

## Activity 7.3

# Comparing the density of different liquids

### How do the densities of vegetable oil, water, and corn syrup help them to form layers in a cup?

Students will carefully pour vegetable oil, water, and corn syrup in any order into a cup and discover that regardless of the order they are poured, the liquids arrange themselves in layers the same way. Students will then weigh the liquids and use their results, along with what they understand about density, to explain why the liquids form layers as they do.

#### Materials needed for each group

Water	Paperclips
Vegetable oil	Piece of a crayon
Corn syrup	Piece of raw pasta
Ruler	Piece of toothpick or popsicle stick
Tape	1 Clear plastic cup
Pencil	7 Small cups
Permanent marker	

#### Notes about the materials

- Be sure you and the students wear properly fitting goggles.
- Each group will need about 50 paperclips.
- Three of the seven cups will be labeled by the teacher and used as source cups for each liquid.

#### Preparing materials

- Label 3 small cups **water**, **oil**, and **corn syrup**.
- Pour about 1/4 cup of each liquid in its labeled cup.

#### Activity sheet



Copy *Activity sheet 7.3—Comparing the density of different liquids*, pp. 413–415, 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”.

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### Question to investigate

## How do the densities of vegetable oil, water, and corn syrup help them to form layers in a cup?

### 1. Have students pour the three liquids in a cup in any order they choose.



Distribute *Activity sheet 7.3—Comparing the density of different liquids*.

#### *Procedure*

1. Slowly and carefully pour about about half of the water, corn syrup, and vegetable oil (in any order you choose) into one empty clear plastic cup.
2. Record your observations.



***Expected results:*** Corn syrup will sink to the bottom, water will be in the middle, and vegetable oil will float on the top.

### 2. Have groups compare their results.

Students will notice that regardless of the order in which the liquids are poured, they will arrange themselves in the same way. Tell students that they will explore what causes these liquids to arrange themselves as they do. Ask students to think of the liquids in terms of sinking and floating. Which liquid floats on water. Which liquid sinks in water? Put the cup with the layered liquids aside but do not throw it away. Students will need the cup of layered liquids for the last part of the activity.

Point out that the water is in the middle and that the oil *floats* on the water and that the corn syrup *sinks* in the water. Ask students, based on their experience with sinking and floating, what this means about the density of oil compared with the density of water, and about the density of corn syrup compared with the density of water. Students should realize that the vegetable oil is less dense than water and that the corn syrup is more dense than water.

### 3. Discuss with students how they could compare the weight of *equal* volumes of the liquids.

Ask students if they were to weigh equal volumes of the three liquids, which they would expect to be the heaviest, lightest, and in-between. Since students know the relative densities of the liquids based on the way they form layers in the cup, they should realize that if they weigh equal volumes of the liquids, corn syrup should be the heaviest, vegetable oil the lightest, and water in-between. Ask students how they might go about weighing equal volumes of the liquids. Students may make or use a balance scale, like the one constructed in *Activity 7.2*, p. 406, to compare the weight of equal volumes of the liquids on each side of the scale. You could also suggest another method to students, in which they weigh each liquid against nonstandard units like paperclips, or some other unit. This method is described in the procedure on the following page.

#### 4. Have students compare the weights of equal volumes of the liquids.

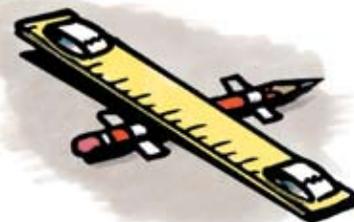
The following procedure has students measure equal volumes of each liquid by marking 1 cm up on a small cup and pouring the liquids directly into the marked cups. Using a spoon to measure equal volumes of these liquids is not accurate because vegetable oil and corn syrup tend to stick to the spoon.

##### Procedure

1. Use a permanent marker to label 3 small cups **vegetable oil**, **corn syrup**, and **water**. Use your ruler to measure 1 cm up from the bottom of the cup and make a line with the marker.
2. Tape the pencil down as shown. Roll 2 small pieces of tape so that the sticky side is out. Stick each piece of tape to the opposite ends of the ruler.



3. Place the empty vegetable oil cup on one piece of tape and the empty unlabeled cup on the other. Be sure that the edge of the cup comes right to the end of the ruler. Lay the ruler on the pencil so that it is as balanced as possible. (Don't worry if you can't make it balance exactly.) Use a pencil or permanent marker to mark the spot on the ruler directly above the center of the pencil. This is the *balance point*.



4. Remove the vegetable oil cup and very carefully add vegetable oil until the oil reaches the mark on the cup. Replace the cup on the ruler. Be sure the edge of the cup is at the end of the ruler and that the marked balance point is directly over the pencil.
5. Add paperclips, one at a time, to the empty cup on the other end. Count the paperclips until the weight of the paperclips causes the oil cup to just lift from the table. Record this number in the chart on the activity sheet.
6. Repeat Steps 4 and 5 for water and corn syrup.



**Expected results:** Depending on the paperclips students used and the amount of liquid poured in each cup, students' results may vary a bit. However, it should be clear that the vegetable oil weighs less than the water and that corn syrup weighs more than the water.

Liquid	Weight in paperclips
Vegetable oil	24
Water	29
Corn syrup	41

## 5. Have students discuss their results.

Ask students questions like the following:

- Why is it important to weigh *equal volumes* of each liquid?
- Do your results from weighing the liquids agree with your observation of the layered liquids?

## 6. Have students place a crayon piece, paperclip, piece of pasta, and piece of popsicle stick into the cup of liquids.

Students should use the cup of layered liquids they made at the beginning of this activity. When students place objects in the liquids, the objects will position themselves in different layers. Ask students to explain, in terms of density, why the objects end up where they do.

