



Drexel-SDP GK-12 ACTIVITY

Activity Template

Subject Area(s): Buoyancy

Associated Unit:

Associated Lesson:

Activity Title: Boats and Buoyancy

Grade Level 6 (6-7)

Activity Dependency: None

Time Required: 50 minutes

Group Size: 3

Expendable Cost per Group: US \$2.00

Summary

In this activity, students explore the buoyancy force and how it relates to boats. Students first learn about the forces involved in floatation and then implement their knowledge to build a model boat out of aluminum foil, duct tape, and pipe cleaners. The students then test their boats buoyancy by putting pennies inside the boat and observing when it sinks.

Engineering Connection

Mechanical engineers use the principles of buoyancy to design hull shapes and materials to ensure that a boat is stable and will float. Mechanical engineers also use models to visualize and test their designs. This activity allows the students to be involved in the same process of design and testing that engineers follow.

Keywords

Boat, Buoyancy, Floatation, Force

Educational Standards

- Science: 3.1, 3.2, 3.4
- Math: None

Learning Objectives

After this lesson, students should be able to:

- Describe how buoyancy allows a boat to float
- Explain why a material may float or sink depending on its shape
- Explain how models can be used to test designs

Materials List

Each group needs:

- 25 cm aluminum foil sheet
- 4 craft pipe cleaners
- 15 cm duct tape

To share with the entire class:

- Tub of water
- Two rolls of pennies

Introduction / Motivation

Have you ever wondered how ships that can weigh thousands of tons can float in water? A large block of metal will sink straight to the bottom of the ocean, but when that same amount of metal is shaped properly, it will float. The name of the force that allows boats to float is called buoyancy. This force was described by Archimedes in ancient Greece. According to the story, when Archimedes went to bathe, he realized that the water spilled over the tub as he entered. Archimedes used his discovery to calculate the density of the king's crown to determine if it was real gold or fake. Archimedes' discoveries are still used today by mechanical engineers. Mechanical engineers spend lots of time designing the shape of a boat to make sure that it will float. In order to ensure that their designs will work, engineers use models to test their designs before building a full size boat. In this activity we are going to build a model boat and test its floatation capabilities.

Vocabulary / Definitions

Word	Definition
Buoyancy	An upward force on an object immersed in a liquid equal in magnitude to the weight of the displaced liquid.
Displace	To push a fluid out of the way and take its place.

Procedure

Before the Activity

- Cut lengths of the aluminum foil and duct tape for each group and fill the tub with water.
- Make copies of the worksheet.

With the Students

1. Ask the students why boats can float even when they are made out of metal, which normally sinks in water.
2. During the discussion explain buoyancy and displacement.
3. After the discussion, divide the class up into groups of three and give each group their materials.
4. Have each group design and build a boat using only the materials it was given.
5. Test each group's boat one at a time by putting the boat in the tub of water and adding pennies one at a time until the boat sinks.
6. Have the students complete the worksheet and discuss the results as a class.

Attachments

boats_worksheet (doc)

boats_worksheet_answers (doc)

Assessment

Pre-Activity Assessment

Class Discussion: Use the discussion to see how much the students know about buoyancy. Talk to them about which materials they know float and which materials they know sink. Discuss how shape effects whether an object will float.

Activity Embedded Assessment

Boat Test: Test the boats the students build to see how many pennies the boat holds before sinking.

Post-Activity Assessment

Boats Worksheet: The worksheet will test the students' understanding of buoyancy and how shape affects an object's ability to float.

References

"Archimedes of Syracuse". The MacTutor History of Mathematics archive. January 1999.
Accessed November 15 2008

<<http://www-history.mcs.st-and.ac.uk/Biographies/Archimedes.html>>

HyperPhysics. "Buoyancy". Georgia State University. Accessed November 15, 2008
<http://hyperphysics.phy-astr.gsu.edu/Hbase/pbuoy.htm>

Owner

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Name: _____

Boats and Buoyancy

Part 1. Buoyancy

If a 2 pound block of wood displaces 3 pounds of water, will it float in water?

If the same block of wood displaces 1.5 pounds of oil, will it float in oil?

If a 5 pound block of metal displaces 1 pound of water, will it float in water?

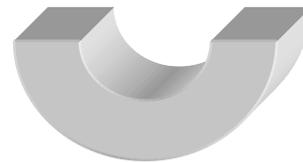
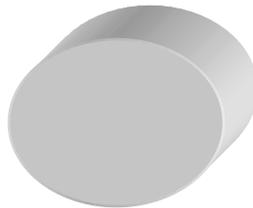
If a 5 pound metal boat displaces 6 pounds of water, will it float in water?

Part 2. Boats

How many pennies did your boat hold before it sank?

What was the average number of pennies for the class?

Which of these shapes do you expect to float the best? Why?



Hot air balloons and helium balloons float because of buoyancy. How can you explain this?

What would you do differently if you had to build a boat again?

Name: Answer Key

Boats and Buoyancy

Part 1. Buoyancy

If a 2 pound block of wood displaces 3 pounds of water, will it float in water?

Yes

If the same block of wood displaces 1.5 pounds of oil, will it float in oil?

No

If a 5 pound block of metal displaces 1 pound of water, will it float in water?

No

If a 5 pound metal boat displaces 6 pounds of water, will it float in water?

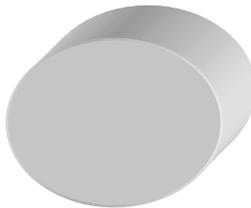
Yes

Part 2. Boats

How many pennies did your boat hold before it sank?

What was the average number of pennies for the class?

Which of these shapes do you expect to float the best? Why?



The third shape, the U shape, will float the best because it will displace the same amount of water as the second shape while weighing the least.

Hot air balloons and helium balloons float because of buoyancy. How can you explain this?

The weight of the balloon and gas inside is less than the weight of the air that is displaced by the balloon.

What would you do differently if you had to build a boat again?