The Bog of Buoyancy

Grade Level: 3-5

Essential Skills: 3, 4, 5

NGSS: 3-PS2-1

Math: 3.MD.2, 3.OA.3, 4.NBT.4, 4.NBT.5, 4.NF.4, 4.MD.2, 5.NBT.5, 5.NF.4, 5.MD.5

Time: 60 minutes

Materials: Bog to Cranberries Kit*

Per student:
- cranberry
- marble
- cup
- water
- liquid measuring cup
- *Buoyancy of a Cranberry* worksheet
- calculator (optional)

***Materials Available from Oregon Agriculture in the Classroom.**

AITC Library Resources:

Books:
Time for Cranberries
Cranberries: Fruit of the Bogs

More Lessons:
The Geography of Thanksgiving Dinner

Description:

Discover the law of buoyancy and its importance in the production of cranberries! Students will explore whether or not a cranberry floats and the phenomena of the buoyancy force.

Background:

The Law of Buoyancy, called Archimedes' Principle, states that a body floating in a fluid is supported (or buoyed up) by a force equal to the weight of the fluid it displaces.
In simpler terms for this experiment, a cranberry will float if it displaces as much water as it weighs. When a ripe cranberry is immersed in water it experiences a force known as the buoyancy force. This force is equal to the weight of the water displaced by the cranberry. Here is another example: a lump of steel will sink because it is unable to displace water that equals its weight, but steel of the same weight, shaped as a bowl, will float. This is because the weight gets distributed over a larger area and the steel in this form is able to displace water equal to its weight. As a result, a heavily laden ship floats because its total weight is exactly equal to the weight of the water it displaces. It is this weight that exerts the buoyant force supporting the ship.

Directions:

Activity 1: Float or Sink Experiment

1. Provide students with a cranberry, a marble, a cup and the *Buoyancy of a Cranberry* worksheet.

2. Instruct students to fill a glass of water and await further instructions.

3. Ask students whether they think a marble would sink or float in the cup, then ask about the cranberry.

4. Instruct students to place the cranberry and marble in their cup of water.

5. Have students make observations on their worksheet about what happened to the marble and the cranberry in the table provided. Invite students to create questions about what happened.

6. Explain to students the Law of Buoyancy or have them watch the video *Why Do Ships Float? by SciShow Kids* (https://youtu.be/CvWrkxzCiaY)explaining the concept.

Activity 2: Why does the marble sink?

The density of an object and the fluid surrounding it determines its ability to float. Today, we are going to calculate the density of the cranberry to compare it with the density of water. Students will determine the volume of a marble and a cranberry using the following steps. Some students will have a larger marble and others with have a smaller sized marble.
1. Fill a liquid measuring cup with water to the 100 mL mark, place the marble in and watch the water line rise.

2. Have students record on their worksheet where the water level rises to with the marble in it.

3. Next, students will determine the volume of the marble by subtracting the original water level without the marble (100mL) by the water level with the marble. This will provide students with the volume of the marble. Students should record the volume of the marble

in the *Volume and Density Chart*.

4. Using the volume of the marble, determine the density by dividing the mass of the marble (5.2 grams for the smaller marble or 20.3 grams for a larger marble) by the volume you determined from above. Record the answer in the *Volume and Density Chart*.

5. Provide students with the density of water, 1 mL of water is 1 gram. Ask students to compare the density of the marble with water and record their answers in the *Volume and Density Chart*.

Activity 3: How does the cranberry float?

1. Using the same measuring cup, remove the penny and check to make sure the water is at 100 mL mark, place your cranberry in and watch the water line rise.

2. Invite students to record the water level on their worksheet with the cranberry in it.

3. To determine the volume of the cranberry, students will subtract the original water level without the cranberry (100ml) by the water level with the cranberry. This will provide the volume of the cranberry. Record the volume of the cranberry on the *Volume and Density Chart*.

4. Using the volume of the cranberry, we can determine the density by dividing the mass of the cranberry (.03 grams) by the volume you determined from above. Record the density of the cranberry in the *Volume and Density Chart*.

5. Ask students to compare the density of the cranberry to water and record their answer in the *Volume and Density Chart* .

7. Ask students to complete the follow up questions on the bottom of the worksheet and discuss the results as a class.

8. Review the following concepts:
    a. Why did the marble sink and the cranberry float?
    b. How does buoyancy work?

9. Transition into learning about cranberries. *The law of buoyancy is very important to cranberry growers, they utilize this concept in the production of cranberries. Let's learn a little more about cranberries!*

Activity 3: Introduction to Cranberry Production

1. Invite students to watch the video Cranberry, *How does it grow? by True Food TV* (https://youtu.be/XZPXQ7nw_9Y)

2. Review the following questions after watching the video:
    a. Where did you see the law of buoyancy being used by cranberry growers?
    b. What are some uses of cranberries?
    c. Why are bogs used multiple times in a year for cranberry production?

Activity Page

Buoyancy of a Cranberry

Student Name: _____

Part 1: Float or Sink Experiment?

In this activity, you will determine if the marble and cranberry float or sink when placed in a cup.

1. Fill a cup with water, place the cranberry and the marble in the water.
2. Record your observations below based on what happened and questions that you have about this experiment.

	Observations	Questions
Marble		
Cranberry		

Part 2: Volume and Density of the Marble

1. Fill a liquid measuring cup with water to the 100 mL mark, place your marble in and watch the water line rise.

2. Where is the water level with the marble in the water?

3. To determine the volume of the marble, you will subtract the original water level without the marble (100mL) by the water level with the marble. This will provide you with the volume of the marble. Record the volume of the marble in the *Volume and Density Chart.*

4. Using the volume of the marble, we can determine the density by dividing the mass of the marble. If you have a small marble the mass is 5.2 grams, if you have larger marble the mass is 20.3 grams. Divide the mass by the volume you determined from above. Record your answer in the *Volume and Density Chart*.

5. The density of 1 mL of water is 1 gram, is the density of the marble greater than, equal to or less than water? Record your answer in the *Volume and Density Chart*.

Part 3: Volume and Density of the Cranberry

1. Using the same measuring cup, remove the marble and check to make sure the water is at 100 mL mark, place your cranberry in and watch the water line rise.

2. Where is the water level with the cranberry in the water?

3. To determine the volume of the cranberry, you will subtract the original water level without the cranberry (100mL) by the water level with the cranberry. This will provide you with the volume of the cranberry. Record the volume of the cranberry on the *Volume and Density Chart*.

4. Using the volume of the cranberry, we can determine the density by dividing the mass of the cranberry (.03 grams) by the volume you determined from above. Record the density of the cranberry in the *Volume and Density Chart* below.

5. The density of 1 mL of water is 1 gram, is the density of the cranberry greater than, equal to, or less than water? Record your answer in the *Volume and Density Chart* below.

Part 4: Analyzing Results

Volume and Density Chart

	Mass	Volume	Density	Density in Comparison to Water (Greater than, equal to, or less than)
Water		1 mL	1 g	
Marble	Small Marble 5.2 g Larger Marble 20.3 g			
Cranberry	.03 g			

1. List observations below about the numbers you calculated in comparison to water?

2. What conclusions can be made about what causes an object to float or sink in water based on the chart above?