THE Great Lakes STORY

EDUCATOR'S ACTIVITIES GUIDE

Educator's Activities Guide

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Welcome to the Great Lakes Story *Educator's Activities Guide.*

Whether you are a classroom teacher, youth group leader, or home-schooling parent, you can use this *Activities Guide* to enhance and extend the educational experience provided by a visit to the *Great Lakes Story* exhibition.

The *Guide* includes background information to supplement the content provided in the exhibition, eight detailed activities, and five shorter activities in the *Just Add Water* section. The guide also includes a detailed glossary and resource section.

Featuring 25 interactive exhibits designed to engage visitors of all ages, the *Great Lakes Story* is the tale of how the Great Lakes were formed, how they have changed, and how science and technology are being used to understand and remediate environmental problems that threaten to destroy this amazing resource.

We hope that you enjoy your visit!

Educator's Activities Guide Introduction

There's no place like **H.O.M.E.S.** especially when you and your students are talking about the Great Lakes. The five Great Lakes: **H**uron, **O**ntario, **M**ichigan, **E**rie and **S**uperior contain 20% of the world's fresh water supply and are home to some fascinating geological, ecological and biological wonders. These wonders are what make the Great Lakes GREAT!

The Great Lakes have a surface area of 94,000 square miles (245,759 square km) and contain over 6 quadrillion gallons of water. How much water is that? If you were to pour the water of the Great Lakes over the 48 contiguous United States, it would cover every state and stand at a depth of 9.5 feet. That's a lot of water – about 90% of the surface fresh water in the United States.

Eight American states and two Canadian provinces border the Great Lakes and are home to more than 35 million people. The Great Lakes shoreline measures more than 10,000 miles, almost half of the Earth's circumference. The Lakes provide an estimated 56 billion gallons of water per day for municipal, agricultural, and industrial use. The Great Lakes have an estimated 250 indigenous species of fish, 100 of which are considered rare.

Over 200 million tons of material goods from all parts of the world are shipped along a 1,270-mile water route. Great Lakes industries produce 90% of the iron ore in the United States and 58% of all automobiles produced in the U.S. and Canada are manufactured in the Great Lakes basin.

WHY ARE THE GREAT LAKES GREAT?

Fire and ice helped form the Great Lakes. The eruption of volcanic fissures laid their foundation. Monumental glaciers molded the earth and left behind the water that filled the Great Lakes. At 8,000 years of age the Great Lakes are a young geological feature of the North American landscape and are in a constant state of change.

The largest of the Great Lakes is Superior; at an average depth of 500 ft, it can hold all four of the other Great Lakes plus three additional lakes the size of Lake Erie. Lake Superior is the cleanest of the five Great Lakes due to its relatively low regional population and northern-most location. Water from Lake Superior flows into Lakes Huron and Michigan via the St. Mary's River, carrying pollutants in the process. Lakes Michigan and Huron are joined by the Mackinac Straits and rise and fall together with seasonal changes in climate. Lake Michigan boasts the largest fresh water sand dunes in the world and Lake Huron is home to Mantoulin Island, the largest freshwater island in the world. Water from these lakes flow into Lake Erie via the St. Clair and Detroit Rivers. Lake Erie is the shallowest of the five Great Lakes, which also makes it the most susceptible to pollution and climate changes. Large industrial cities add to the pollution problems of Lake Erie.

It is the flow from Lake Erie into Lake Ontario that makes the biggest roar. The Niagara Falls drop in elevation 325 ft. Lake Ontario is the last of the Great Lakes. From here the water makes its way through the St. Lawrence Seaway and empties into the Atlantic Ocean.

Educator's Activities Guide Introduction

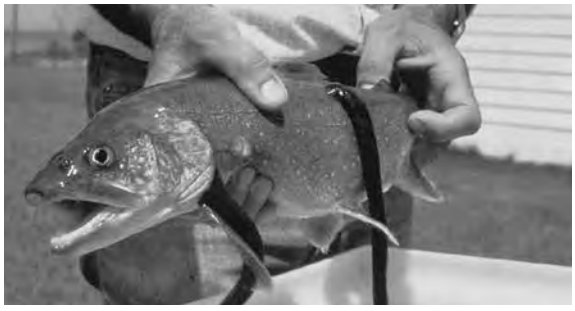
CHANGES AND THREATS TO THE GREAT LAKES

Settlement: The first human inhabitants of the vast Great Lakes basin arrived about 10,000 years ago before the Lakes had reached their present form. This group of people had little impact on the Lakes. The arrival of 19th century European settlers brought more rapid change to the region. By using the fertile soil for agriculture, settlers began a process of clearing and farming that put the Great Lakes in danger.

Agriculture, Logging and Forestry: In the mid-1800s settlers began clearing land for farming. The clearing of old growth forest made land available for farming. Removing trees that once held back topsoil now allowed fertilizers and topsoil to run off into the Lakes. Agriculture was essential for sustenance; however, lumbering was the first major industry of the Great Lakes region. The immense system of rivers and Lakes provided the lumber industry with ready transportation.

Transportation: The construction of canals after the War of 1812 increased shipping and brought new threats in the form of exotic species that disrupted the natural food web. Without natural predators in the system, animals like the sea lamprey, zebra mussel and spiny water flea deplete food sources, drain oxygen, and out compete natural predatory fish.

Urbanization: The industrialization of the area brought additional challenges to the Great Lakes ecosystem. Increased population and housing needs required more land usage infringing upon animal habitats. Large industries dumped vast quantities of waste directly into the watershed making drinking water hazardous. Smog and smoke were being released into the air, causing acid rain and particulate problems. DDT and PCBs affected fish and bird populations causing the extinction of some and threatening others.



RESTORING THE GREAT LAKES ECOSYSTEM

The 1960s brought a new awareness of environmental threats. We began taking a closer look at the damage to the Great Lakes ecosystem. New legislation and environmental treaties were implemented. Areas of Concern were identified and Remedial Action Plans were put into effect. This brought a new awareness of the need for clean water supplies and self-sustaining ecosystems. The Great Lakes are making a comeback.

