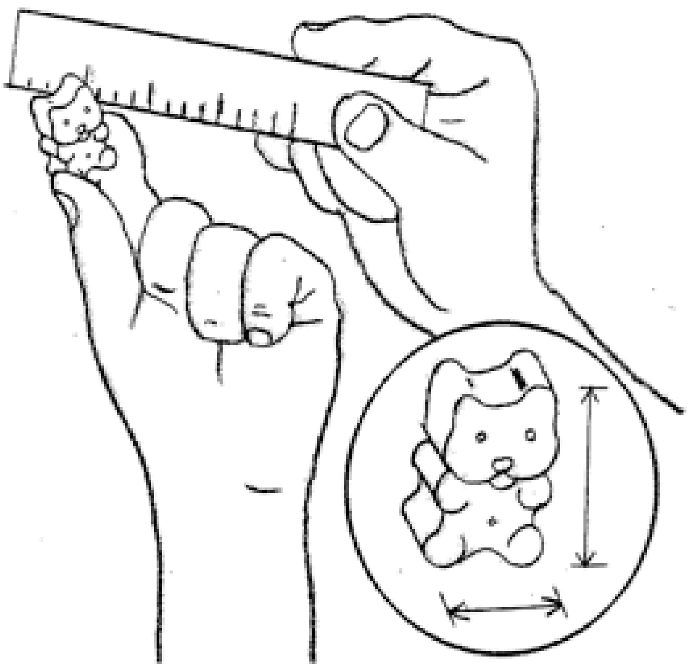
Gummy Growth

By Eric Muller

Gummy Growth

When you drop a gummy bear in water, it doubles in size after a day or two. How much space does the water-logged gummy bear take up compared to a dry bear?



In this activity, students use water displacement to compare the volume of an expanded gummy bear with a gummy bear in its original condition. This activity shows an important scaling phenomenon: when you increase the size of an object, volume grows much faster than height or surface area.

Materials List (for each student pair)

- 9-10 gummy bears (other gummy shapes can be tried, but they may not work as well)
- small containers
- graduated cylinder, measuring cup, or similar container
- water
- ruler
- paper

Pre-Activity Discussion

Tell students they will be doubling the height and width of a gummy bear and ask them to predict how much space the expanded bear will occupy compared with a normal bear.

Activity Instructions

This activity takes two to three days to complete.

On the first day, ask the students to measure the height and width of one gummy bear and record the measurements on a sheet of paper. Have each student or group fill a small cup with about three inches of water and drop the measured gummy bear into the cup. The bear will absorb water and grow to about twice its original size. Have the students write down their predictions of how much the bear's volume will increase if it doubles in size.

After one or two days, have each student carefully remove the bear from the water. (It will be softened and delicate and may lose a limb or two—students should retrieve all the pieces for the next parts of this activity.) Lay the expanded bear on a ruler and measure its expanded width and height. Record the new measurements on the sheet of paper. Compare the "before" and "after" measurements (the expanded dimensions should be roughly double the original dimensions).

Fill the measuring container half full of water. Record the volume of water in the container. Drop a dry bear in the container and note the change in the water level. Subtract the original water level from the water level with the bear to measure the increase in the volume. Tell the students that the change in the water level, or the amount of water displaced by the bear, is equal to the bear's volume. (This is called Archimedes' Principle, named after the Greek mathematician who discovered that an object submerged in water will displace, or move, a volume of water equal to the volume of the submerged object.)

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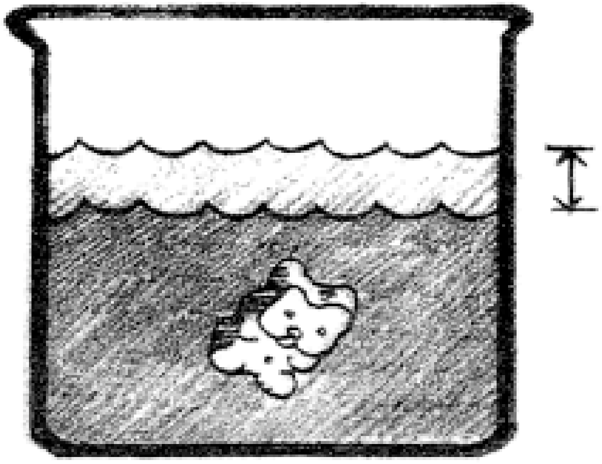
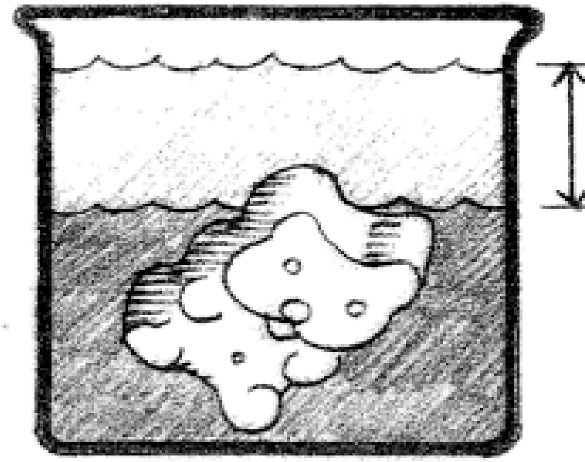
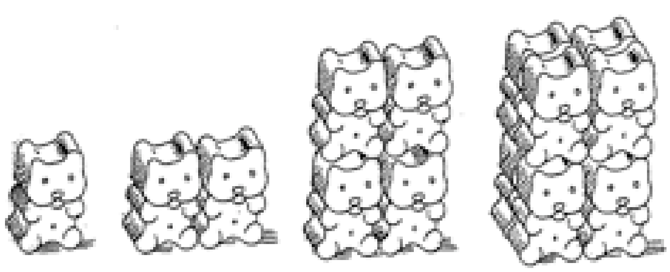




Remove the bear and refill the container to the same level as before. Now drop the expanded bear into the water and record the change in the water level. How much did the water level increase with the expanded bear versus the dry bear? (If the expanded bear is twice the height of a dry bear, the change in water volume should be eight times greater.) Were the student predictions close to the actual increase in the bear's volume?

Discussion

Guide students through a discussion of what happens when you double the size of an object. Have them put one gummy bear on the table and tell them to double it. To do that, they must double all the bear's linear dimensions—length, width, and depth. They



must place a second bear next to the original bear to double its width. To double the height they have to place a bear above the heads of each of the first two bears. To double the dimensions have only increased by a factor of two, the volume—as you can see by counting the bears—has increased by a factor of eight.

Etcetera . . .

As you increase the size of an object, volume grows much faster than length or surface area. In most land animals, volume and weight are roughly proportional, so an animal twice the size of another weighs roughly eight times more. (This doesn't work all the time. For instance, an average adult is about twice the height of a 5-year-old child but the adult does not weight eight times more. That's because children aren't simply scaled-down versions of adults: their heads, hands, and feet are proportionally much larger than an adult's.)

This scaling phenomenon has implications for animals both large and small. The bigger and heavier you are, the more gravity affects the way you move and live. A grasshopper can jump over 50 times its body length; even with a running start the most accomplished human athlete has difficulty jumping five times his or her length. (The world's record for the long jump is 29 feet 4.5 inches.) Cows and horses can sleep lying down, but elephants have to sleep on their feet. If a full-grown elephant were to lie down for more than an