



## Laboratory Activity

# Acid Rain

Have you ever seen stained buildings, crumbling statues, or trees that have lost their leaves because of acid rain? Acid rain is a harmful form of pollution. Its effects are also easy to see. Acid rain is precipitation that contains high concentrations of acids. The precipitation may be in the form of rain, snow, sleet, or fog.

The major products formed from burning fossil fuels such as coal and gasoline are carbon dioxide and water. However, nitrogen dioxide and sulfur dioxide are also formed. These gases dissolve in precipitation to form acid rain.

When acid rain falls on a pond or lake, the acidity of the water increases. The rise in the acidity is usually harmful to organisms living in the water. If the acidity becomes too high, all living things in the water will die. The pond or lake is then considered to be “dead.”

### Strategy

You will generate a gas that represents acid rain.

You will observe the reaction of this gas with water.

You will demonstrate how the gas can spread from one location to another.

### Equipment

96-well microplate

plastic microtip pipette

distilled water

paper towel

universal indicator solution

forceps

calcium carbonate,  $\text{CaCO}_3(cr)$

scissors

soda straw

sealable, plastic sandwich bag

white paper

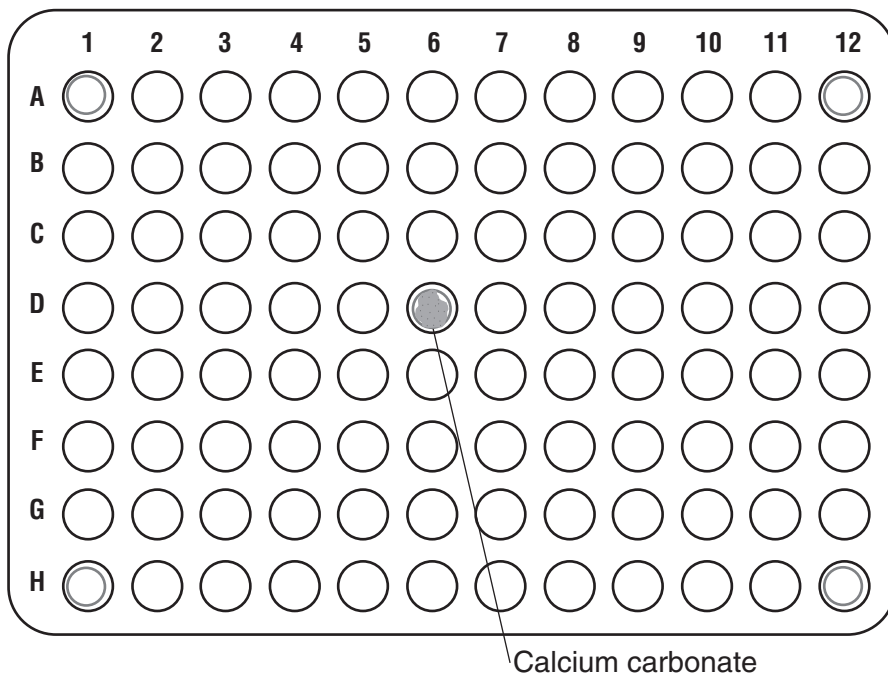
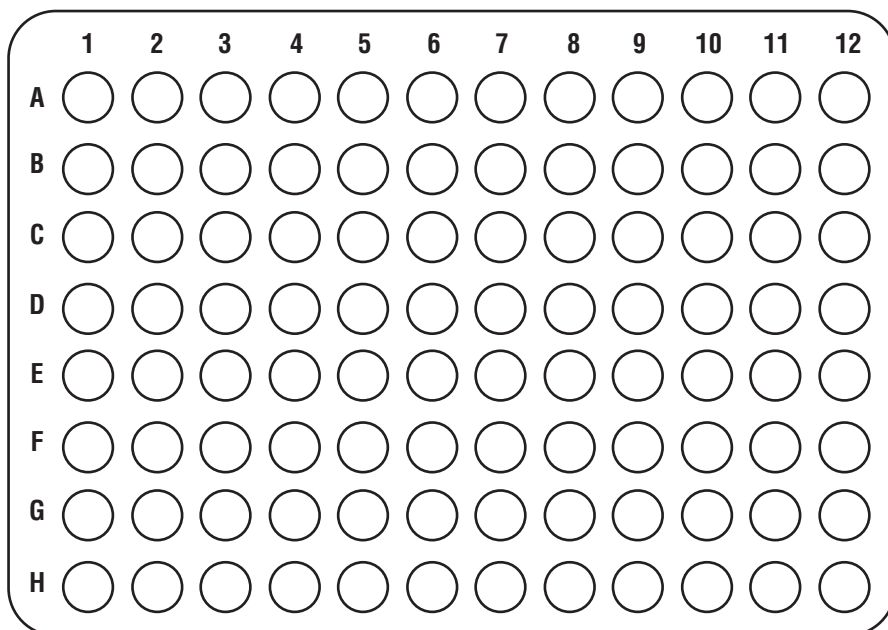
hydrochloric acid solution,  
 $\text{HCl}(aq)$

watch or clock

**CAUTION:** *The hydrochloric acid solution is corrosive. The universal indicator solution can cause stains. Avoid contacting these solutions with your skin or clothing. Wear an apron and goggles during this experiment.*

### Procedure

- Place the microplate on a flat surface.
- Using the plastic microtip pipette, completely fill all the wells except A1, A12, D6, H1, and H12 with distilled water.
- Use a paper towel to wipe away any water on the surface of the microplate.
- Using the microtip pipette, add 1 drop of the indicator solution to each well containing water. Rinse the microtip pipette with distilled water.
- Use the forceps to add a small lump of calcium carbonate to well D6.
- Use the scissors to cut four 1-cm lengths of soda straw. Insert one length of soda straw in each of the wells A1, A12, H1, and H12 as shown in Figure 1. Cut a 0.5-cm length of soda straw and place it in well D6.
- Carefully place the microplate into the plastic sandwich bag and seal the bag. Place the bag on the piece of white paper.
- Using the scissors, punch a small hole in the plastic bag directly over well D6.
- Fill the microtip pipette one-fourth full with the hydrochloric acid solution.
- Slip the tip of the pipette through the hole above well D6. Direct the stem of the pipette into the soda straw in well D6.
- Add 4 drops of hydrochloric acid to the well. Observe the surrounding wells.
- After 30 seconds, note any color changes in the surrounding wells. Record a color change in the solution in a well by marking a positive sign (+) in the corresponding well of the microplate shown in Figure 2a in Data and Observations.
- Repeat steps 11 and 12 two more times. Record your two sets of observations in Figure 2b and Figure 2c, respectively.

**Laboratory Activity 2 (continued)****Figure 1****Data and Observations****Figure 2a**

**Laboratory Activity 2 (continued)****Figure 2b**

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H	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Figure 2c**

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**Laboratory Activity 2 (continued)****Questions and Conclusions**

1. Calcium carbonate and hydrochloric acid react to produce a gas. What is the gas?

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2. What does this gas represent in this experiment?

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3. What physical process caused the gas to move through the air in the plastic bag?

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4. Why were the lengths of soda straws placed in wells A1, A12, H1, and H12?

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5. Discuss how this experiment demonstrates how acid rain can spread from the source of the chemicals that produce acid rain to other areas.

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6. What factors that may cause the spread of acid rain in the environment are not demonstrated in this model experiment?

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**Strategy Check**

\_\_\_\_\_ Can you generate a gas that represents acid rain?

\_\_\_\_\_ Can you detect the reaction of this gas with water?

\_\_\_\_\_ Can you show how the gas can spread from one place to another?