Today, some threatened species of wildlife, such as the Bald Eagle, are making a comeback. This is due mostly to the banning of the pesticide DDT. But, many habitats are still threatened and large areas of the Great Lakes are still in peril.

VISITING THE GREAT LAKES STORY

This exhibition is designed to tell you and your students the Great Lakes Story and how we are trying to preserve this environment for future generations.

See how glaciers grew and receded to leave behind one-fifth of the world's accessible fresh water. Fill the Great Lakes and compare volume and surface area. Examine the threats to the Great Lakes. Learn about the efforts being made to correct past mistakes and preserve this amazing resource for future generations. Come and discover ***The Great Lakes Story.***

Capture, Store and Release

ACTIVITY 1

Introduction: Students will recognize that groundwater, surface water and precipitation contribute to the health of wetlands. Students will also be able to describe how wetlands capture, store and release water.

In The Great Lakes Story Exhibition:

- *Great Lakes and States Puzzle*: Learn the geography of the Great Lakes and better understand the components of a watershed.
- *Take Away the Great Lakes*: Use stencils to draw each of the Great Lakes. Make size and volume comparisons.
- *When Bloom is Doom*: Explore the effects of agricultural runoff.
- *RAP on RAPs*: Learn how Remedial Action Plans are being used to preserve and restore wetlands.

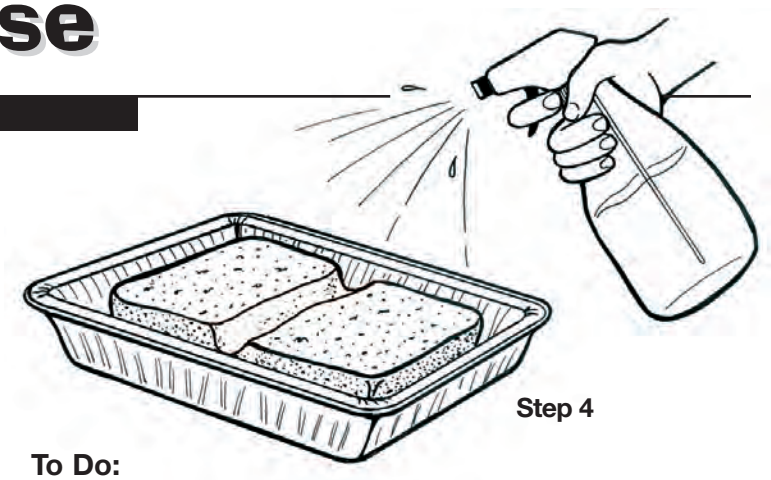
Key Concepts:

- Geography of the Great Lakes
- Math computation – size and volume
- Ecological importance of wetlands

Materials:

- Pictures of wetlands
- Colored water
- Large light colored sponges (one per group)
- Aluminum foil trays about the size of the sponges (one per group)
- Wood block or large book
- Utility knife (for teacher use only)
- Spray bottle
- Measuring cup
- Cardboard
- Towels
- Hammer and a nail

Background: Wetlands plays a vital role in the Great Lakes watershed. Wetlands capture, store and release water into the Great Lakes system. Wetlands absorb pollutants before they can make their way into the drinking water supply. Wetlands also provide habitats for nesting birds and spawning fish. A wetland's ability to hold water makes it valuable to watershed management. This activity is designed to allow your students to see a model watershed at work.



Step 4

To Do:

Step 1: In each sponge cut a one-inch wide strip, using the utility knife. Do not cut all the way through the sponge. It should look like a trough and should extend from one side of the sponge to the other. Cut strips of cardboard to fit into the cutaway portion of the sponge.

Step 2: Divide the class into small groups. Give each group a sponge, a foil tray and a strip of cardboard. Instruct the students to place the cardboard strip into the sponge trough and place the sponge in the foil tray. Explain that this sponge represents a wetland. The trough represents a stream.

Step 3: Pour 1 cup colored water into the trough of the sponge and observe what happens. Students should see that the streambed absorbs some of the water. Demonstrate how depressions in the sponge allow water to collect as well by pushing down on the sponge with your finger.

Step 4: Instruct the students to spray water over the sponges to show how precipitation feeds the streams. Eventually the sponge will saturate having absorbed all of the water in the pan. Additional water will settle *around* the sponge.

Step 5: Remove the sponges from the pan and wring them dry. Instruct the students to carefully make a hole in one end of the pan. Return the sponge to the pan and elevate the opposite end of the pan using the book or wood block.

Step 6: Pour 2 cups of water into the elevated end of the tray. Use the cup to collect the water as it drains from the hole at the opposite end. How much water is collected compared to the amount poured in? How long did it take for the water to drain?

Extensions: Using a larger pan and additional sponges students can make more elaborate wetland models. By adding colored sand to the model they can demonstrate how silt and contaminants can be held by the wetland without returning to tributaries, streams or lakes.

Water Clarity

ACTIVITY 2

Introduction: Students will examine water supplies to learn how sediment can disrupt the natural food web.

In The Great Lakes Story Exhibition:

- *When Bloom Is Doom*: Learn how algae and decomposition can affect a water supply.
- *Biomagnification*: Helps students realize that toxic substances can be part of sediment that is stirred up in the Great Lakes waters.
- *Top Ten Great Lakes Environmental Concerns*: Discover other factors that affect the Great Lakes ecosystem.
- *Rap on RAPs*: Learn how Remedial Action Plans are implemented to restore and preserve Great Lakes waters.

Key Concepts:

- Scientific method
- Measuring and recording data
- Importance of clean fresh water to a community

Background: Sediment in a water supply can pose many problems. When a lake bottom is disturbed by transportation and dredging, heavy metals and pollutants once trapped in the sediment can be released into the water. These pollutants are absorbed into the food web and biomagnified as they climb the food chain.

