Websites to Assist PBL

The following sites were chosen to support each project-based unit in this book. Take time at the beginning of each unit to tour the sites and familiarize yourself with their offerings. Some provide pictures and others have short informative videos on unit topics. Many sites offer additional activity ideas, worksheets, and suggestions for games. It is up to you to determine if you will incorporate a site into your students' activities, use it for research, or for background information. All have something special to offer. By preparing ahead of time, you will know just where to go to enhance your students discoveries and help extend their explorations.

Bats

Bats Bats Everywhere—*www.bats4kids.org/*
Where bats live, what type of homes they occupy, and how they help humans. The big nine bat facts are discussed.

Defenders of Wildlife—*www.defenders.org/bats/basic-facts*
Information about the size, behavior, diet, habitat, life span, and appearance of the bat.

KidzCave—Bat Conservation International, Inc.—
http://www.batcon.org/index.php/all-about-bats/kidz-cave.html
The main site offers information about bats, and bat conservation. Additional age-appropriate materials and a video about echolocation can be found in the Kidz Cave.

KidZone Bats—*www.kidzone.ws/animals/bats/index.htm*
Support the bat unit with printable activity worksheets, online activities, facts, and photos.

Buoyancy

eHow—*www.ehow.com/how_8159938_teach-buoyancy-grade-school-children.html*
This site suggests several experiments to extend the concept of buoyancy.

Mythbusters Discovery—
http://dsc.discovery.com/videos/mythbusters-lets-talk-buoyancy.html
Watch the "Let's Talk Buoyancy" video and listen to the Mythbusters discuss the science behind why boats float.

Exploring Color

Activities for Kids—*http://activitiesforkids.com/printable-color-wheel*
Check out different color wheel activities and an idea for a magic potion drink to show color mixing—a "must try" beverage, and so simple!

First School—*www.first-school.ws/activities/artapp/rainbow-color-mixing.htm*
This site provides good illustrations of a rainbow and primary and secondary colors.

Buoyancy and Boat Design

STEM Objectives

1. Students will research, investigate, and experiment to find out how a boat's design affects its buoyancy.
2. Students will create boats to determine which design will support the most weight without sinking.
3. Students will be able to explain why some boat designs work better than others.
4. Data will be collected, recorded, and evaluated using charts, graphs, and/or spreadsheets.

Introduce the Topic – Buoyancy

1. Read a nonfiction book about buoyancy. Then discuss the concepts of buoyancy using appropriate vocabulary. (See page 30.)
2. Share nonfiction and fiction books about water vessels and buoyancy. Discuss each book after it has been read and keep copies on display.

Suggestions

Early Reader: Sink or Float? by Lynn Salem and Josie Stewart

Floating and Sinking (First Facts: Our Physical World) by Ellen Sturm Niz

Red Fox and His Canoe (I Can Read Book 1) by Nathaniel Benchley and Arnold Lobel

What Floats? What Sinks?: A Look at Density by Jennifer Boothroyd

Will It Float or Sink? (Rookie Read-About Science) by Melissa Stewart

3. Talk about sinking and floating. Experiment with some classroom objects and a container filled with water. Before each item is placed in the water, vote on whether it will sink or float. Add the term "buoyant" when discussing the items that float to help students make connections.
4. Provide opportunities for students to go online for additional information and check the suggested buoyancy websites on page 9.

Buoyancy and Boat Design *(cont.)*

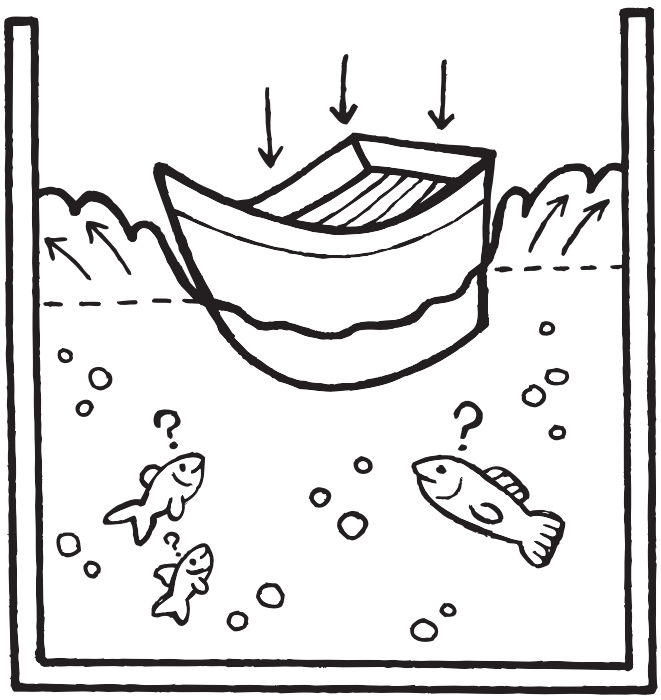
Brainstorming Sessions

1. Help students list what they already know about *buoyancy* on a KWL chart.
2. Create a list of questions to discuss related to buoyancy.
   Start with these:

