

Using candy to learn about material fractures

By Sherri Rukes

Question to investigate:

How does temperature affect the way candies break?



Introduction

Engineers carefully pick materials to use for their building projects. And they always look for ways to make things better. One thing they need to keep in mind is picking the best materials for where the project will be built. This includes the weather and temperature of the location.

This activity shows this idea by comparing different types of candy. It explores how candies break, or fracture, when bent at different temperatures. Which candies snap suddenly and which bend or stretch? This shows the difference between brittle (stiff) and ductile (bendy) materials.

Procedure

1. Place one of each type of candy in the freezer overnight and leave the other one out at room temperature.
2. Hold both ends of one of your room-temperature candies. Slowly start to bend it in half. How hard is it to bend? Is it very stiff? Is it easy to bend and flexible? Record your observations in the data table below.
3. Continue bending the candy until it breaks. How does it break? Does it snap very suddenly (brittle), or does it stretch out and tear gradually (ductile)? Does it break from bending? If not, can you break it by pulling it? You can write your observations in the table below.
4. Get the same type of candy out of the freezer and repeat the steps above. Remember to watch how the candy breaks. Is the candy easier or harder to bend? Does it break in a different way when it's frozen?
5. Repeat steps 2-4 for each type of candy.



What did you observe?

What effect did temperature have on the matching candies? How did the different types of candies compare to each other during the bending test?

After spending the night in the freezer, you should have seen that the candies became stiffer and more brittle. Most candies will have a very clear switch from ductile to brittle when they're frozen. For example, the Airheads bend and stretch easily and need to be pulled apart at room temperature. But they are hard and snap when you bend them when frozen. Some very soft and floppy candies might become harder to bend when frozen, but they still don't have a brittle fracture. This is because some candies are ductile even when frozen! And some candies are brittle even when they are warm, like Kit-Kat bars.

SAFETY SUGGESTIONS

- Safety goggles required
- Thoroughly wash hands after this activity

Materials

- 2 Snickers bars (you can use 3 Musketeers, Milky Way, or other chewy candy bars)
- 2 Airheads (you can use any chewy taffy-type candy)
- 2 Gummy worms
- 2 Kit-Kat bars (you can use Crunch bars, Butterfingers, or other crisp candy bars)
- Freezer

Candy Name	Room Temperature	Frozen

How does it work?

In this activity, you saw two different types of fractures (breaks):

- Brittle fracture: Occurs when a material snaps or cracks with very little bending. Hard candy and chocolate are examples of brittle materials at room temperature.
- Ductile fracture: Occurs when a material stretches, bends, or changes before it eventually breaks. Gummy and chewy candies are examples of ductile materials.

A lot of materials, like your candy, become more brittle when they are cold. When your candy is warm, the little molecules it's made of can wiggle around and stretch more. Like the stringy caramel in the Snickers bar or the stretchy taffy of the Airheads. When the candy is frozen, the molecules don't wiggle or stretch as much. So they are more likely to break apart.

The changes in how materials bend and break at different temperatures are important for engineers to keep in mind. Especially when they're planning to build a product. They need a material that is strong enough to endure the location's temperatures.

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