Materials:

- Several quart size clear jars
- Permanent black marker
- 3 x 5 index card
- Plastic lid from a 3-lb. coffee can
- String
- Ruler
- Small weights, large metal nuts or fishing sinkers will work

To Do:

Step 1: Fill the jars with water samples from local water sources: ponds, streams, lakes, etc. Mark the lid of each jar to indicate its source. You might send the jars home with students to collect samples from around their homes and neighborhoods.

Step 2: Using a black marker write the following words on the index card in large capital letters. “CAN YOU SEE ME?”

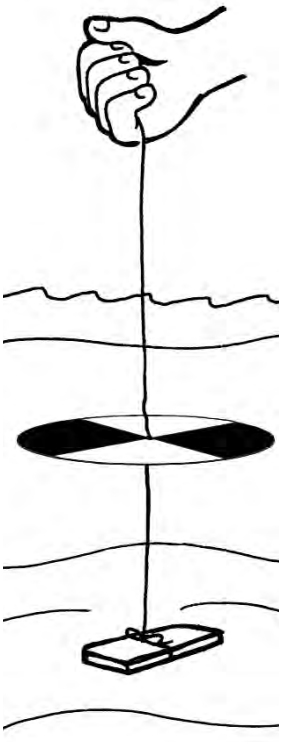
Step 3: Shake each water sample and place the card behind the jar with the words against the glass. Can you read the text? How clear is the type?

Step 4: Indicate the clarity of each sample using descriptive words such as: cloudy, dirty, clear, milky, clean, murky, etc. Record the results.

Step 5: Discuss how water clarity impacts plant and aquatic life.

Extensions:

Explain that scientists test water clarity by using a Secchi Disk. Use the coffee can lid and marker to make your own. Divide the lid into quarters and color two opposing quarters. Punch a hole in the center of the lid and thread an 18" length of string through the hole, tie knots above and below the lid and attach a weight to the end of the string beneath the lid. Visit local water sources and test water clarity by lowering the disc into the water. Have the students predict about the distance the disk can be lowered before it can no longer be seen. Were their predictions correct?



Species Survey

ACTIVITY 3

Introduction: Students will achieve a better understanding of how species surveys are conducted. They practice how environmentalists and ecologists keep records of specific species.

In The Great Lakes Story Exhibition:

- *Great Lakes Alien Species*: Learn about exotic species.
- *Where Have All the Species Gone?*: Familiarize students with the endangered species of the Great Lakes basin.
- *Biomagnification*: Help students see the impact pollutants have on specific species.

Key Concepts:

- Math skills
- Graphing
- Applying math skills to a larger scientific investigation

Background: Scientists and environmentalists map species to track movement and keep track of the population. Species mapping is important in the control of exotic species as well.

Materials:

- 9 x 13 clear glass baking dish
- 2 boxes of blue gelatin dessert
- 1 box of Runts candy or other small multicolored candies
- Paper plates
- Knife
- White paper
- Ruler
- Black marker
- Tape

To Do:

Step 1: Place the baking dish on the white paper and draw the outline of the dish.

Step 2: Using the ruler divide the outline into 12 equal squares.

Step 3: Mark each square sequentially with a letter of the alphabet.

Step 4: Tape the paper to the outside bottom of the dish so that you can read the letters through the dish.

Step 5: Prepare the gelatin according to the directions on the package for a “soft set” or “quick set” preparation.

Step 6: Disperse your candy randomly through the dish and allow the gelatin to set overnight.

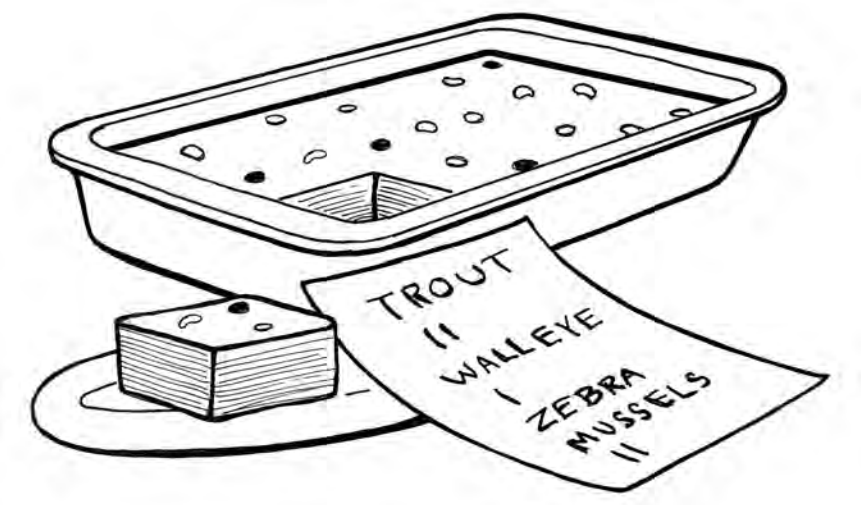
Step 7: Use your knife and cut the gelatin along the lines of the pieces marked on your paper.

Step 8: Write one letter on each of the paper plates and place the corresponding squares of gelatin onto the plates.

Step 9: Distribute the plates among your students. Explain that each color of candy stands for a different species of aquatic life. The students’ job is to find the species in their square and record the numbers.

Step 10: Transfer the results to a large graph and discuss the results.

Extensions: Other activities might include adding exotic species such as M&M’s to indicate sea lamprey or zebra mussels. Discuss how exotic species can disrupt an entire ecosystem.



Biomagnification and the Herring Gull

ACTIVITY 4

Introduction: This activity will introduce the biomagnification process. Students will see the amount of pollution concentration increase from plant life, to fish to birds.

In The Great Lakes Story Exhibition:

- *Biomagnification*: See the progression of ingested chemicals as they climb the food chain.
- *Where Have All the Species Gone?*: Learn about specific species that are threatened by pollution in the Great Lakes basin.
- *Rap on RAPs*: Understand how Remedial Action Plans are put in place to repair the damage done to the Great Lakes.