- Can heavy objects float?
- What happens if you put a heavy object on something like a raft?
- Are you buoyant? (Yes, you can float if you lay flat. Your body has air in it. A penny cannot float by itself, even though it is little, because there is no air in it.)
- Why are there different designs for boats?
- What type of boat designs carry heavy loads?
- What type of boat designs would go fast?
- What boat designs might hold the most weight without sinking?

Buoyancy		
K	W	L
Some things don't sink. Ducks don't sink on the water. Boats can float.		

Buoyancy and Boat Design Vocabulary



buoyancy—an object's ability to float in water (or air, or other liquid); the power of a liquid to keep something afloat

hull—the main body of a ship or large boat including the bottom, sides, and deck

surface area—the part of an object that is exposed to the surface of the water

water displacement—the water that is pushed away by an object

vessel—ship or large boat; a hollow container

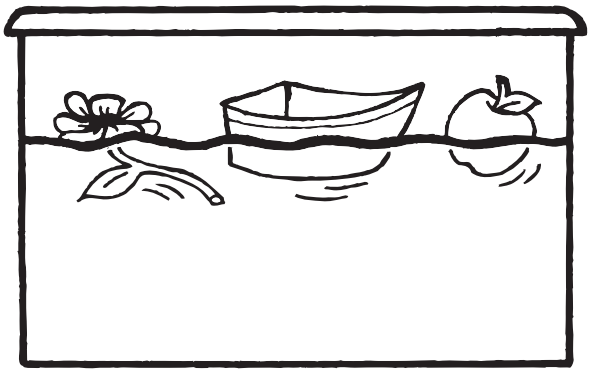
Explanations

1. When an object is placed in the water, it pushes water out of the way.

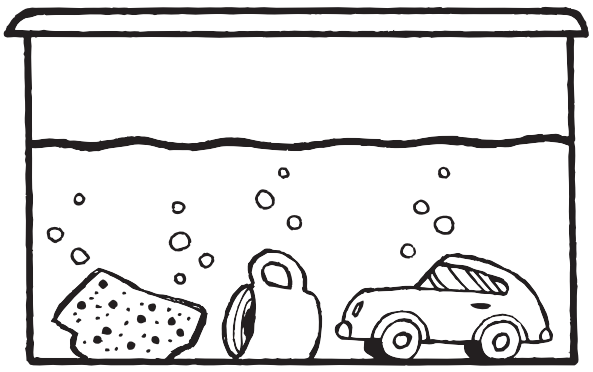
- If the object weighs less than the amount of water that is pushed out of the way, the object will **float**.
- If the object weighs more than the amount of water that is pushed out of the way, the object will **sink**.

2. Increasing the surface area of a boat increases the amount of water that it pushes away without increasing the weight of the boat, and that allows a larger boat to float.

Float



Sink

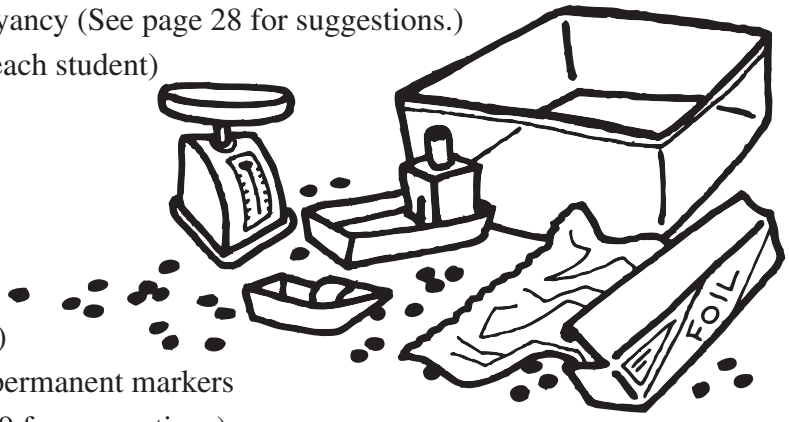


Buoyancy and Boat Design

The following project-based buoyancy activities are designed to encourage collaborative learning and discovery. Students can work independently or in small groups (3 to 4) depending on the setup for each activity. Encourage students to notice when they are using *science, technology, engineering*, or *math* during their buoyancy explorations.

