CHAPTER 12 LAB Activity

Chemical Weathering and Temperature

Skills and Objectives

- ***Model*** a chemical weathering process.
- ***Graph*** the data from the model and ***Interpret*** the graph.
- ***Predict*** what will happen when the model is modified.

Materials

- lab apron
- safety goggles
- 5 250-mL beakers
- 5 thermometers
- hot water (40–50°C)
- ice water
- 5 effervescent antacid tablets
- stopwatch
- graph paper
- map of Earth's climates, page 470

Whether it's the granite of a New Hampshire mountain breaking down into sand and clay or the limestone of Kentucky decomposing to form rich soil, all chemical weathering processes involve water. What effect does the temperature of the water have on the rate of chemical weathering?

Carbonic acid is a weak acid that forms when carbon dioxide dissolves naturally in water. A common chemical weathering process is the reaction of carbonate rocks, such as limestone and marble, with carbonic acid. In this lab activity, you will observe the dissolution of effervescent tablets in water of varying temperatures. These tablets contain sodium bicarbonate, which dissolves in water in much the same way that carbonate rocks dissolve in carbonic acid.

Procedure

1. CAUTION: Put on your lab apron and safety goggles.
2. Arrange five beakers in a row, numbered from 1–5. Place a thermometer in each beaker.
3. Add combinations of hot and ice water to each beaker so that the temperature of the water matches the following: Beaker 1, 0–10°C; Beaker 2, 10–20°C; Beaker 3, 20–30°C; Beaker 4, 30–40°C; Beaker 5, 40–50°C. Each beaker should contain about 200 mL of water.
4. Remove any ice from Beaker 1. Make sure that the water is within the correct temperature range. When the temperature reading stabilizes, record the start temperature of the water in Beaker 1 on a copy of the data table. Remove the thermometer from the beaker and set it aside.
5. Drop an antacid tablet into Beaker 1. Start the stopwatch at the instant the tablet enters the water. Stop the stopwatch when the last piece of the tablet dissolves. (Do not wait for the bubbling to stop; wait only for all pieces of the tablet to dissolve completely.) Record the time on the stopwatch to the nearest whole second.
6. Place the thermometer back in Beaker 1 and wait until the temperature stabilizes. Record the end temperature of the water in Beaker 1. Calculate the average temperature of Beaker 1 by adding the start and end temperatures and dividing by 2. Record the average temperature of the water in Beaker 1.
7. Repeat Steps 4, 5, and 6 for each of the remaining beakers.

6. Plot a graph of the data for the five trials. Place "Average Temperature (°C)" on the x-axis and "Time (seconds)" on the y-axis. Connect the five points with a smooth curve.

Beaker No.	Start Temp. (°C)	Time (sec.)	End Temp. (°C)	Average Temp. (°C)
1				
2				
3				
4				
5				

Analysis and Conclusions

1. In which beaker did the reaction occur most slowly? In which beaker did the reaction occur most rapidly?

2. Based on your observations, hypothesize the relationship between temperature and the rate of chemical weathering. What are some possible reasons for this relationship? Explain.

3. Look at the temperatures you recorded. Are all of these temperatures likely to occur on Earth's surface? If so, where? Which of the beakers corresponds with the water temperature of your local area?

4. Turn to the map of Earth's climates on page 470. Locate Rio de Janeiro in South America and Seattle in North America. The map key indicates that both cities have climates with abundant moisture.

   a. Compare the likely weathering rate of a limestone in Rio de Janeiro with that of a limestone in Seattle. Is there a difference?

   b. Which of the two locations is likely to have thicker soil?

5. Now locate Barrow, Alaska, on the map. Why is a limestone in Barrow likely to weather very slowly?

6. How would the rate of the reaction have been different if the tablets had been ground into a powder before they were dropped into the water? Would a graph for such a reaction result in a curve above or below the line of your actual data? Do you think the shape of the curves would be the same? Explain your answers.