Activity 7.1
Defining density

Do heavy things always sink and light things always float?

In this introductory demonstration and activity, students are introduced to the concept of density as they explore a rock and a wooden block in water. First students address the misconception that heavy things sink and light things float by observing a small rock and a larger heavier wooden block on a balance and then in a tank of water. The lighter rock sinks while the heavier wooden block floats. Students realize that there must be something more to sinking and floating than size or weight. Students investigate further by using the water displacement method to find volumes of water equal to a block of wood and a rock. After comparing the weight of each object with the weight of an equal volume of water, students can generalize an important rule about sinking and floating: Objects that are less dense than water float, and objects that are more dense than water sink.

Materials needed for the demonstration

Water
Clear plastic cup or larger container
Wooden block
Rock
Balance

Materials needed for each group

Water
Block of wood
Rock
5 Tall clear plastic cups
Wide plastic deli container or bowl

Notes about the materials

- **Be sure you and the students wear properly fitting goggles.**
- The rock you use in the demonstration should be smaller and lighter than the wooden block.
- The rock students use should be about the size of a golf ball. It does not need to be round.
- The wood and the rock need to fit inside a clear plastic cup.
- The wide plastic container should be big enough to hold a clear plastic cup as shown.

Activity sheet

Copy *Activity sheet 7.1—Defining density*, pp. 398–401, and distribute one per student when specified in the activity.

Assessment

An assessment rubric for evaluating student progress during this activity is on pp. 437–439. For this formative assessment, check a box beside each aspect of the activity to indicate the level of student progress. Evaluate overall progress for the activity by circling either "Good", "Satisfactory", or "Needs Improvement".

Activity 7.1
Defining density

Question to investigate

Do heavy things always sink and light things always float?

Take a closer look

1. Have students read the investigation story on *Activity sheet 7.1* and watch the demonstration.

Procedure

1. Place a rock that weighs *less* than a wooden block on one end of a balance.

2. Place the wood on the other end.

3. Ask students which is heavier, the rock or the wood. Ask them to predict which will sink and which will float. Then, place the rock and wooden block in water.

***Expected results*: Even though the rock weighs less than the wood, the rock sinks and the wood floats.**

2. Discuss students' ideas about why the lighter rock sinks and the heavier wood floats.

Ask students why they think the smaller lighter rock sinks and the bigger heavier wood floats. Some students may say that even though the rock is light, it's also small and actually *heavy* for its size. And even though the wood is heavier, it's bigger and actually *light* for its size. This answer is moving in the right direction because it shows an awareness that the relationship between the weight of the object and its size is important. Let students know that this relationship, between the *weight* of an object and its volume (the amount of space an object takes up), is called *density*.

Ask students questions like the following to get them to think about how density might apply to sinking and floating:

- Which do you think is more dense, the rock or the wood?
- Why do you think that?

Students should realize that the rock must be more dense than the wood. Tell students that they will do an activity where they compare the density of wood to the density of water.

Distribute *Activity sheet 7.1—Defining density*.

Try this!

3. Have students compare the weight of a wooden block to the weight of an equal volume of water.

Pass out a small wooden block to each group. Tell students that the size and shape of the wood determine how much space it takes up. The amount of space the block takes up is called its *volume*.

Procedure

1. Place the wood in a cup and look at the wood to see about how much space or volume it takes up.
2. Lift the cup to get a sense of the weight of the wood. Do you think the same volume of water would weigh more or less than the wood?
3. Pour an amount of water that you think is about the same volume as the wood into another cup.
4. Lift both cups to see which seems heavier, the wood or the water.

***Expected results*: The water should feel heavier than the block of wood.**

4. Discuss students' observations.

Ask students questions such as the following:

- Which feels heavier, the wood or the water?
- Which is probably more dense, the water or the wood?
- Do you think this might have anything to do with why the wood floats?

Students will probably say that the water weighs more. Tell students that if you compare two things that take up exactly the same amount of space, the heavier one is more dense. Explain that the method students used was not very accurate, so next they will learn a better way to figure out how much space a block of wood takes up.

5. Have students use the water displacement method to find a volume of water that is equal to the volume of the wood.

Procedure

1. Label 2 cups **displaced water—wood** and **displaced water—rock**. You will also need two cups which are unlabeled.
2. Stand one unlabeled cup inside the larger container. Pour water into the cup until it is filled as high as possible without overflowing.
3. Gently place the wood in the water and slowly push it down until it goes just beneath the surface of the water. Water should overflow into the container.

4. Carefully remove the inside cup and put it aside. Then pour the water that overflowed into the cup labeled "displaced water—wood". Remove the wood from the water and place it in an empty cup.
5. Lift the cup with the wood in it and the cup with the displaced water to see which feels heavier.

***Expected results*: The water should feel heavier than the block of wood.**

6. Discuss the water displacement method and weigh samples of wood and water from each student group.

Explain to students that when they push the wood into the water, the wood takes up the space where there was once water. So the wood pushed away or *displaced* a volume of water equal to the volume of the wood. The volume of water that overflowed into the outside container is equal to the volume of the wood.

Choose a block of wood and its displaced water from any group and weigh them. The water will weigh more than the wood. Ask students whether the water or the wood is more dense. Review with students that since they are comparing the same volume of water and wood, the one that weighs less must be less dense. Explain that the wood floats because it is less dense than water.

7. Have students use the water displacement method to compare the weight of a rock to the weight of an equal volume of water.

Procedure

1. Stand an unlabeled cup inside the larger container. Pour water into the cup until it is filled as high as possible without overflowing.
2. Gently place the rock in the water. Water should overflow into the container.
3. Carefully remove the inside cup and put it aside. Then pour the water that overflowed into the cup labeled "displaced water—rock". Pour the water out so that only the rock is left in the cup.
4. Lift the cup with the rock in it and the cup with the displaced water to see which feels heavier.

***Expected results*: The rock should feel heavier than the water.**

Ask students which they think weighs more, the rock or an equal volume of water. Choose a rock and its displaced water from any group and weigh them. The rock will weigh more than the water. Ask students whether the rock or the water is more dense. Review with students that since they are comparing the same volume of water and rock, the one that weighs more must be more dense. Explain that the rock sinks because it is more dense than water.

What's next?

8. Ask students to predict whether wax and clay will float or sink in water.

Tell students that in the next activity, they will compare equal volumes of wax, clay, and water and then predict which will float and which will sink.

Ask students questions like the following:

- Do you think wax will sink or float in water?
- Would you expect wax to weigh more or less than an equal volume of water?
- Do you think clay will sink or float in water?
- Would you expect clay to weigh more or less than an equal volume of water?

Remind students that objects that weigh less than an equal volume of water are less dense and float. Objects that weigh more than an equal volume of water are more dense and sink.