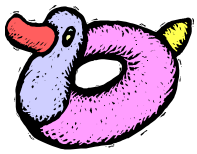
Grade Level(s): One and Two
Lesson Title: Rubber Ducky, You Make Floating So Much Fun!



Focus: (Concept or skills to be emphasized)
Buoyancy, models as representations of real things, estimation of weight/mass

Objectives: See end of lesson for objectives and standards achieved.

Background Information:

In the story of Peter and the Wolf, a duck is swimming in a pond. The duck is able to float because it is buoyant in fresh water.

Buoyant force is the upward force exerted on a substance which is partly or completely immersed in a fluid. According to Archimedes' principle, buoyant force acting on a substance in a fluid is equal to the weight of the fluid displaced by an object. An object will float in a fluid if the total weight of the fluid displaced by an object is greater than the weight of the object itself. Conversely, an object will sink if the weight of the fluid displaced by an object is less than the weight of the object.

Note: Modeling clay is used in the experiments presented in this lesson to demonstrate buoyancy. It is used in this lesson to show how buoyant force increases when the volume of an object is increased (in this experiment a bubble is formed inside of a piece of clay). While most modeling clay that is free of bubbles will sink in regular tap water you may wish to test your clay to make sure that it sinks prior to this experiment.

Activities (Procedures):

1. Read the story of *Peter and the Wolf*, as found in the Teacher's Section under The Verizon Literacy Resource Section with your class. Ask students to differentiate between the living and non-living things that are part of the story. SC.1.4.1 Draw special attention to the pond and the duck and make a distinction between the living duck and the non-living pond.
2. Ask students why they think the duck was able to float in the story *Peter and the Wolf.* SC.1.1.1, SC.2.1.1 As a class, ask students to think of things that float and things that do not float. Arrange these things on a chart arranged into columns named "Things that float" and "Things that do not float". If students have not already done so, ask them to think of things in the classroom and to predict which objects will or will not float; record the predictions on the chart. SC.1.2.2, SC.2.2.2, SC.2.2.5 Show students a rubber duck and ask them to predict whether or not it will float in water. SC.1.4.9 Ask the general question: "Why do some things float and other things do not?"

a. Pick several objects in the classroom that you do not mind getting wet. Starting with a rubber duck as a model of the duck in the story *Peter and the Wolf*, begin placing objects into a large water-filled container to see which ones float and which do not. SC.1.3.2, SC.2.3.2 Track results on the chart.
b. Once you have tested all objects, ask students to identify which objects did not behave as expected. Ask them to think of reasons why their predictions may have differed from the actual results.
c. Place the rubber duck onto a balance scale. Form a ball of clay of an equal weight to the duck on the other side of the balance (make sure there are not air pockets inside the clay) – add or remove clay until both weights are equal. Once balanced, explain that both the clay and the duck weigh the same. Ask students to predict whether the clay and the duck will float or sink when placed in the water and to justify their prediction. Place the duck and the clay into the water and record the results. If the actual results differ from students' predicted results, ask them why they think this happens.
d. Repeat step "c", but this time form clay into a "pancake" equal in weight to the rubber duck. Form the pancake into a ball with an air pocket (think of this as a "clay bubble"). Seal the central air pocket carefully (practice making "clay bubbles" before the experiment; the objective of this step is to make the "clay bubble" float).
e. Finally, ask students to predict what will happen when vegetable or olive oil is poured into water, and record their predictions. Encourage students to justify their predictions. Pour vegetable oil or olive oil into a clear cup or jar partially filled with water. Wait long enough for the oil to float as a distinct layer on the surface of the water. Explain that oils are types of fats, and that all fats are more buoyant than water, so they float in water.
f. Explain to students that objects with the same weight can have different densities. Tell students that the reason the rubber duck floats is because it is filled with air, which makes it buoyant. Say that the reason water wings (inflatable floatation devices attached to each arm to help teach people to swim) and inflatable rubber rafts help people float is because they are filled with air. SC.1.4.18 Explain that air is lighter than water, so if something is filled with enough air, even if it is very heavy (e.g. a ship), it can float in water. Tell students the reason real ducks, such as the one in *Peter and the Wolf*, can float is because they have air in their lungs and are made of substances, including fats, which float in water.

