5th Grade - Lesson 2.5
The Density of Liquids

Objective
Students will be able to explain that the density of a liquid has to do with how heavy it is for the sample size. Students will also be able to explain that if a liquid is more dense than water, it will sink when added to water, and if it is less dense than water, it will float.

Key Concepts
- A liquid, just like a solid, has its own characteristic density.
- The density of a liquid is a measure of how heavy it is for the amount measured. If you weigh equal amounts or volumes of two different liquids, the liquid that weighs more is more dense.
- If a liquid that is less dense than water is gently added to the surface of the water, it will float on the water. If a liquid that is more dense than water is added to the surface of the water, it will sink.

Note: We are purposely using the terms "size" and "amount" instead of "volume" in this lesson about density. We are also using "heavy", "light", and "weight" instead of "mass". If your students have already learned the meanings of volume and mass, you can easily use those terms to define density (Density = mass/volume), and then use those terms in this lesson.

NGSS Alignment
- **NGSS 5-PS1-3**
  Make observations and measurements to identify materials based on their properties.

Summary
In the previous lesson, students learned that density has to do with how heavy an object or substance is relative to its size, and that density determines whether an object sinks or floats. Students also observed that you can compare the density of a substance to the density of water by comparing the weights of equal amounts of the substance and water using a balance.
In this lesson:
- As a demonstration, the teacher will compare the weight of an equal amount or volume of water and corn syrup so students can observe that corn syrup is more dense than water and sinks.
- Students will compare the weight of an equal amount or volume of water and vegetable oil and see that vegetable oil is less dense than water and floats.
- Students add corn syrup to layered oil and water and see the corn syrup sinks below both the oil and water.

Evaluation
Download the student activity sheet and distribute one per student when specified in the activity. The activity sheet will serve as the Evaluate component of the 5-E lesson plan.

Safety
Make sure you and your students wear properly fitting safety goggles. Isopropyl "rubbing" alcohol is a flammable liquid. Keep away from heat, sparks, open flames, and hot surfaces. Isopropyl alcohol is also irritating to eyes and skin, and may cause drowsiness or dizziness if

inhaled. Work with isopropyl alcohol in a well-ventilated room. Read and follow all warnings on the label.

Clean-up and Disposal

Remind students to wash their hands after completing the activity. All common household or classroom materials can be saved or disposed of in the usual manner.

Materials

- Water
- 2 Clear plastic cups
- Corn syrup (Karo syrup), 1 cup
- Food coloring
- Popsicle stick or plastic spoon
- Vegetable oil
- Isopropyl “rubbing” alcohol (70%)
- Ice cubes
- Balance

Teacher preparation

Pour 50 mL of corn syrup, 50 mL of water, and 50 mL of vegetable oil into three plastic cups for each group.

Note: Corn syrup and vegetable oil can be difficult to clean out of graduated cylinders. To avoid this mess, measure and pour 50 mL of water into each of three plastic cups. Then mark the outside of each cup to indicate the level of the liquid in each cup. Pour out the water from two of the cups and dry the inside with a paper towel. Next, use those cups to measure the amount of corn syrup and vegetable oil for each group. Add 1 drop of food coloring to the corn syrup.

Each group will need 50 mL of corn syrup, 50 mL of water, and 50 mL of vegetable oil in separate cups.

For the demonstration, you will need 50mL of water and 50 mL of corn syrup (colored with 1 drop of food coloring) in separate cups.

ENGAGE

1. Do a demonstration to compare the density of corn syrup and water.

Materials for the Demonstration:

- Water in a clear plastic cup
- ¼ cup corn syrup (Karo syrup) with food coloring in a clear plastic cup
- Popsicle stick or plastic spoon
- Graduated cylinder or beaker
- Balance

1. Hold up two cups and tell students that you have water in one cup and the same amount or volume of corn syrup (colored blue) in the other cup.
2. Place the cups on opposite ends of a balance.