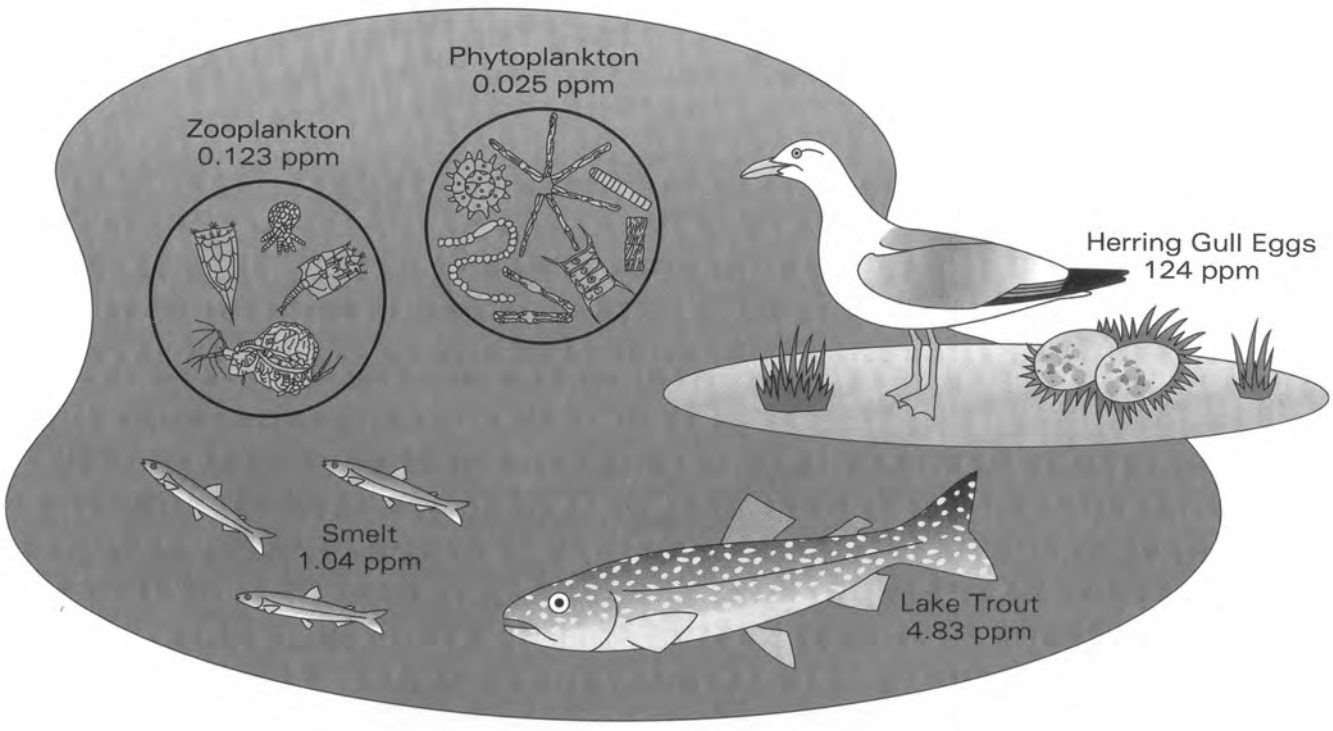
Key Concepts:

- Math skills
- The impact of pollutants on the Great Lakes ecosystem

Background: Toxic chemicals that reach the Great Lakes bioaccumulate in the smallest of life forms, phytoplankton and zooplankton – microscopic plants and animals that are food for larger plants and animals. As the larger animals ingest contaminated foods they accumulate a greater concentration of pollution. This is called biomagnification. The concentration of pollution that accumulates is measured in parts per million (ppm). Pollutants that bioaccumulate are not broken down or eliminated.

For example a Smelt may have a pollutant concentration of 1.04 ppm. A Lake Trout eats many Smelt. The pollutants concentration can increase as much as four times. By the time a Herring Gull has consumed its fill of Lake Trout it may have a concentration of 124 ppm of pollutants in its eggs.

Chemicals such as DDT and PCBs have been shown to bioaccumulate in the cells of animals over time. Even though DDT was banned in the 1970s it is still present in aquatic ecosystems, showing up in fish, birds and other wildlife.



Materials:

- Each student should begin with:
  - 5 squares of green paper – these represent zooplankton and phytoplankton which is food for the fish.
  - 1 square of blue paper – this represents small lake fish called smelt.
- 10 squares of orange paper – these represent lake trout and will be used later.
- 5 squares of white paper – these represent herring gull and will be used later.

To Do:

Step 1: Ask students to place one or two Xs on each of the five green squares. The Xs represent pollutants.

Step 2: Collect all of the green squares and place them face down randomly throughout your classroom space.

Step 3: Allow students 30 seconds to collect as many smelt (green squares) as possible.

Step 4: Have students count the total number of Xs on their green squares and draws that many Xs on their blue square of paper.

Step 5: Collect the blue squares. Place them randomly around the room as before.

Step 6: Select 10 students to represent trout. Give each an orange square of paper. Ask students to collect the blue squares (smelt).

Step 7: Count the number of Xs on their blue squares and draw that many Xs on their orange square.

Step 8: Collect the orange squares. Distribute around the room as before.

Step 9: Count the Xs on the orange squares and write the total number on the white square.

Step 10: Graph the results.

Step 11: What do you notice about the amount of pollutants through the food chain? Does the size of the eater make any difference? How would the result be different if the last eater were a person instead of a gull? Do humans eat as many fish as a gull?

Extensions: Students should look up the definition of biomagnification and also research average body weights for specific fish and birds and discuss pollution content with respect to body weight.

Sediment sampling on Lake Superior

Seek the Source

ACTIVITY 5

Introduction: This activity will demonstrate how chemicals and pollutants released in one region can move through groundwater and into other regions. Using a model, students must locate the source of groundwater contamination through sampling and testing soil.

