POLAR TREC
Learning Resources

Details

Completion Time: Less than a week
Permission: Download, Share, and Remix

The Incredible Shrinking Cup

Overview
Students decorate polysterene cups later to be submerged in the ocean. Subsequent activities have students consider the effects of water pressure and depth with respect to their cups.

Objective
Students will determine mass and volume of a styrofoam cup. They will calculate the density and research the depth of the Bering, Beaufort and Chukchi Seas. They will also make scientific observations and take measurements using the metric system.

Lesson Preparation
Part One: This activity takes place before cups are taken to the Bering, Beaufort and Chukchi Seas. Many researchers will submerge a polystyrene cup for students. Contact your local COSEE, Sea Grant, Oceanographic Institution, etc.

This lab can be used to introduce concepts such as reading a meniscus, taking scientific measurements using a triple beam balance, determining volume by displacement, or the importance of good scientific observations. It can also be a review to practice these skills. The observations taken in Part One are essential to discussing what happens to the cup and the effect water pressure has on objects. Follow the attached worksheets and answer all questions.

Procedure
1. Divide the class into four groups.
2. Students decorate their Styrofoam cup using permanent markers.
3. Students will sketch and describe their cups.
4. Calculate the mass of the Styrofoam cup using a triple beam balance. Record.
5. Calculate the volume of the Styrofoam cup using

Materials

For Each Lab Group:
- Styrofoam cup
- Permanent markers (i.e. Sharpies)
- Extra large graduated cylinder
- Metric ruler
- Triple Beam Balance
- Calculator
- Lab Worksheet (attached)

displacement. Fill an extra large graduated cylinder to a determined mark. Place a 20 gram weight in your Styrofoam cup and place it in the graduated cylinder. Note the amount of water displaced by subtracting your beginning amount with your ending amount. Subtract the water displaced by the 20 g used to "sink" the cup. This was 6 ml when we did it. Record.
6. Calculate density using the formula D=mass/volume. Record.
7. For further research - students will research the depth of each of the Bering, Beaufort and Chukchi Seas.

Extension
n/a

Assessment
n/a

Credits
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Learning Resources

National Science Education Standards (NSES):

Content Standards, Grades 5-8

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inqui

Content Standard B: Physical Science
a. Properties and changes of properties in matter

Content Standards, Grades 9-12

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

Content Standard B: Physical Science
b. Structure and properties of matter

Group Names _____	**Subject _____**
Date _____	**Class _____**

Incredible Shrinking Cup Lab Worksheet Part One

Materials (For Each Lab Group)
Styrofoam cup
Sharpie markers
Extra large graduated cylinder
Metric ruler
Triple Beam Balance
Calculator
Lab Worksheet

Activities:
1. Decorate your Styrofoam cup using the Sharpie markers.

2. Sketch your cup and label diameter of top, diameter of bottom and cup height.

3. Calculate the mass of the Styrofoam cup using a triple beam balance. Record.

Mass of Styrofoam Cup _____ grams

4. Calculate the volume of the Styrofoam cup using displacement. Fill an extra large graduated cylinder to a determined mark. Place a 20 gram weight in your Styrofoam cup and place it in the graduated cylinder. Note the amount of water displaced by subtracting your beginning amount with your ending amount. Subtract the amount of water displaced by the 20 g used to "sink" the cup. Record.

Beginning water level _____ Ending water level _____

Displaced Water - Amount displaced by masses = Volume of cup cm^3

_____ - _____cm^3 = _____ Volume of cup cm^3

5. Calculate density using the formula $D=\frac{mass}{Volume}$ (Show your work) Record.

6. For further research find the depth of the Bering, Beaufort and Chukchi Seas and any other interesting information.

7. Predict what you think will happen if your cup is sent to a specified depth in the Bering, Beaufort, and Chukchi Seas.

Group Names _____	**Subject _____**
Date _____	**Class _____**

Incredible Shrinking Cup Lab Worksheet Part Two

Materials (For Each Lab Group):
Styrofoam cup
Sharpie markers
Extra large graduated cylinder
Metric ruler
Triple Beam Balance
Calculator
Lab Worksheet

Activities:
1. Sketch your cup and label diameter of top, diameter of bottom and cup height.

2. Calculate the mass of the Styrofoam cup using a triple beam balance. Record.

Mass of Styrofoam Cup _____ grams

3. Calculate the volume of the Styrofoam cup using displacement. Fill an extra large graduated cylinder to a determined mark. Place a 20 gram weight in your Styrofoam cup and place it in the graduated cylinder. Note the amount of water displaced by subtracting your beginning amount with your ending amount. Subtract the amount of water displaced by the 20 g used to "sink" the cup. Record.

Beginning water level _____ Ending water level _____

Displaced Water - Amount displaced by masses = Volume of cup cm^3

_____ - _____cm^3 = _____ Volume of cup cm^3

4. Calculate density using the formula $D=\frac{mass}{Volume}$ (Show your work) Record.

5. Your cup was submerged on a CTD rosette in the Barrow Canyon off the coast of Alaska. It went to a depth of 1647 meters. How many feet is that? Find the conversion and show your work. How many miles is that? Find the conversion and show your work.

6. How do your observations from Part One compare with those from today?

7. Explain why this happened to your cup.
(HINT: Think about how and why the density of your cup changed.)

8. What implications does this have on ocean exploration?

Group Names _____	**Subject _____**
Date _____	**Class _____**

Water Pressure Lab Worksheet

Materials:
tin can
container of water with small cup
masking tape
shallow basin to collect water
paper towels
lab worksheet

Activities:

1. Divide into groups of four and assign each student in the group a role:
- *Materials* - to collect and maintain materials needed for the lab.
- *Recorder* - to record information from the lab.
- *Technician* - to perform maneuvering of the lab work.
- *Maintenance* - to clean up the lab station and be prepared for spills.

2. Hypothesize what you think will happen when the tape is removed. The recorder should record these on question 1.
3. Place the tin can in a shallow basin with the holes plugged by masking tape.
4. Fill the can with enough water to cover each hole. Be sure the water is not leaking from the tape.
5. While holding the can with one hand, the technician removes the tape. Observe and record on question 2.
6. Which hole had the stronger stream? Which hole has the weaker stream? Why? Record the answers to questions 3, 4, and 5.
7. Have one member of the group share lab results with the class.

Questions:

1. Which hole do you think will have the strongest stream of water when the tape is removed? Why?
2. What happened when the tape was removed?
3. Which hole had the strongest stream when the tape was removed?
4. Which hole has the weakest stream when the tape was removed?
5. Why was there a difference in water flow between the weak and strong streams?
6. How does this difference in water pressure effect human divers and equipment used underwater?

Resources
http://pao.cnmoc.navy.mil/educate/neptune/lesson/science/pressure.htm