Supplies

- one or more large containers of water (Clear storage bins can accommodate 2–3 students.)
- nonfiction and fiction books about buoyancy (See page 28 for suggestions.)
- aluminum foil (two 4" x 6" pieces for each student)
- butcher paper (for large graph)
- examples of different types of boats
- pictures of different types of boats
- scale *(optional)*
- fan *(optional)*
- *Boat Designs* recording sheet (page 36)
- pencils, crayons, fine-tipped markers, permanent markers
- buoyancy research websites (See page 9 for suggestions)
- pennies or other uniform-sized counters (30–50 per student at a water station.)



Teacher Preparation

1. Print a *Boat Designs* recording sheet for each student.
2. Familiarize yourself with the vocabulary (See page 30.), concepts of buoyancy, and different types of boat designs.
3. Display examples and pictures of several types of boats for the students to refer to during the activities. Ask students to name as many different types of boats as they can and compare them. Does it carry people or products? Is it for work or pleasure? How much could it carry? End the discussion by focusing on the bottom shape of each boat. Does the boat have a flat or a V-shaped hull?
   - airboat
   - barge
   - canoe
   - catamaran
   - fishing boat
   - kayak
   - rowboat
   - sailboat
   - container ship
   - cruise ship
   - dingy
   - ferry
   - speed boat
   - tanker
   - tugboat
   - yacht
4. Create a graph so that each student can record the number of objects that his/her boat held before sinking. (See Station 3 on page 34.)
5. Create additional charts, graphs, or spreadsheets as needed to record group responses and as part of the culminating events.
6. Arrange stations where students can research and design boats, construct boats, then complete their buoyancy experiments.

Buoyancy and Boat Design *(cont.)*

Student Preparation

1. Review the concept of buoyancy and other information from the brainstorming sessions. Ask if any new information has been discovered which can be added to the KWL chart.
2. If appropriate, set up a **Sink** or **Float** station in the classroom and allow students time to test different items before beginning the *Buoyancy and Boat Design* activities.

3. Ask students to name as many types of boats as they can. Discuss the examples of boats and the purpose of different boat designs.
4. Post an enlarged copy of the vocabulary page and/or ask students to create illustrated vocabulary word cards.

Introduce *Buoyancy and Boat Design* Activities

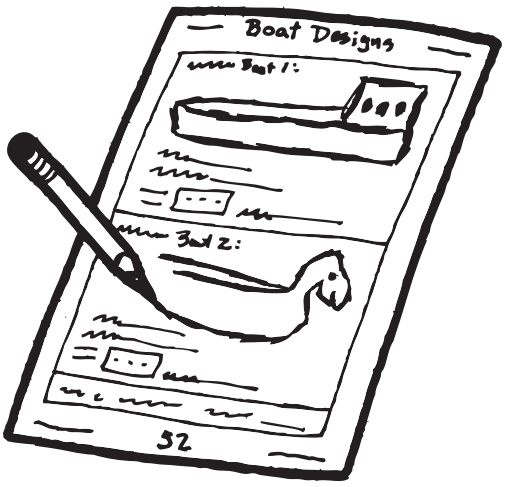
1. Divide the students into small groups to complete their buoyancy activities. Determine how many students can be in each station at a time.
2. Explain that each student will be designing and creating two boats using aluminum foil and then conducting experiments to determine how many pennies each boat can hold without sinking.
3. Outline the process of designing the boats using aluminum foil. Explain how to research to find ideas for different hull designs.
4. Establish Station 1 in the reading area, or create the research station at a table near the computer.
5. Model how to create a plan for the boats on the *Boat Designs* recording sheet. (See page 36.) Each student will create two different hull designs (narrow, wide, thick, or thin).
6. Distribute a *Boat Designs* recording sheet to each student. Encourage students to refer back to their resources as needed and to use the new vocabulary words when completing the activities.
7. Explain how to proceed at each work area. Model how to use the materials, if necessary, and remind student-engineers that they are designing and creating a boat for a specific purpose— to hold the most weight (mass).

