In Lab 17.1, you learned about the effect of temperature and concentration on reaction rate. Another factor that affects reaction rate is the amount of surface area of the reactants. If a chemical reaction is to take place, the molecules of reactants must collide. Changing the amount of surface area modifies the rate of collision, and, thus, the rate of reaction. If surface area increases, collision frequency increases. If surface area decreases, so does the number of collisions. In this lab, you will examine the effect of surface area on rate of reaction. You will also determine how a combination of factors can affect reaction rate.

**Problem**
What effect does surface area have on reaction rate? What effect do a combination of surface area and temperature have on reaction rate?

**Objectives**
- Determine the effect of varying surface areas on reaction rates.
- Measure the rate of reaction.
- Determine the effect of more than one factor on reaction rates.

**Materials**
- effervescent antacid tablets (5)
- 25-mL graduated cylinder
- test tubes (18)
- test-tube rack
- timer
- mortar and pestle
- stirring rod

**Safety Precautions**
- Always wear safety goggles and a lab apron.
- Hot objects may not appear to be hot.
- Do not eat or drink anything in a laboratory.

**Pre-Lab**
1. Summarize the collision theory and how surface area applies to reaction rates.
2. Read the entire laboratory activity. Form a hypothesis about how an increase in surface area will affect the reaction rate. Form a second hypothesis about how the rate of a reaction might be predicted. Record your hypotheses on page 134.
3. Summarize the procedures you will follow to test your hypotheses.
4. What factors are constant in this experiment?

**Procedure**
1. Obtain five effervescent antacid tablets. Break each tablet into four equal pieces. One of these pieces will be used for each trial.
2. Measure exactly 15.0 mL of room-temperature tap water. Pour the water into a test tube.
3. Drop a piece of the antacid tablet into the water. Immediately start the timer. Stir the contents of the test tube throughout the reaction.
4. Measure the time until the reaction stops. Record this time in **Data Table 1**.
5. As another trial, repeat steps 2 through 4 for a second piece of tablet.
6. Take another piece of tablet and break it into several smaller pieces. Repeat steps 2 through 5, using the smaller pieces of tablet.

7. Use a mortar and pestle to grind a piece of tablet into a powder. Repeat steps 2 through 5, using the powdered tablet.

8. Repeat steps 2 through 7 using cold water.

9. Repeat steps 2 through 7 using very warm water.

**Cleanup and Disposal**

1. Pour the solutions down the drain.
2. Wash all test tubes and stirring rods.
3. Return all lab equipment to its proper place. Report any broken or damaged equipment.
4. Wash your hands thoroughly before leaving the lab.

**Hypotheses**

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**Data and Observations**

<table>
<thead>
<tr>
<th>Data Table 1</th>
<th>Time (s)</th>
<th>Water temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Room temperature</td>
</tr>
<tr>
<td><strong>Particle size</strong></td>
<td><strong>Trial number</strong></td>
<td></td>
</tr>
<tr>
<td>One piece</td>
<td>1</td>
<td></td>
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<tr>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>Several pieces</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
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<td>2</td>
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</tr>
<tr>
<td></td>
<td>Average</td>
<td></td>
</tr>
</tbody>
</table>
LABORATORY MANUAL

LAB 17.2

Analyze and Conclude

1. **Using Numbers** Average the times for each set of two trials. Record these values in **Data** Table 1.

2. **Observing** What evidence did you observe to indicate that a reaction had taken place?

3. **Inferring** What relationship exists between reaction time and reaction rate?

4. **Drawing Conclusions** Write statements that summarize the results of the lab activity.

5. **Predicting** Can relative reaction rates be predicted with certainty when more than one factor that affects reaction rate is involved? Explain.

6. **Drawing Conclusions** How does the collision theory explain the reaction times?

7. **Error Analysis** Were your hypotheses supported? Explain. What could you have done to improve the accuracy of the predictions?

Real-World Chemistry

1. Why does painting metallic objects that contain iron help prevent formation of rust?

2. How might particle size of reactants be varied to promote the sale of a product designed to neutralize stomach acids?