In The Great Lakes Story Exhibition:

- *Top Ten Great Lakes Environmental Concerns*: Learn about environmental challenges of the Great Lakes basin.
- *How to Renew the Great Lakes*: Balance ecological threats and solutions to help renew the chemical, biological and physical integrity of the Great Lakes.
- *Great Lakes News Update*: Log onto the Web to read up-to-date articles on the state of the air, water and soil of the Great Lakes region. Discover how toxins in the Great Lakes affect human health.

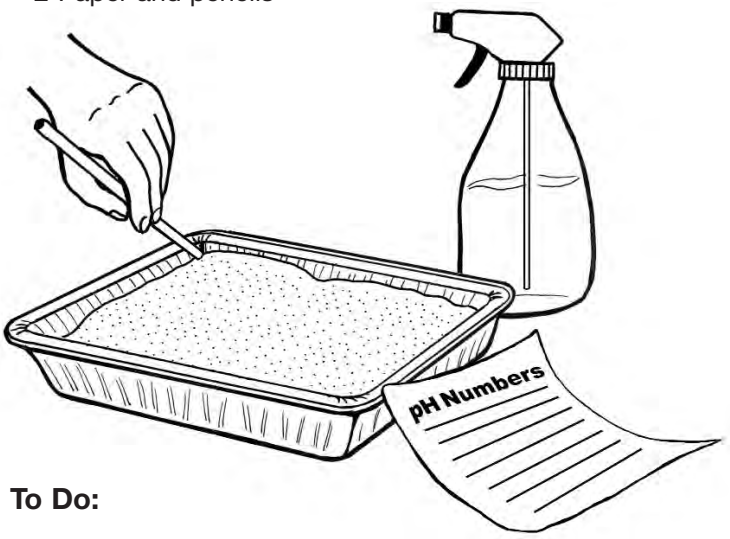
Key Concepts:

- Mapping
- Scientific testing
- Accurate data recording and analysis

Background: Groundwater lies just below the surface of the Earth in supersaturated rock, soil and in aquifers. This groundwater gradually seeps into other areas depending on climate, geology, and weather conditions. High rains can cause groundwater to travel from one area to another – carrying minerals and contaminants with it. If the concentration of contaminants is high enough, an entire water supply might be compromised. This is why dumping of toxic and hazardous chemicals is regulated.

Materials:

- Disposable 9 x 13 foil pans (one for each group of students)
- Play sand
- Unsweetened lemonade flavored drink mix (one packet for each group of students)
- Plastic drinking straws (one for each group of students)
- pH paper
- Spray bottles (one for each group of students)
- 12 oz. drinking cup filled with water (one for each group of students)
- Wood blocks or books
- Permanent black marker
- Paper and pencils



To Do:

Step 1: Divide the class in small groups and number them.

Step 2: Mark the pan with the group number. Mark two sheets of paper with the group number. Mark the four sides of the pan with the compass points N, S, E, W.

Step 3: Fill the pan with 2 inches of sand. Dig a 2" hole in the sand and fill it with the drink mix.

Step 4: On one sheet of paper create a map. Show the four compass points and mark the spot where the contaminant is hidden with a large X. On the other sheet write in the four compass points. Do not show the contaminant.

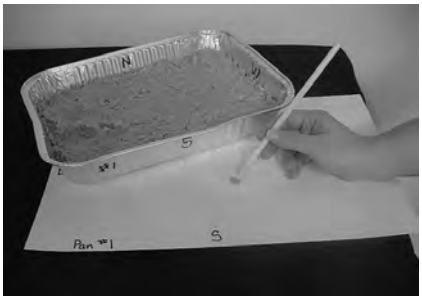
Step 6: Groups will trade pans along with the sheet that does not show the contaminant location. The map will be used to plot samples and record pH.

Step 7: Test the pH of the water in the group's spray bottle. This will be the control pH.

Step 8: Spray the sand tray gently but steadily. No surface runoff or standing water should occur.

Step 9: Use the drinking straw as a drill and remove soil samples from 13 different locations within the tray marking each location on the map. This can be done by inserting the straw into the sand and placing your index finger over the open end of the straw. The straw is then extracted from the sand and the sand is placed onto the tabletop by releasing the index finger. Press the pH paper onto the soil sample. Compare the color of the paper to the pH scale that accompanies the paper.

Step 10: As you test each soil sample using the pH paper, attach the pH paper to the map in the location from which the sample was taken. Record the pH reading on the map that coincides with the sampling.



Step 11: Instruct the students to rinse the drill in the cup of water between samples.

Step 12: When they believe that they have found the location of the contamination, shown by the highest pH level, they should mark an X on their map.

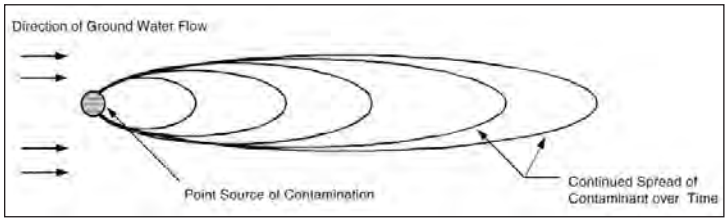
Step 13: Compare this map to the map held by the original group. Were the students successful in locating the highest concentration of contaminants?

Extensions:

- Use several glass baking dishes. Vary the combinations of sand and gravel or different elevations of the pan. Have students predict the shape of the "contamination" plume and its formation depending upon the elevation of the pan and the sand to gravel ratio.

- Change the drink mix from the colorless lemon flavor to a grape or cherry flavor. Bury the drink mix as directed above and ask the students to predict what might happen when water is sprayed on the sand. Students can see the plume of contamination by raising the glass dish and viewing it from underneath.

- Have the students investigate groundwater contamination in your area. What are some of the precautions being taken to prevent groundwater contamination?



Borrow and Return

ACTIVITY 6

Introduction: Students will gain an understanding of wastewater treatment. They will see how wastewater is separated and filtered to remove as much waste as possible before returning water to its source.

