STEM at HOME

SCIENCE ★ TECHNOLOGY ★ ENGINEERING ★ MATH

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Popcorn Science

Test the effects of water and freezing temperatures on popcorn's "popping" abilities. Investigate the science of this exciting, healthy, and delicious snack food!

TEKS:

SCI 3.5: The student is expected to predict, observe, and record changes in the state of matter caused by heating or cooling such as ice becoming liquid water, condensation forming on the outside of a glass of ice water, or liquid water being heated to the point of becoming water vapor.
SCI 5.2 A: The student is expected to describe, plan, and implement simple experimental investigations testing one variable.
SCI 5.2 C: The student is expected to collect and record information using detailed observations and accurate measuring.
SCI 5.2 D: The student is expected to analyze and interpret information to construct reasonable explanations from direct (observable) and indirect (inferred) evidence.

Materials:

- 3 brown paper bags
- Freezer
- Microwave
- Paper and pencil
- Paper towels
- Popcorn kernels (at least 600, or approximately ½ a cup)
- 2 small bowls
- Water

How To:

1. Count out three groups of 200 popcorn kernels each.
2. Place one group of 200 popcorn kernels into a bowl and cover the kernels with water. These kernels will act as your experiment's "water" group.
3. Place a second group of 200 popcorn kernels into a bowl and place this bowl into the freezer. These kernels will act as your experiment's "freezer" group.

4. Allow these two groups of popcorn kernels to sit for at least one hour, and up to three hours.
5. Place the final group of 200 popcorn kernels into a brown paper bag and fold the top down 2-3 times. These will act as your experiment's "control" group.
6. Place the control brown paper bag into the microwave and microwave on high power for 2-3 minutes. Watch and listen closely! Once you hear pauses of approximately 2 seconds between each "pop," remove the bag from the microwave. Take note of how long you microwaved this bag of popcorn.
7. Drain the popcorn kernels that you soaked in water and dry the kernels with a paper towel. Place these water kernels into a brown paper bag, fold the top down 2-3 times, and microwave on high power for the same amount of time that you microwaved your control popcorn.
8. Remove the popcorn kernels from the freezer and immediately place them into the third brown paper bag, folding the top down 2-3 times. Microwave these freezer kernels on high power for the same amount of time that you microwaved your control popcorn.
9. One by one, carefully open each brown paper bag (watch out for hot steam!), pour out the contents of the bag, and count how many unpopped popcorn kernels remain. Record how many unpopped kernels remain for each group.
10. Which popcorn kernels popped best, or, had the fewest unpopped kernels? Which popcorn kernels had the most unpopped kernels? Why do you think this is? Read the STEM Explanation below to find out!

STEM Explanation:

Did you know that Americans consume 18 *billion* quarts of popcorn each year? That much popcorn could fill the Empire State Building 18 times! Popcorn is considered a "perfect snack food" by some nutritionists because it is a whole grain, low in fat, and a good source of fiber, and this snack has been around for thousands of years. Archeologists have found preserved popcorn kernels that are over 5,600 years old! Native Americans throughout North and South America documented this snack as an essential part of their cuisine, and the popcorn-eating tradition quickly spread to European settlers. Some early settlers even ate popcorn with milk and sugar, like breakfast cereal!

One of the most exciting things about popcorn is the way that it pops! A popcorn kernel has three parts: the pericarp, the germ, and the endosperm. The pericarp is the hard, outer shell of the popcorn kernel, which protects the germ, or baby seed embryo inside. Next to the germ is the popcorn kernel's endosperm, which contains water and starch to feed the germ if/when it sprouts. The water holds the key to how a hard kernel turns into a fluffy, delicious snack! When a popcorn kernel is heated to 355 degrees Fahrenheit, the trapped water inside the endosperm turns into steam. This causes pressure to build inside the kernel. However, the popcorn kernel's pericarp is strong and can hold that pressurized steam inside until the pressure reaches 9.2 atm. This allows the starch inside the kernel to turn into a gelatinous material, and once the pressure gets above 9.2 atm, the pericarp bursts and turns the entire kernel inside-out. The gelatinous starch cools and solidifies on the outside of the kernel and gives popcorn its yellow-white, puffy appearance.

Scientists have determined that a 14% moisture content inside kernels is the optimal water level for perfectly-popped popcorn. A common way to determine if popcorn kernels are high quality is by measuring their "popping yield," which is calculated by counting how many kernels pop versus how many remain unpopped after heating. Which group of experimental kernels popped the best during your experiment?

The freezer likely caused the kernels to dry out, which would produce a lower popping yield, while the bowl of water might have increased the water content inside the kernels, creating a higher popping yield. Based on the results of your experiment, can you think of any other ways to optimize fluffy popcorn production?

Career Connection:

Physical chemists study chemical systems at macroscopic and atomic levels. They are interested in how motion, energy, force, and time affect and change chemicals. Physical chemists research chemical systems in order to better understand the world around us, and help solve everyday problems.

Resources:

https://www.carolina.com/teacher-resources/Interactive/the-science-of-popcorn/tr23952.tr
https://www.scientificamerican.com/article/explore-the-pop-in-popcorn/
https://www.thespruceeats.com/the-history-of-popcorn-1328768 https://littlebinsforlittlehands.com/why-does-popcorn-pop/
https://sites.psu.edu/siowfa16/2016/09/15/unpopped-popcorn/