gloves or tying back long hair.
- Use all materials carefully, following the directions given.
- Be sure to clean up and dispose of materials properly when you are finished with an activity.
- Wash your hands well after every activity.

Never eat or drink while conducting an experiment, and be careful to keep all of the materials used away from your mouth, nose, and eyes!

Never experiment on your own!

For more detailed information on safety go to www.acs.org/education and click on "Safety Guidelines".