In The Great Lakes Story Exhibition:

- T*op Ten Great Lakes Environmental Concerns*: See what environmental challenges restorers of the Great Lakes basin face.
- *How to Renew the Great Lakes*: Balance threats and solutions to renew the chemical, biological and physical integrity of the Great Lakes.
- The *Great Lakes News Update*: Log onto the Web to read up-to-date articles on the state of the air, water and soil of the Great Lakes region.

Key Concepts:

- Water filtration and treatment
- Scientific method

Background: Sewage is treated at water treatment facilities before the water can be released back into lakes, rivers and streams. In some cities, sewage lines are separated from storm drains, but with sudden heavy rainfall, overflow from the sewage lines may flow into the storm drains and into lakes, rivers or streams without treatment.

The release of raw sewage into a drinking water source can create a myriad of problems. Beaches can be closed to swimmers and homes and businesses may be required to boil drinking water. Historically, contaminated water supplies may have led to disease epidemics.

Materials:

- Used coffee grounds
- Leftovers from meals (Avoid meats.)
- Cooking oil
- A blender or food processor
- 1 32 oz. jar with lid
- 2 two-liter bottles with 2 inches removed from bottom (funnel)
- 2 two-liter bottles cut two inches below the neck (reservoir)
- A 3" x 3" square of nylon window screen
- A small gravy ladle
- Turkey baster
- Large funnel
- Coffee filters
- Clean sand
- Aquarium charcoal

To Do:

Step 1: Chop up one-half of your leftovers into large bits.

Step 2: Place the other half in the blender or processor and puree them with one ounce of oil.

Step 3: Place 1/3-cup of puree, 1/3-cup of chopped food, and 1/3-cup coffee grounds in the jar. Fill with tap water.

Step 4: Place the lid on the jar and shake it up. Place one of the two-liter bottles with bottom-removed neck down into one of the two-liter bottles with the top removed. This will create a funnel and reservoir set up.

Step 5: Place the nylon screen inside funnel so that it covers the opening at the neck of the bottle. This will filter out the large food particles.

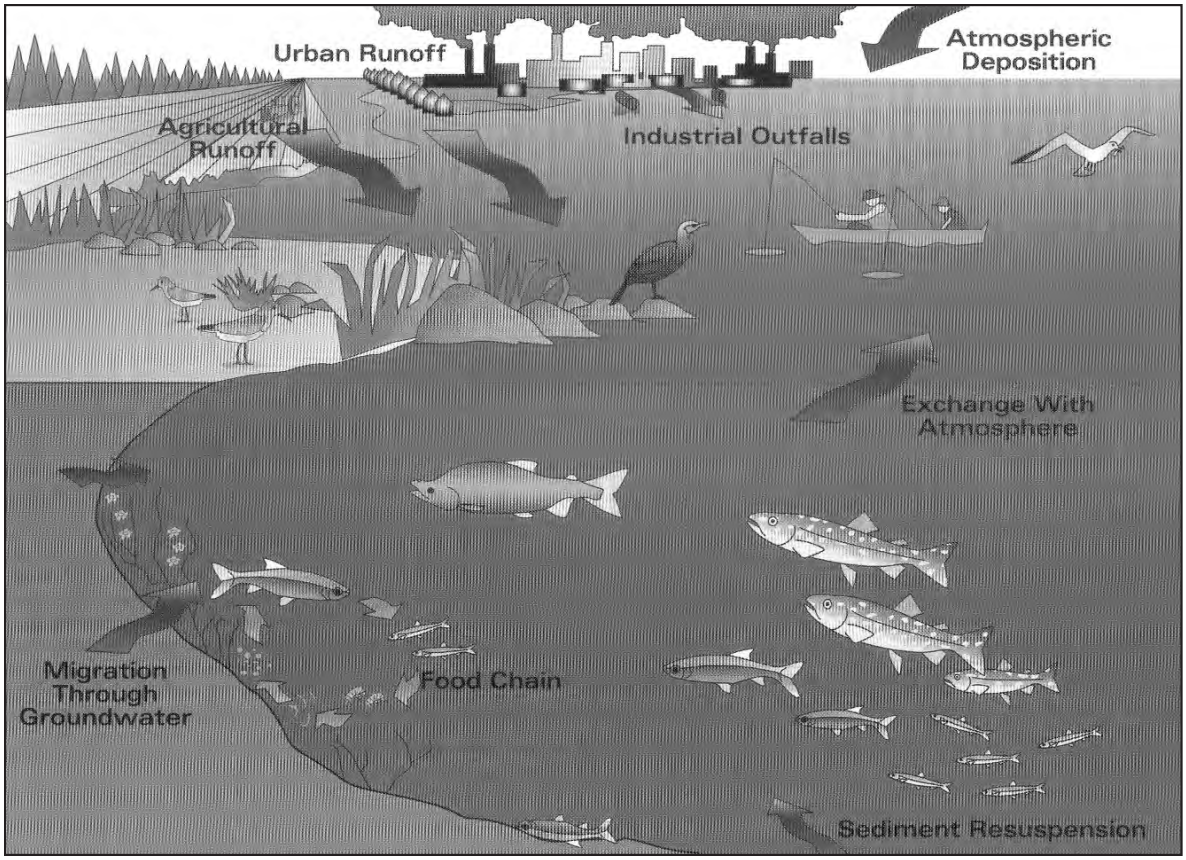
Step 6: Pour the contents of the jar slowly into the funnel and allow it to drain.

Step 7: Once the water has drained through, allow the reservoir to rest undisturbed overnight. Do not cover. The mixture should separate: light oils on top, dirty water in the middle and sediment on the bottom.

Step 8: The next morning, using the gravy ladle, skim as much of the oil off the top as possible. (If you can, refrigerate the reservoir. This will help any fats to solidify and make them easier to remove.)

Now it's time to filter the water.