Buoyancy and Boat Design *(cont.)*

Station 1 – Research and Design Boats – *Science/Technology/Engineering/Math*

Tools

- nonfiction books, posters, and pictures about boats and water vessels
- examples of different types of boats
- access to approved *buoyancy* and *boat* websites
- pencils, colored pencils, fine-tipped markers, crayons
- *Boat Designs* recording sheet (for each student)



Procedure

1. Look through several books about boats and compare examples. Research boats online and print out pictures.
2. Choose two different boat designs and draw them on your *Boat Designs* recording sheet. One boat should have a narrow bottom and one boat should have a wider, flat bottom.
3. Add details to your boat designs on your planning sheet.
4. Label each boat design—*narrow, wide, round, square, rectangular, oval,* or other words.

Station 2 – Constructing Boats – *Science/Engineering/Math*

Tools

- aluminum foil (two 4" x 6" pieces for each student)
- scissors
- pencils, crayons, fine-tipped markers, permanent markers (to add details to boats)
- *Boat Designs* recording sheet
- nonfiction and fiction books about buoyancy

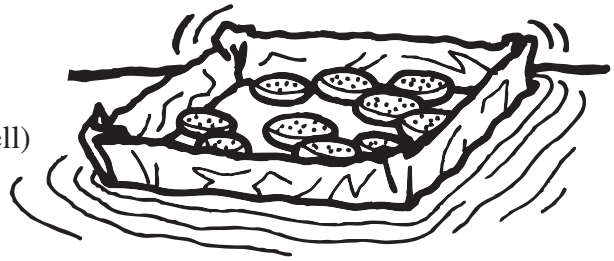
Procedure

1. Construct your boats following the designs that you drew. Use your drawings, pictures, websites, and books as guides.
2. Bend or fold the foil to create the hulls of each boat. Trim it with scissors if needed.
3. Label your boats **Boat 1** and **Boat 2**. Add your initials.
4. Add extra details to your boats with the permanent markers, if desired.

Buoyancy and Boat Design *(cont.)*

Station 3 – Prediction and Experimentation *– Science/Engineering/Math*

Tools

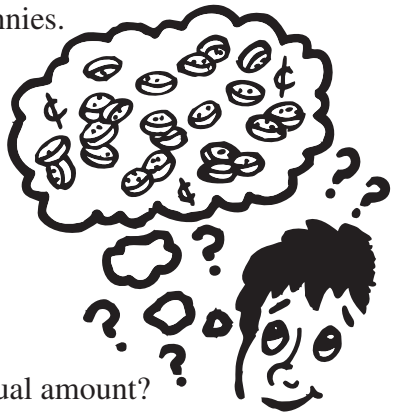


- 2 boats per student, labeled **Boat 1** and **Boat 2**
- large tubs of water (clear storage bins work well)
- *Boat Designs* recording sheet and pencils
- butcher paper for class graph
- pennies (30–50 per student) or other uniform-sized counters

Teacher Notes: The tubs should be large enough to hold at least two boats at a time. Larger tubs can accommodate two or three students and their boats at a time. Tubs should be filled with water high enough (5") to allow boats to turn on their sides and still sink completely.

Procedure

1. Prepare to test both boats to see which one can hold the most pennies.



Round 1

1. Predict how many pennies **Boat 1** will hold before sinking. Record this number on your *Boat Designs* recording sheet.
2. Place **Boat 1** in the tub of water and add one penny at a time until it sinks.
3. Record the number of pennies that **Boat 1** held before sinking on your *Boat Designs* recording sheet.
4. Was your prediction **greater than**, **less than**, or **equal to** the actual amount? Circle the correct symbol on your *Boat Design* recording sheet.

Round 2

1. Predict how many pennies **Boat 2** will hold before sinking. Record the number on your *Boat Designs* recording sheet.
2. Place **Boat 2** in the tub of water and add one penny at a time until it sinks.
3. Record the number of pennies that **Boat 2** held before sinking on your *Boat Designs* recording sheet.
4. Was your prediction **greater than**, **less than**, or **equal to** the actual amount? Circle the correct symbol on your *Boat Designs* recording sheet.

