How Much Sugar Is in Your Chewing Gum?

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Topic

Percentage composition of a common substance

Time

45 minutes

Safety

Please click on the safety icon to view the safety precautions. Take care when driving the nail not to strike your fingers with the hammer. Be careful of the sharp edges on the metal strip.

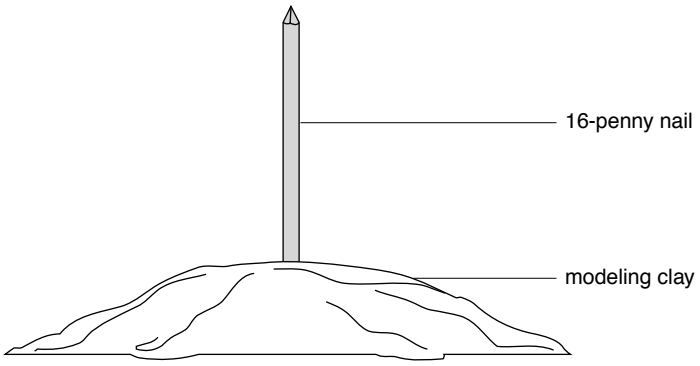
Materials

handful of modeling clay
three sticks of chewing gum, *not* sugarless
6-penny nail
50 straight pins, all exactly the same size
16-penny nail
hammer
thin strip of metal about 18 cm 2 4 cm (A piece of aluminum pie plate will work, but something a bit less flexible gives even better results.)
waxed paper
ruler
pencil
wood block or other surface for hammering
two soft-drink bottle caps, screw-type

Procedure

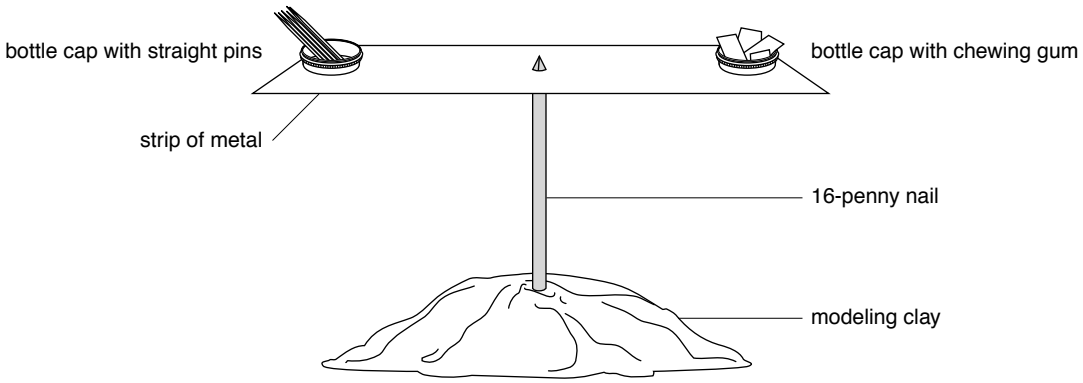
1. Before you start, write down your prediction of how much sugar you expect to find in the chewing gum, in terms of percentage. What proportion of the weight of the whole stick of gum do you think is made up of sugar and will thus be lost in chewing? _____ %
2. Carefully use a pencil and ruler to draw crossing diagonals on the metal strip. This locates its center of gravity.
3. Place the metal strip on the wood block or another surface that will not be damaged by hammering. Using the hammer and 6-penny nail, make a small hole in the metal strip at its center of gravity, where the two diagonal lines cross.
4. Soften the handful of modeling clay, and mold it into a mound shape on a tabletop. Press the 16-penny nail into the clay with the tip pointing straight up. Make sure the nail is straight, and mold some of the clay around its base for extra support, as shown in figure 1.

Figure 1



5. Place the metal strip on the vertical nail.
6. Put a tiny piece of clay under each bottle cap as adhesive, and position the two caps on opposite ends of the metal strip so that the strip balances level as shown.
7. Break up a stick of chewing gum, and place the pieces in one of the bottle caps.
8. Place straight pins in the other bottle cap until the metal strip again balances level (see figure 2).

Figure 2



9. On the data table, record the number of pins used as the mass of the unchewed gum.

DATA TABLE			
Trial	Mass of unchewed gum	Mass of chewed gum	% Sugar
1			
2			
3			

10. Chew the gum for 5 min.
11. Place the chewed gum on a piece of waxed paper to dry for 10 min.
12. Place the chewed gum into one of the bottle caps on the balance.
13. Again, place straight pins in the other bottle cap until the metal strip balances level.
14. On the data table, record the number of pins used as the mass of the chewed gum.
15. Repeat steps 7 to 14 with two more pieces of gum, and record the results on your data table.
16. Calculate the percentage of sugar in each stick of gum tested, using the following formula:

$$\frac{\text{mass of unchewed gum} - \text{mass of chewed gum}}{\text{mass of unchewed gum}} \times 100 = \%$$

    If you found different percentages in the three pieces, why do you think that was the case?
17. Find the average percentage of sugar in the three sticks of gum tested. To do this, add the three percentages for the three sticks tested and divide the result by 3.
18. How does the average percentage of sugar in the chewing gum compare with your prediction?
19. Why is it necessary to allow the chewed gum to dry before determining its mass?
20. Why is it important to use straight pins that are all the same size?

What's Going On

The percentage of sugar found in each stick may vary a bit due to experimental error, or possibly because of variations in the product itself. The percentage of sugar in chewing gum varies by brand. Anything in the range of about 67% to 74% is a common result. That is, about ⅔ to ¾ of the mass of the gum is made up of sugar.

Predictions are often lower than the results. Many people do not realize how much of a stick of gum is actually made up of sugar. When you first measured the gum it was dry. As you chew, saliva from your mouth is mixed in with the chewing gum. This helps you digest the sugar. Like any liquid, saliva has a measurable mass, and if you were to measure the gum before the saliva had evaporated, its presence would affect the accuracy of your measurement and throw off your percentage calculations. In this procedure the pins serve as units of measurement. That is, your homemade balance measures the gum's mass in units of "pins" instead of grams or ounces. The unit of measurement must be standard for the measurement of an object to be meaningful. If the pins were different sizes, thus different masses, the same size stick of gum would have different masses depending on which pins you used.

Connections

When you chew a stick of gum, even though you don't swallow any of it, the gum gets smaller. How is this possible? The gum is composed of some substance that gives it its chewy texture and sugar that gives it flavor. When you chew the gum, the chewing action and the digestive chemicals in your saliva break down and release the sugar from the gum mixture. The sugar then mixes with the saliva in your mouth, and you swallow it in this liquid form, perhaps without realizing it. That is why gum tastes sweet at first, and then gradually loses its flavor. In this experiment you constructed a simple balance in order to determine the percentage of sugar by weight in a stick of chewing gum.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say "be careful with hot liquids" or "don't cut yourself with the knife" does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don't use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES