

## The Magical Diving Sub

Grade Level(s): K, 1-2, 3-5

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Grades K-6: In this two-day exploration, students use their background knowledge of how scientists work to discuss and predict if a given object will sink or float. They record these predictions on a data sheet. They then test the objects and organize them into floating/sinking groups. Students also observe the floating and sinking of a toy submarine and infer what is causing the sub to float or sink.

## THE MAGICAL DIVING SUB

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### Lesson Summary for Grades K–6

In this two-day exploration, students use their background knowledge of how scientists' work to discuss and predict if a given object will sink or float. They record these predictions on a data sheet. They then test the objects and organize them into floating/sinking groups. Students also observe the floating and sinking of a toy submarine and infer what is causing the sub to float or sink.

Students then read the book *Floating and Sinking* and mold a ball of clay into various shapes to see which ones float and which ones do not. From the book and the ball and clay experiment, students deduce that if an object has a lot of air in it or a large volume, the air or empty space helps the object float.

On the second day, students predict what will happen if different chemical substances are used in the sub and compare and contrast the effects different substances have on the sub.

Students work in cooperative groups in which each student has a role to fulfill. As an assessment for the whole group, students write a description of how the magical diving sub can both sink and float.

### Science Activity: The Magical Diving Sub

*Students learn that density affects whether an object sinks or floats.*

Key Science Topics:

- float and sink
- properties of air

Key Process Skills:

- observing
- inferring
- predicting
- comparing/contrasting

Ohio Proficiency Learning Outcomes for Science:

Fourth Grade

I-1 Create or use categories to organize a set of objects or phenomena (sink and float).

I-2 Organize observations of an event, object, or organism.

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**Materials**

- objects for float/sink testing (rocks, wood, marbles, etc.)
- toy diving sub (found in Kellogg's® cereal boxes)
- basin filled with at least 6 to 7 inches of room-temperature water
- teaspoon of baking powder
- spoon
- small cup

**Getting Ready**

Day One:

1. Prepare a selection of objects for students to predict and test for floating and sinking. Be sure to have some that may surprise students, such as pumice.
2. Prepare the water basins with 6 to 7 inches of room-temperature water for each group. A towel for underneath the basin is a good idea.

Day Two:

1. Align and snap together the two halves of the diving sub.
2. Make a large class chart for recording observations. (Older grades can have their own individual charts for recording.) The chart should have a column labeled “submarine” and another labeled “what happened.”

**Introducing the Activity**

Day One:

Discuss what a scientist does. Start out by telling the students that scientists make predictions, conduct tests, and write about their results. Briefly discuss sinking and floating by putting objects that sink and objects that float into a basin of water one at a time. Discuss why some objects sink while others float. *The ones that sink are denser than water, and the ones that float are less dense.* Have students predict whether an object will sink or float before it is put in the basin. Discuss the reasons behind the predictions. Groups can record these predictions on a recording chart for future reference. Test the objects, then sort them into floating vs. sinking groups. What do the objects in the floating group have in common? What do the objects in the sinking group have in common? Use a balance scale to compare the mass of the objects, because many students may think that all heavy things sink. Show them this is not always true. Read aloud *Floating and Sinking* by Karen Bryant-Mole for more information on the reasons why something floats or sinks. Be sure to test a rolled up ball of clay then shape the clay into a small boat. Why does it sink as a ball and float as a boat shape?

Day Two:

The next day, show students a toy submarine and a basin of water. Tell them that you can make the sub sink and float without even touching it. How can this be done? Discuss their ideas, writing them down on a large chart paper to refer to later.

**Procedure**

Day One:

1. Using a basin of water and a sub without any baking powder added, gently lay the sub onto the surface of the water and observe. What happens? *The sub will float. Why? It is less dense than water.* Now have the students slightly submerge the sub under the water and shake gently until the sub fills up with water. What happens now? *It sinks. Why? The sub with the*

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*water in it is denser than the sub without the water.* Record these observations on a large class chart under “empty sub” and “sub filled with water.”

Day Two:

1. Ask students how they could make the sub both float and sink. Show the students baking powder and sprinkle water on top of it. It will fizz and produce bubbles.
2. Let the students know that it was not boiling, as they may think, but a gas and bubbles are being made.
3. Take each sub and fill the inside chamber with baking powder. To do this, pull apart the two halves of the diving sub and add fresh baking powder (not baking soda) to the center of the chamber of the upper half of the diving sub. Do not pack the baking powder. Use your finger to cover the baking powder filled chamber, and shake off any excess baking powder from the upper half.
4. First, have the students predict together what will happen when they gently place the baking powder sub onto the surface. Also have them explain their reasons behind their predictions. Record predictions on class chart. Now, gently place the sub onto the surface of the water and observe. What happened? Next, hold the diving sub upside down underwater and shake all the air bubbles out. When you see the bubble come out from the center of the bottom of the sub, flip the sub over and place it upright.
5. Release the sub into the water and observe. What happens? *It should sink to the bottom of the basin. Why? It was denser than the water.*
6. Students keep observing the sub, and after about 30 seconds the sub will slowly rise to the surface. Why did it rise? Have students observe carefully.
7. After about 10 seconds, the bubble is released, and the sub sinks back to the bottom. Students should observe this cycle many times before making any inferences or conclusions.
8. Students will see a small air bubble released from the side of the sub when it is at the surface. The sub tips to the side as the bubble is released. With this tipping motion, the sub fills back up with water and sinks to the bottom of the basin again. At the bottom, the small air bubble is made again and causes the sub to float to the surface. The cycle keeps repeating itself.
9. Once students have made these observations, discuss how the air bubble can possibly be getting to the bottom of the sub. Have them consider how they could find out for sure what is causing the air bubble? *Take the sub apart and look at the sub.* What is inside the sub? *A powdery substance.* Tell the students the substance is baking powder.
10. Using a spoon, have students take a little of the baking powder out of the center chamber and place it in the small cup. Then put a few drops of water from the basin onto the powder. What happened? *The powder starts to fizz and bubbles are formed.*
11. When baking powder and water are combined, gas is given off, which is why we see bubbles. Using what they just learned about the baking powder, ask students to explain why the sub floats and then sinks. (If needed, refill the chambers with baking powder and have the students observe the cycle again.) *The bubble makes the sub less dense than water and it floats. When the bubble pops, the sub fills up with water and the sub becomes denser than water and therefore sinks.*

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**Mathematics Activity**

*Students sort objects into groups that sink or float.*

Ohio Proficiency Learning Outcomes for Mathematics:

Fourth Grade

I-1 Sort or identify objects on multiple attributes.

Given a group of objects, students first predict if they sink or float in water. Sort the objects into sink and float groups. Next, have students actually test their predictions in a basin of water, then re-sort the objects based upon what they found.

**Literature Activity**

*Read aloud Floating and Sinking by Karen Bryant-Mole.*

Ohio Proficiency Learning Outcomes for Writing:

Fourth Grade

II-3 Write an organized and logical response that stays on topic and is written legibly in print.

*Floating and Sinking* by Karen Bryant-Mole is a simple book that discusses all the factors that go into why something floats or sinks. Have students write an explanation or verbally explain why some objects float and others sink. This writing may be done either by whole groups or individually in science journals.

**Citizenship Activity**

*Students learn cooperation by being assigned jobs for the various activities.*

Ohio Proficiency Learning Outcomes for Citizenship:

Fourth Grade

VI-17 Identify and assess the possibilities of group decision-making, cooperative activity, and personal involvement.

Throughout the activity, students work in cooperative groups and discuss their observations together. The groups could be assigned jobs of: materials getter, reporter (reports the group's observations to the class), starter (the first one to start the activity), and cleaner (the one to make sure the table is cleaned and hand the materials back in).

**Art Activity**

*Students make objects out of clay and determine which ones sink and which ones float.*

Page 17 of *Floating and Sinking* by Karen Bryant-Mole shows a boy using two pieces of clay that have the same weight. He makes one into a ball and it sinks, and the other is made into a boat shape and it floats. Using clay, have students test this out by making a ball first. Next, design a boat that will float. Use the clay to try to design other shapes that will float as well.

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**Assessment**

As a whole group or in individual science journals, students should explain how the diving sub was able to sink and float. The response should mention that the bubble formed by the baking powder made it float because air makes things float. When the bubble popped, the air left the sub and the sub sank. When the bubble formed again, the sub floated back up, and the cycle kept repeating.

**Reference**

Bryant-Mole, Karen. *Sinking and Floating*; Heineman Interactive Library: Des Plaines, IL, 1998.

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### RECORDING CHART

Name \_\_\_\_\_

<b>Object</b>	<b>Predict (Sink/Float)</b>	<b>Actual (Sink/Float)</b>