

# Activity 5.10

## Formation of a precipitate

### What happens when soap is added to hard water?

Sometimes when two liquids combine, a solid forms and falls to the bottom of the liquid. This solid is a new substance, called a *precipitate*, and is evidence that a chemical reaction has occurred. Soap scum, a common example of a precipitate, forms when certain minerals in hard water react with soap molecules. In this activity, students will compare the bubbling of soap-scum-in-water to the bubbling of soap-in-water to show that the soap scum that formed is a different substance than soap.

### Materials needed for each group

Water	2 Popsicle sticks
Epsom salt	2 Straws
Piece of Ivory® soap	6 Clear plastic cups
Piece of paper	1 Small cup
Coffee filter	1 Tablespoon
1 Dropper	1 Teaspoon

### Notes about the materials

- Be sure you and the students wear properly fitting goggles.
- One bar of soap is enough for an entire class to do this activity.

### Preparing materials

- Label 1 small cup **Epsom salt** for each group.
- Place 2 teaspoons of Epsom salt in its labeled cup.
- Cut one bar of Ivory® soap into eighths with a knife.

### Activity sheet



Copy *Activity sheet 5.10—Formation of a precipitate*, pp. 302–304, and distribute one per student when specified in the activity.

### Assessment

An assessment rubric for evaluating student progress during this activity is on pp. 305–307. 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 5.10

## Formation of a precipitate

### Question to investigate

## What happens when soap is added to hard water?

### 1. Have students make a soap solution and hard water.



Distribute *Activity sheet 5.10—Formation of a precipitate*. Tell students that they are going to make *hard water* and see how it reacts with soap. Explain that hard water is water that has minerals dissolved in it. In some areas, minerals like calcium, iron, or magnesium are naturally dissolved in the water. These minerals interfere with the cleaning ability of soap. Tell students that in this activity, they will add soap to hard water to create *soap scum*. Then they will compare the bubbling ability of soap and soap scum to find out whether or not soap scum is different from soap.

### Procedure

1. Label 3 plastic cups **soap**, **water**, and **hard water**.
2. Place 3 tablespoons of water in the *soap* cup and 2 tablespoons of water into each of the *water* and *hard water* cups.
3. Hold a piece of Ivory soap on a piece of paper. Use a popsicle stick or plastic spoon to scrape soap flakes onto the paper.
4. Add about 1 tablespoon of soap flakes to the water in the *soap* cup, and stir about 1 minute until the water is white.
5. Make “hard water” by adding 2 teaspoons of Epsom salt to the water in the *hard water* cup, and mix until no more Epsom salt will dissolve.



### 2. Have students add soap solution to water and hard water.

The procedure below recommends using a dropper to transfer soapy water into a teaspoon in order to add this soap solution to the water and hard water. This method helps to avoid picking up large pieces of undissolved soap.

### Procedure

1. Use a dropper to pick up soap solution from the *soap* cup. Carefully squirt several droppers-full of the soap solution into a teaspoon until it is full.
2. Pour this teaspoon of soap solution into the *water* cup. Use the dropper to collect another teaspoon of soap solution, and also add it to the *water* cup.
3. Using the same method described in Steps 1 and 2, add 2 teaspoons of soap solution to the *hard water* cup.
4. Look at the cups from the top and the side.



### 3. Discuss student observations.

Ask students if they notice any differences in the way soap combines with water compared with hard water.

**Expected results:** The soap solution will mix with water and cause the water to look cloudy. When soap solution is added to hard water, a white curd-like substance will form. This is the precipitate, soap scum. Expect about  $\frac{1}{8}$  to  $\frac{1}{4}$  teaspoon of precipitate.

### 4. Ask students how they could design a test to compare soap and soap scum.

Ask students if they think the white substance in the hard water is soap or some other substance. Ask them for their ideas about tests they could conduct on this substance to find out whether or not it is still soap. Students might suggest comparing the ability of each to clean, the way they feel, whether they dissolve in water, or whether they can be used to make bubbles.

Since bubbling is easy to test, suggest that students compare the bubbling ability of this white substance to the bubbling ability of soap. Students may suggest adding soap to water and soap scum to water in separate containers and shaking them or blowing air into them to compare the amount of bubbling.

### 5. Have students compare the bubbling of a soap and soap scum solution.

The following is an example of one way to compare soap and soap scum based on how well they bubble when air is blown into them.

## How do you know that soap scum is different from soap?

### Procedure

#### Prepare the cups

1. Label one cup **soap** and the other **soap scum**.
2. Add 2 tablespoons of water to each of the labeled cups.  
These cups will be used after the soap scum is collected.



#### Collect the soap scum

3. Place a coffee filter on the top of a plastic cup as shown. Hold the filter in place as you pour the hard water and soap scum into the filter.
4. Allow some of the water to drain through. Then carefully remove the filter and gently squeeze the remaining water into the cup.
5. Carefully lay the coffee filter on a paper towel as shown. Use a popsicle stick to scrape the filter to collect the soap scum.

### Compare the amount of bubbling in each cup

6. Look at the amount of soap scum you have. Then place a similar amount of soap flakes into the cup labeled *soap* and stir gently.
7. Add the soap scum to its labeled cup and stir gently.
8. Place a straw into both cups. Gently blow through each straw and compare the amount of bubbling.

**Expected results:** The soap scum may look like soap, but it does not dissolve as well as soap. Also, soap scum in water does not bubble as much as soap in water when air is blown through it. Students may notice some bubbling in the soap scum and water. This may be due to some residual unreacted soap. However, the difference in the amount of bubbling in each cup should be enough to show that the soap scum is different than the original soap.



### 6. Have students share their observations and conclusions.

Ask students questions such as the following:

- Based on your observations, do you think that soap scum is different from soap?
- Would you consider adding soap to hard water a chemical change? Why or why not?

Adding soap to hard water is a chemical change because a new substance, soap scum, is formed. You may want to mention to students that detergents were created because they do not react with hard water the way that soap does.