

## Lab

# Percentage of Water in Popcorn

Popcorn pops because of the natural moisture inside each kernel. When the internal water is heated above 100°C, the liquid water changes to a gas, which takes up much more space than the liquid, so the kernel expands rapidly.

The percentage of water in popcorn can be determined by the following equation.

$$\frac{\text{initial mass} - \text{final mass}}{\text{initial mass}} \times 100 = \text{percentage of } H_2O \text{ in unpopped popcorn}$$

The popping process works best when the kernels are first coated with a small amount of vegetable oil. Make sure you account for the presence of this oil when measuring masses. In this lab, you will design a procedure for determining the percentage of water in three samples of popcorn. The popcorn is for testing only, and *must not* be eaten.

## OBJECTIVES

- **Measure** the masses of various combinations of a beaker, oil, and popcorn kernels.
- **Determine** the percentages of water in popcorn kernels.
- **Compare** experimental data.

## MATERIALS

- aluminum foil (1 sheet)
- beaker, 250 mL
- Bunsen burner with gas tubing and striker
- kernels of popcorn for each of three brands (80)
- oil to coat the bottom of the beaker
- ring stand, iron ring, and wire gauze



**Always wear safety goggles and a lab apron to protect your eyes and clothing.** If you get a chemical in your eyes, immediately flush the chemical out at the eyewash station while calling to your teacher. Know the locations of the emergency lab shower and the eyewash station and the procedures for using them.



**When using a Bunsen burner, confine long hair and loose clothing.** If your clothing catches on fire, WALK to the emergency lab shower and use it to put out the fire. When heating a substance in a test tube, the mouth of the test tube should point away from where you and others are standing. Watch the test tube at all times to prevent the contents from boiling over.

## Percentage of Water in Popcorn *continued*

### PREPARATION

Use the **Data Table** provided to record your data.

### PROCEDURE

1. Measure the mass of a 250 mL beaker. Record the mass in the **Data Table**.
2. Add a small amount of vegetable oil to the beaker to coat the bottom of it. Measure the mass of the beaker and oil. Record the mass in the **Data Table**.
3. Add 20 kernels of brand A popcorn to the beaker. Shake the beaker gently to coat the kernels with oil. Measure the mass of the beaker, oil, and popcorn. Record the mass in the **Data Table**.
4. Subtract the mass found in step 2 from the mass found in step 3 to obtain the mass of 20 unpopped kernels. Record the mass in the **Data Table**.
5. Cover the beaker loosely with the aluminum foil. Punch a few small holes in the aluminum foil to let moisture escape. These holes should not be large enough to let the popping corn pass through.
6. Heat the popcorn until the majority of the kernels have popped. The popcorn pops more efficiently if the beaker is held firmly with tongs and gently shaken side to side on the wire gauze.
7. Remove the aluminum foil from the beaker and allow the beaker to cool for 10 minutes. Then, measure the mass of the beaker, oil, and popped corn. Record the mass in the **Data Table**.
8. Subtract the mass in step 7 from the mass in step 3 to obtain the mass of water that escaped when the corn popped. Record the mass in the **Data Table**.
9. Calculate the percentage of water in the popcorn.
10. Dispose of the popcorn in the designated container. Remove the aluminum foil, and set it aside. Clean the beaker, and dry it well. Alternatively, if your teacher approves, use a different 250 mL beaker.
11. Repeat steps 1–10 for brand B popcorn.
12. Repeat steps 1–10 for brand C popcorn.

### DISPOSAL

13. Dispose of popped popcorn and aluminum foil in containers as directed by your instructor. Do not eat the popcorn.



14. Clean beakers. Return beakers and other equipment to the proper place.
15. Clean all work surfaces and personal protective equipment as directed by your instructor.
16. Wash your hands thoroughly before leaving the laboratory.

Percentage of Water in Popcorn *continued*

Data Table			
	Popcorn Brand A	Popcorn Brand B	Popcorn Brand C
Mass of 250 mL beaker (g)			
Mass of beaker + oil (g)			
Mass of beaker + oil + 20 kernels (before) (g)			
Mass of 20 kernels (before) (g)			
Mass of beaker + oil + 20 kernels (after) (g)			
Mass of 20 kernels (after) (g)			
Mass of water in 20 kernels (g)			
Percentage of water in popcorn			

## Analysis

- 1. Applying Ideas:** Determine the mass of the 20 unpopped kernels of popcorn for each brand of popcorn.
- 2. Applying Ideas:** Determine the mass of the 20 popped kernels of popcorn for each brand of popcorn.
- 3. Applying Ideas:** Determine the mass of the water that was lost when the popcorn popped for each brand.

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Percentage of Water in Popcorn *continued*

## Conclusions

1. **Applying Data:** Determine the percentage by mass of water in each brand of popcorn.
  
  
  
  
  
  
  
  
  
  
2. **Inferring Relationships:** Do all brands of popcorn contain the same percentage water?

## EXTENSIONS

1. **Designing Experiments:** What are some likely areas of imprecision in this experiment?

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Percentage of Water in Popcorn *continued*

- 2. Designing Experiments:** Do you think that the volume of popped corn depends on the percentage of water in the unpopped corn? Design an experiment to find the answer.