Round 3

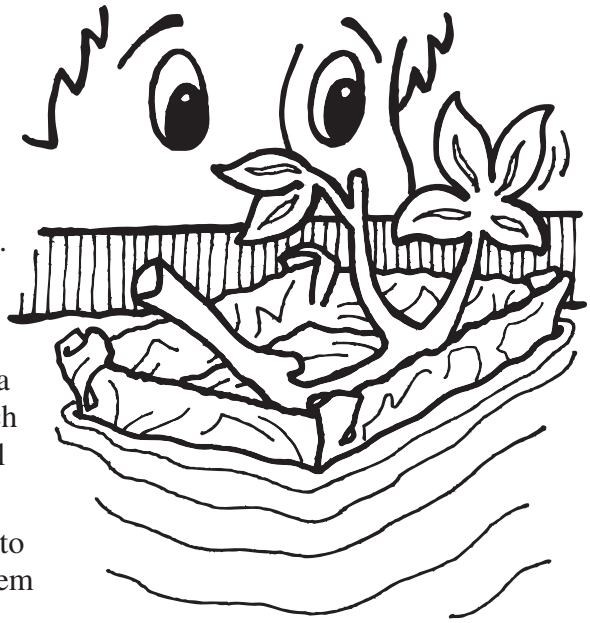
1. Compare the results of the tests for **Boat 1** and **Boat 2**.
2. Which boat held the greatest amount of pennies? Fill in the answer on the bottom of your *Boat Designs* recording sheet.
3. Record the amount of pennies that this boat held on the class graph.

Buoyancy and Boat Design *(cont.)*

Culminating STEM Activities

More					
50					
45					
40					
35					
30					
25					
20					
15					
10					
5					
	JO	LT	MJ	ST	RB

1. Evaluate the graph to determine which boat held the most pennies (objects), and which held the fewest. Consider publishing a version of the graph on the computer.
2. Have a variety of boat-building materials and a scale available in a discovery center for further exploration (clay, wood, plastic, Styrofoam, paper, etc.)
   - Will another material build a stronger boat?
   - How much weight did each new boat hold? Use the scale to weigh the pennies or other small uniform-size counters. Record this information on a new class graph.
3. Send home the Family Connection letter (page 37) to be completed collaboratively. Later, create a class book using the Family Connection pages and each family's favorite boat.
4. Challenge another class to a contest to create a boat and experiment to see which boat holds the most objects.
5. Have students test the boat buoyancy experiment using found objects (both natural and manmade). For example: parts of plants (tree bark, leaves, branches), various containers, cooking items, toys, manipulatives, etc. What is the heaviest object a boat can hold? a rock? gravel?
6. Have students share what they discover about buoyancy when experimenting with various materials.
7. Invite a guest speaker into class to discuss boats, sailing, or working on a boat.
8. Find out more about different kinds of boats. Create a chart or collage and keep adding to it. Research which boats are the largest, carry the most weight, and travel the fastest.
9. Research and design boats built for speed rather than to carry weight. Try testing them using a fan to blow them across the water.
10. See if a boating field trip is possible.



Boat Designs

This is my design for **Boat 1:**

I predict Boat 1 will hold _____ objects before sinking.

The actual number of objects was _____.

My prediction was **<** **>** **=** the actual number of objects that **Boat 1** held before sinking.

This is my design for **Boat 2:**

I predict **Boat 2** will hold _____ objects before sinking.

The actual number of objects was _____.

My prediction was **<** **>** **=** the actual number of objects that **Boat 2** held before sinking.

The boat that held the greatest amount of objects was Boat _____.

Student's Name: _____

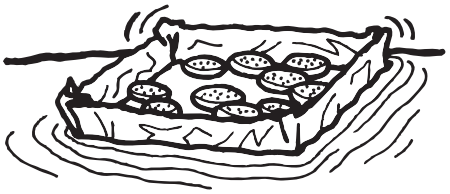
Date:_____

Hello,

We are investigating **BUOYANCY!** We each made two different-styled boats out of aluminum foil in project-based STEM activities to see which one could hold the most pennies without sinking.

Ask your child to tell you some of the facts that we have discovered about buoyancy and boat design. Here are some questions to get your discussion started.

- What type of bottom helps a boat carry the most weight?
- Are flat-bottomed boats better for holding heavy things than V-shaped boat hulls?



Ask your child to explain how the design of the boat determines its purpose, whether it is designed for carrying heavy loads or for speed.

Please return this completed page so your child will be able to share your boat with our class.

Directions

1. Discuss different types of boats and choose the type of boat that your family likes best.
2. Draw the boat your family would like to have in the space below.
3. Think of a creative name for the boat, and print it on the line provided below.

_____