# Chemical Pollution

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## Topic

Buffering capacity of natural waters

## Time

1½ hours

## Safety

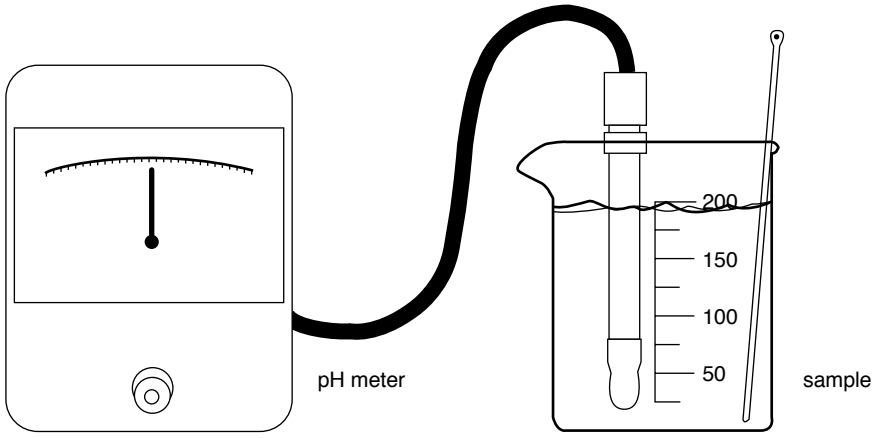
**Please click on the safety icon to view the safety precautions. Keep HCl solution and pH buffers from touching your skin, mouth, or clothes. Do not drink the samples of natural water, and do not let the water get in your eyes. The water may contain dangerous bacteria.**

## Materials

glass jars for collecting samples (250-mL capacity)
distilled water
pH meter
medicine dropper
pH buffers for pH 4, pH 10, and pH 7
0.2 *M* HCl solution
250-mL beaker
Celsius thermometer
stirring rod

## Procedure

1. In glass jars, collect water samples from nearby lakes, rivers, and streams. You will need 200-mL samples. If solids are present in the samples, remove them by filtering or by allowing the sediments to settle to the bottom before you take pH readings.
2. As a control, first find the buffering capacity of distilled water. To do this, take a 200-mL sample of distilled water, and, using the pH meter, measure its pH at 20°C (see figure). Using the medicine dropper, add the HCl solution 1 drop at a time until you have lowered the pH of the solution to 4. Stir the solution well after each addition of HCl. Wait at least 30 sec before reading the pH meter. Carefully count the number of drops required to reach the desired pH. Record this figure. You will use this base number of drops as a comparison.
3. Repeat the procedure in step 2 for each of your samples of natural water. To find the buffering capacity of each sample, subtract the base number you found in step 2 from the number of drops required for the sample.




4. A body of water with a buffering capacity of 40 or higher is relatively safe from acid rain. A body of water with a buffering capacity of 4 or 5 may be in immediate danger if the precipitation is very acidic. Based on your data, how vulnerable are the bodies of water in your area to acid rain?
5. If you performed the experiment called "Does Your Town Have Acid Rain?"(see 1.22-1), relate the results of that experiment to the results of this one. How would you rate the overall dangers of acid rain to your town? What impact might these dangers have on life in your town?

## What's Going On

The results of this laboratory activity will vary depending on the water sample. Chemical pollution, either as a result of direct dumping or acid rain, threatens many of our streams, rivers, and lakes. These bodies of water have a natural capacity to absorb certain amounts of pollution without affecting their ecosystem. This is called their *buffering capacity.* The buffering capacity of a solution is the degree to which it can absorb acidic or alkaline substances and maintain a nearly constant pH value. If the amount of pollution exceeds the water's natural buffering capacity, there is a potential danger to its ecosystem.

In this experiment, you discovered the buffering capacity of your local waters and saw how effectively they reduce damage to aquatic life by acid rain and chemical pollution.

## Connections

The Ohio River Basin covers 11 states and runs through major coal and agriculture areas. Its source in Pittsburgh, Pennsylvania, is polluted and worsens on its path through urban centers and along its 981-mile run. It has high acidity from coal mining areas in Pennsylvania and West Virginia, high fecal counts, and high magnesium and iron concentrations. In addition, it has high levels of toxic chemicals. There has been a concerted level of activity focused on cleaning the Ohio River Basin. However, it will take years to clean up the damage caused to such a beautiful natural resource.

# Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say "be careful with hot liquids" or "don't cut yourself with the knife" does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

### PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

### PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

### USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don't use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

### USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

### HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

### WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

### GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

### FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES