Activity 7.7
Changing the density of an object—Changing shape

Can changing the shape of an object affect whether it sinks or floats?

Throughout the activities in this investigation, students may have wondered how a boat made out of steel, which is more dense than water, can float. This activity addresses that question. Students will see that changing the shape of an object, like a clay ball, that is more dense than water, can affect whether the object will sink or float. The density of the clay used in this activity does not change, but the volume of the object made from the clay increases. This increase in volume decreases the overall density of the object, making it float.

Materials needed for the demonstration
Water
2 Clay balls
Plastic bowl
Sensitive scale

Materials needed for each group
Water
2 Clay balls
Clear plastic cup, deli container, or bowl

Notes about the materials
- **Be sure you and the students wear properly fitting goggles.**

Preparing materials
- Roll 2 balls of clay for the demonstration and for each group. The balls should be close in size, about 3 cm in diameter.

Activity sheet
Copy *Activity sheet 7.7—Changing the density of an object—Changing shape*, pp. 435–436, 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 7.7
Changing the density of an object—Changing shape

Question to investigate

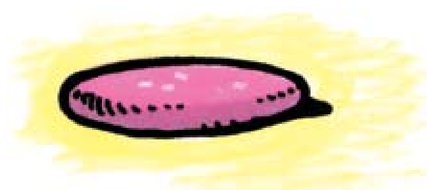
Can changing the shape of an object affect whether it sinks or floats?

1. Introduce the idea that substances that are more dense than water can be made to float.

Tell students that most metal, like steel, sinks but that many big boats are made of out of steel. Explain that this activity will help students understand how something that is more dense than water can be made to float. Remind students that a lump of clay also sinks. Then ask students if they think changing the shape of clay might help make it float.

Demonstration

2. As a demonstration, make a clay box that will sink.



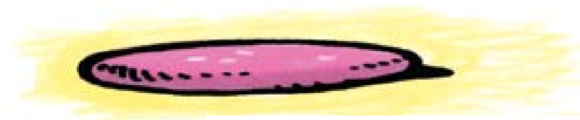
Procedure

1. Flatten one ball of clay into a small fat pancake shape about 5 cm or more in diameter.
2. Bend the edges up on the clay pancake to make a small thick-sided open box.
3. Add water to a plastic bowl until it is about ¾ full.
4. Slowly and carefully place the clay box on the surface of the water. It should sink.
5. Remove the clay box from the water and use a ruler to measure its length, width, and height in centimeters. Find the value for the volume (l × w × h) of the clay box and write it on the board. Your answer should be in cubic centimeters.

3. Have students make a clay "box" that floats.

Distribute *Activity sheet 7.7—Changing the density of an object—Changing shape*. Show students the small thick-sided clay box that they saw sink in water in the demonstration. Ask students if they think making the box bigger would make it float. Have students try making a larger box and seeing if it floats.

Procedure



1. Flatten one ball of clay into a large thin pancake shape about 10 cm or more in diameter.

2. Bend the edges up on the clay pancake to make a large shallow open box.

3. Add water to a plastic bowl until it is about ¾ full.

4. Slowly and carefully place your clay box on the surface of the water. It should float. If it does not float, remove it from the water and try increasing its volume again.

5. After you get the clay box to float, remove it from the water and use a ruler to measure its length, width, and height in centimeters. Find the value for the volume (l × w × h) and write it on the activity sheet. Your answer should be in cubic centimeters.

***Expected results*: Students' larger thin-sided boxes should float. Their calculated volumes should be greater than the volume of the small thick-sided box used in the demonstration.**

4. Discuss student observations.

Ask students: Why did your clay box float better than mine? Students should realize that the larger volume of their box caused it to float.

Weigh (in grams) the small thick-sided clay box from the demonstration and calculate its density using density = mass/volume. Make a chart on the board and record the values for the density, mass, and volume of your clay box. Then weigh some of the students' clay boxes and record their masses and volumes in the chart. Have students calculate the densities of these clay boxes.

***Expected results*: The density of the students' boxes should be less than yours. Theirs should be less than the density of water, which is 1 g/cm^3, while yours should be greater than the density of water.**

Ask students questions such as the following:

- What do you notice about the volume compared to the mass for the clay boxes that float in water?
- How is this relationship different than the volume and mass for the clay box used in the demonstration?
- Use what you know about density to explain why your clay box floats.
- Why do you think a heavy ship made out of steel can float?

Students should realize that clay boxes with a value for volume greater than the value for mass will float. Increasing the volume of the box without increasing the mass decreases the overall density of the object. When the density of an object is less than the density of water, it will float. Explain that the density of the clay itself doesn't change when it is reshaped, but the density of the clay box, as an object, does. This same idea can be used to explain why a heavy steel ship can float. Although the density of steel is greater than water, the steel is shaped so that the ship has a large volume. Increasing the volume decreases the density. The ship floats because the density of the ship is less than the density of water.