Expected results
The corn syrup is heavier, which shows that it is more dense than water.

Ask students:

- **Since we weighed equal amounts and the corn syrup was heavier, is water or corn syrup more dense?**
  Corn syrup is more dense than water.
- **Predict what will happen if we pour the corn syrup into the water. Will the corn syrup float or sink when added to the water?**
  The corn syrup should sink in the water.

3. Pour the colored corn syrup into the cup containing water to see if the corn syrup floats or sinks in the water.

Expected Results
The corn syrup sinks in the water.

Give each student an Activity Sheet.
Students will record their observations, and answer questions about the activity on the activity sheet.

EXPLORE

2. Have students compare equal volumes of water and vegetable oil and test whether the oil floats or sinks when added to water.

Question to investigate:

Is vegetable oil more or less dense than water?

Materials for each group

- 50 mL of water in cup
- 50 mL of vegetable oil in cup
- 50 mL of corn syrup in cup
- Balance

Procedure

1. Place the cups of water and vegetable oil on opposite ends of a balance.

Expected results
The oil weighs less (is lighter) than an equal volume of water.

Ask students:

- **Which is less dense, water or vegetable oil?**
  The vegetable oil is less dense than water because it weighs less than an equal volume of water.
- **Predict what will happen when you pour the vegetable oil into the water. Will the oil sink or float?**
  The oil will float on the water.

2. Pour the vegetable oil onto the water to see if it sinks or floats.

Expected Results
The oil floats in a separate layer on the water.

3. Have students pour colored corn syrup into the oil and water.

Explain to students that that they have discovered that vegetable oil is less dense than water, and that the corn syrup is more dense than water.

In one hand, hold up a cup containing vegetable oil floating on water, and in the other hand, hold up a cup containing colored corn syrup.

Ask students:

- **Predict what will happen if you pour the corn syrup into the vegetable oil and water.**
  The corn syrup should sink to the bottom because it is the most dense.

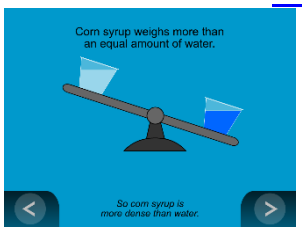
3. Pour the corn syrup into the cup with oil floating on water.

Expected results
The corn syrup will sink through the oil and water resulting in three distinct layers in the cup. There will be oil on top, water in the middle, and corn syrup on the bottom.

EXPLAIN

4. Use an animation to review and explain student observations.

Show the Animation Density of Liquids



Explain that to compare the density of corn syrup and water you can compare the weight of equal volumes of water and corn syrup. Since the same volume of corn syrup is heavier than water, it is more dense and sinks in water. Explain that to compare the density of oil and water you need to compare the weight of equal volumes of water and oil. Since the oil is lighter, it is less dense than water and floats on water.

EXTEND

5. Do a demonstration to compare the density of water and isopropyl alcohol.

Materials for the demonstration

- 2 clear plastic cups
- Water
- Isopropyl "rubbing" alcohol (70%)
- 2 ice cubes

Procedure

1. Label one cup **Water** and the other **Alcohol**. Pour water and isopropyl alcohol into their labeled cups until each is about ½ full.

   Show students the two liquids and point out that they look very similar.

2. As students watch, place an ice cube in each liquid.

Expected results
An ice cube floats in water but sinks in alcohol.

Ask students:

- **Do you think water and isopropyl alcohol have the same density or different densities?**
  The liquids must have different densities because the ice cube floats in one but sinks in the other.

  Explain that since ice floats in water, liquid water must be more dense than ice. Since ice sinks in isopropyl alcohol, alcohol must be less dense than ice. This means that water and isopropyl alcohol must have different densities and that the water is more dense than isopropyl alcohol.

  You could check this by comparing the mass of 50 mL of water and 50 mL of isopropyl alcohol on a balance.

Expected results
The water will weigh more than the same volume of isopropyl alcohol (but not by much).