Sources & Pathways of Pollution



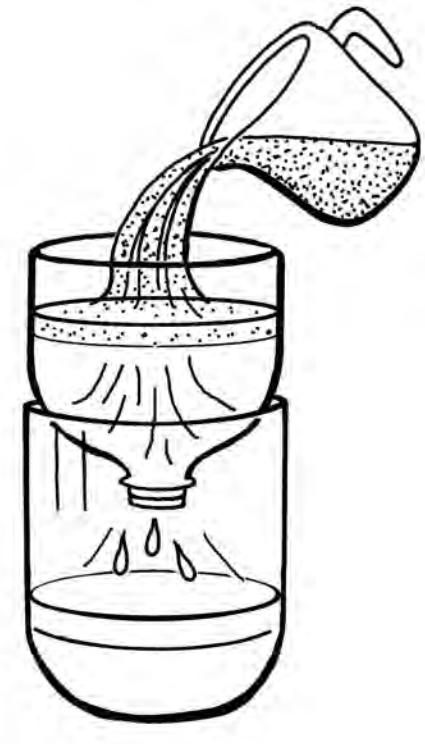
Step 9: Create another funnel set-up using the two remaining two liter bottles.

Step 10: Place a coffee filter in the funnel. Spread two tablespoons of charcoal evenly on the filter. Fill the filter to the top with clean play sand.

Step 11: Use the turkey baster to collect the water from the prepared mixture. Be careful to avoid the sediment in the bottom.

Step 12: Slowly pour the water from the baster into the sand/charcoal funnel/filter. Don't force it. Just let it drip through.

Though your treated water is not safe to drink, you have just modeled water treatment.



Extensions: Prepare several filter set-ups. Filter the water over and over using a clean filter each time. Have students take samples from each filtration and test pH levels and describe the color, clarity and smells of the water. Does it change with each filtration? Visit a water treatment facility in your area and see firsthand how water treatment takes place.

Exotic PSA

ACTIVITY 7

Introduction: This activity is designed to have students learn about the natural history and impacts of exotic species in the Great Lakes.

In The Great Lakes Story Exhibition:

- *Where Have All the Species Gone?*: Learn about specific species that are threatened by pollution in the Great Lakes basin.
- *Great Lakes Alien Species*: Learn about exotic species.
- *Top Ten Great Lakes Environmental Concerns*: See what environmental challenges face the Great Lakes.
- *Great Lakes News Update*: Log onto Web sites and read up-to-date articles on the state of the air, water and soil of the Great Lakes region.
- *Louis the Lamprey Show*: View a lighter look at the exotic species problem facing the Great Lakes ecosystem.

Key Concepts:

- Public speaking skills
- Research and a analysis of information
- The impact exotic species have on an ecosystem

Background: Exotic species are not just found in the Great Lakes. They impact ecosystems throughout the United States. Since the 1800s more than 130 nonindigenous species have established themselves in the Great Lakes.

Aquatic nuisance species, such as the zebra mussel, can cost some municipalities hundreds of thousands of dollars each year.

Compared to their native habitats, exotic species have few natural predators, parasites, pathogens or competitors that keep them in check in non-native waters. Under the right conditions, non-native species can displace natives, reduce biodiversity and limit the uses of our rivers, lakes and streams. Once these species establish themselves many are nearly impossible to eradicate or control.

Materials:

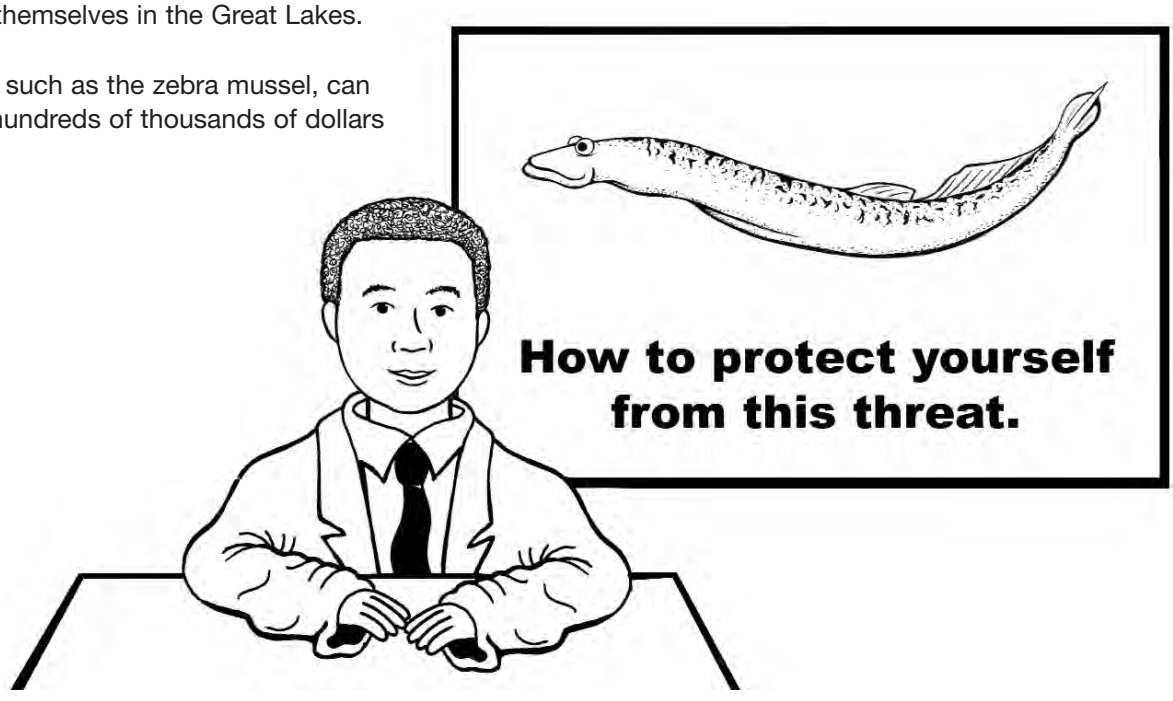
- Computers with Internet access – see resource page for suggested sites
- Paper and pencils
- Video recording equipment if available

To Do:

Step 1: Students should research exotic species of the Great Lakes and other regions.

