

## Activity 4.3

# Temperature affects dissolving

### Does cocoa mix dissolve better in hot water or cold water?

Most solids dissolve better in a liquid when the liquid is heated. Students will begin this activity by comparing how well cocoa mix dissolves in cold and hot water. They will see that cocoa mix dissolves much better in hot water. In the follow-up *Demonstration 4a*, students will see that heating a liquid affects the solubility of different solids to different extents.

### Materials needed for each group

Hot water  
Cold water  
Powdered cocoa mix  
2 Clear plastic cups  
2 Popsicle sticks or stirrers  
Small-volume measures like  $\frac{1}{4}$  cup and 1 teaspoon

### Notes about the materials

- Be sure you and the students wear properly fitting goggles.
- Since student groups will plan their own experiment to answer the question, the materials and amounts may vary.

### Preparing materials

- Either give each group one packet of cocoa mix or place about 2 teaspoons of cocoa mix in a small labeled cup for each group.

### Activity sheet



Copy *Activity sheet 4.3—Temperature affects dissolving*, p. 195, and distribute one per student when specified in the activity.

### Assessment

An assessment rubric for evaluating student progress during this activity is on pp. 218–219. 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 4.3

### Temperature affects dissolving

#### Question to investigate

### Does cocoa mix dissolve better in hot water or cold water?

#### 1. Have students discuss their experiences dissolving substances in hot and cold water.

Ask students how they would make hot chocolate from a powdered cocoa mix. Then ask students if they could make “cold chocolate” by stirring the mix into cold water or milk. Tell students that in the following activity, they will compare how well cocoa mix dissolves in both cold and hot water.



Distribute *Activity sheet 4.3—Temperature affects dissolving*.

#### 2. In groups, have students design an experiment to compare how well hot cocoa mix dissolves in cold and hot water.

As you listen to each group’s discussion make sure they address the following variables:

- Number of cups needed
- Amount of water in each cup
- Amount of cocoa in each cup
- Method and amount of time stirring

Students should realize that they will need to keep these variables the same. The only thing that should be different in each cup is the temperature of the water. Either have each group conduct its own experiment according to the groups’ plans, or have a class discussion to decide on a procedure that everyone will use.

#### 3. Have students conduct an experiment to see how well cocoa mix dissolves in cold and hot water.

The following procedure is one method students can use. Many different ratios of cocoa mix and water will work. The amounts suggested in this procedure do not follow the preparation directions on the package, but use convenient teaspoon and tablespoon measurements.

#### *Procedure*

1. Place  $\frac{1}{4}$  cup of cold and hot water in each of 2 cups.
2. At the same time, add 1 teaspoon of cocoa mix to each cup.
3. Stir each for 10 seconds and observe.
4. Stir for another 10 seconds and observe again.



#### 4. Discuss students' procedures and their results.

Ask students how they conducted their experiments and what they did to ensure that their test was fair.

**Expected results:** The cocoa mix in the hot water will appear to mix in with the water, coloring it dark brown. The cocoa mix in the cold water will remain mostly dry on the surface of the water. With time and enough stirring, the cocoa mix in the cold water will also mix into the water and color it.

**Note:** Cocoa mix is used in this activity because making hot chocolate from a mix is a common experience and shows how heating a liquid can affect the way a solid dissolves and mixes into it. The term “dissolving” is not used in its most technical sense in this activity because not all of the components in cocoa mix actually dissolve. Cocoa mix is made up of different ingredients, such as sugar, corn syrup, powdered milk, and cocoa. Some of these substances, like sugar and corn syrup, actually do dissolve in water. The cocoa and the milk probably don't dissolve because they have a fat component that is insoluble. These are likely mixed into the water as a *suspension* as opposed to being part of a solution. For the purpose of this activity, and considering the experience your students have with science, you can use the term “dissolve” to describe the process of the cocoa mixing into the water. For more information about the definition of dissolving, check the *Science background information*, pp. 174–179.

Ask students questions like the following:

- Does cocoa mix dissolve faster in hot or cold water?
- Could you make “cold chocolate” by stirring cocoa mix into cold water?
- What might you do instead if you wanted “cold chocolate”?

#### 5. Have students add to the class list about dissolving.

Ask students: What did you find out about dissolving from this activity? Students should realize that the temperature of a liquid affects dissolving, and that substances seem to dissolve better when a liquid is warmer.