Assessment/Evaluation*:

1. Student completed class chart of flotation ability.
2. Student participation in class discussions.

Supplemental Materials and Equipment Needed:
Balance scale
Rubber duck
Various everyday classroom objects – some that will float, some that will not float
Modeling clay
Vegetable oil or olive oil
Large partially water-filled container (ideally a large clear container, such as an aquarium)
Clear partially water-filled cup or jar

Resources:
Information on buoyancy:
http://www.pbs.org/wgbh/nova/lasalle/buoybasics.html
http://science.howstuffworks.com/question254.htm
Information on buoyancy, Archimedes, and Archimedes' Principal:
http://www.encyclopedia.com/html/a/archimedes.asp
http://www.mcs.drexel.edu/~crorres/Archimedes/contents.html
http://www.engineering.usu.edu/jrestate/workshops/buoyancy/buoyancy.php
Other buoyancy experiments:
http://education.usace.army.mil/clubhouse/science/buoyancy.html

References:
Ostdiek, Vern J. & Bord, Donald J. (2000). Inquiry into Physics. Brooks/Cole: Pacific Grove, CA.

National Standards Achieved:
Science
Content Standard A
Abilities necessary to do scientific inquiry:
- Ask a question about objects, organisms, and events in the environment
- Communicate investigations and explanations

Mathematics
Understand patterns, relations, and functions:
- Sort, classify, and order objects by size, number, and other properties

WV Content Standard Objectives:

First-Grade

SC.1.1.1	ask questions about themselves and their world.
SC.1.2.2	use scientific instruments and everyday materials to investigate the natural world (e.g., hand lens, balance, magnets, thermometer, seeds, rocks).
SC.1.3.2	use models as representations of real things.
SC.1.4.1	classify objects as living or non-living.
SC.1.4.9	predict and investigate the buoyancy of objects in water.
SC.1.4.18	identify important uses of air.
MA.1.4.3	Compare two objects or events according to one or more of the following attributes: length, height, weight, time, temperature, and volume.

Second-Grade

SC.2.1.1	recognize science as the human's search for an understanding of the world by asking questions about themselves and their world.
SC.2.2.2	manipulate scientific instruments and everyday materials to investigate the natural world (e.g., hand lens, balance, thermometer, metric ruler, magnets, weather instruments, calculators).
SC.2.2.5	conduct simple investigations; observe, collect and record information using a variety of classification systems; describe trends of data; and make predictions based on that data (e.g., seasonal changes and plants; temperature and weather).
SC.2.3.2	use models as representations of real things.
MA.2.5.4	formulate questions, collect data, organize and display as a chart/graph.

Kentucky Program of Studies

S-P-SI-1
Students will ask simple scientific questions that can be answered through observations.

S-P-SI-2
Students will use simple equipment (e.g., aquariums), tools (e.g., magnifiers, spoons), skills (e.g., observing, pouring), technology (e.g., video discs), and mathematics in scientific investigations.

S-P-SI-3
Students will use evidence (e.g., observations) from simple scientific investigations and scientific knowledge to develop reasonable explanations.

S-P-SI-4
Students will design and conduct different kinds of simple scientific investigations.

S-P-SI-5
Students will communicate (e.g., speak, draw) designs, procedures, and results of scientific investigations.

S-P-SI-6
Students will question scientific investigations and explanations of other students.

M-P-GM-16
Students will determine length, weight, and volume with nonstandard units.

M-P-PS-11
Students will collect and display data.

Ohio Academic Content Standards

First-Grade

Y2003.CSC.S05.GKG-02.BA.L01.I01

Doing Scientific Inquiry /

01. Ask "what happens when" questions.

Y2003.CSC.S05.GKG-02.BA.L01.I02

Doing Scientific Inquiry /

02. Explore and pursue student-generated "what happens when" questions.

Y2003.CSC.S05.GKG-02.BB.L01.I06

Doing Scientific Inquiry /

06. Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers, timers and simple balances and other appropriate tools).

Y2003.CMA.S02.GPK-02.BD.L01.I04

Use Measurement Techniques and Tools /

04. Estimate and measure weight using non-standard units; e.g., blocks of uniform size.

Second-Grade

Y2003.CSC.S05.GKG-02.BC.L02.I05

Doing Scientific Inquiry /

05. Use evidence to develop explanations of scientific investigations. (What do you think? How do you know?)

Y2003.CSC.S05.GKG-02.BB.L02.I07

Doing Scientific Inquiry /

07. Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers, non-breakable thermometers, timers, rulers, balances and calculators and other appropriate tools).

Y2003.CSC.S05.GKG-02.BB.L02.I08

Doing Scientific Inquiry /

08. Measure properties of objects using tools such as rulers, balances and thermometers.

Y2003.CSC.S05.GKG-02.BC.L02.I10

Doing Scientific Inquiry /

10. Share explanations with others to provide opportunities to ask questions, examine evidence and suggest alternative explanations.

*All Assessments are to be at the expected state assessment standard; in West Virginia this is mastery level; in Ohio this is benchmark level; and, in Kentucky, this is academic expectations level.