Step 2: Explain to your students that Public Service Announcements (PSAs) are used to teach the public about problems in their community. These announcements can cover anything from community service projects to advisements about health risks in their community or beach closures.

Step 3: In groups of three or four, students will create a 60-second PSA for television about the risk of exotic species in a local ecosystem. Specific species may be assigned by the teacher or chosen by each student group.



Step 4: Students explain what their species is, how it affects the environment and what citizens can do to prevent the spread of this species. They should use visual aids. Ask them to consider what type of Public Service Announcement would attract their attention.

Step 5: If you have video recording equipment available give students the opportunity to record and view their PSA. If recording facilities are not available just have the students present their announcements in front of the class.

Step 6: Ask students to constructively critique their peers' announcements. Did they learn something that they didn't know? Was the species and it's impact fully explained? Was the advice on preventing the spread of an exotic species clear and concise? Were the students able to get all of the necessary information across in a 60-second PSA? What additional information might they have been able to convey with more time?

Extensions: Have the students research exotic species in your area. How do they impact the local ecosystem? What can they do to help control these exotics? Are there local environmental programs already in place where they might volunteer?

Some Exotic Species Affecting the Great Lakes:

- Round Goby
- Sea Lamprey
- Rusty Crayfish
- White Perch
- Flowering Rush
- Curly Leaf Pondweed
- Zebra Mussel
- Ruffe
- Spiny Water Flea
- Eurasian Milfoil
- Purple Loosestrife

This shopping cart was left in zebra mussel-infested waters for a few months. The mussels have colonized every available surface of the cart.

Problem or Solution?

ACTIVITY 8

Great Lakes Region Organization and Utilization Project

BUDGET MEETING !

Introduction: This activity will provide students a chance to analyze and debate Great Lakes environmental issues.

In The Great Lakes Story Exhibition:

- *Top Ten Great Lakes Environmental Concerns*: See what environmental challenges face the Great Lakes basin.
- *How to Renew the Great Lakes*: Balance threats and solutions to renew the chemical, biological and physical integrity of the Great Lakes.
- *Great Lakes News Update*: Log onto the Web site to read up-to-date articles on the state of the air, water and soil of the Great Lakes region.

Key Concepts:

- Public speaking skills
- Relationship of science, technology and society

Background: Much work has been done to restore the Great Lakes. However, approaches to Great Lakes restoration are not always agreed upon. Different groups have different ideas about what the primary issues are concerning the lakes. Fishermen are concerned with the impact that exotic species will have on their favorite sport fish. Tourists may be concerned with the impact that pollution will have on parks and swimming areas. Each group tries to have their voice heard. This activity allows students to choose, research, analyze, discuss and debate specific environmental concerns and offer possible solutions.

Materials:

- Computers with Internet access to research the topic
- Paper and pencil

To Do:

Step 1: Divide the class into teams. Assign each team one of the environmental concerns.

Step 2: Each team will research their assignment and prepare a proposal presentation to the budget committee. The purpose of the presentation would be to convince the committee of the importance of the issue and the need to continue funding efforts. Remind students that more creative and well-researched presentations may have a better chance for funding.

Step 3: Arrange for a group of 3 judges to attend the presentations and make the decisions concerning funding. (Choose the 5 presentations most worthy.)

Extensions: Visit a local environmental project in your area and attend a meeting of an environmental organization in your area. Were the issues discussed relevant to the students? Did they gain a greater awareness of issues that impact directly on them and their community?

Top Environmental Concerns:

- Acid Rain
- Agricultural Contamination
- Climate Change
- Eutrophication
- Exotic Species
- Garbage and Waste Reduction
- Heavy Metal Contamination
- Indoor Air Pollution
- Industrial Emissions
- Loss of Species Diversity
- Ozone Hole
- Physical Changes to Environment and Landscape
- Toxic Chemical Contamination
- Urban Sprawl
- Water Pollution

Just Add Water

Aquatic Overload

Objectives: This activity demonstrates how fertilizers in the form of agricultural runoff can cause algal blooms. Algae may grow and upset the natural environment for aquatic life.

To Do:

Step 1: Fill two jars or fish bowls with water and place a water plant in the bottom. NO FISH.

Step 2: Place the jars in a sunny spot and add an amount of plant food to one jar.

Step 3: Wait a week and add more plant food.

Step 4: Monitor the changes in the water and the plants. Discuss how runoff from farms and fields can increase algae growth in the lakes causing algal bloom. Algal bloom decrease oxygen levels needed by other forms of aquatic life.

The Acid Test

Objectives: Acid rain can play a part in upsetting the Great Lakes ecosystem. Acid rain changes the pH of the water, and may alter reproductive cycles as well. Students will see how acids affect the shell of an egg.

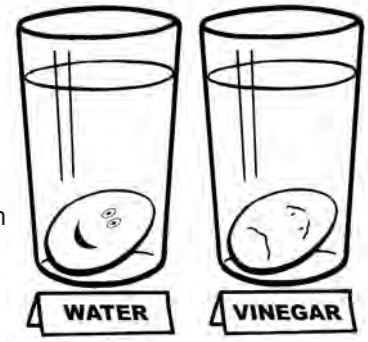
To Do:

Step 1: Fill two glass jars, one with vinegar and one with tap water.

Step 2: Label the jars. Test the pH of both.

Step 3: Place a hard-boiled egg in each jar.

Step 4: Over the following days observe and record all changes and observations. Try coins and leaves. Research and discuss how acid rain might affect the environment.



Traveling Trash

Objectives: Students will achieve a better understanding of how pollution can travel through the air from one place to another.

To Do:

Step 1: Place a clean bucket half full of water in an outdoor open place.

Step 2: Leave it for a week.

Step 3: After a week pour the water through a fine mesh screen, a clean leg of nylon pantyhose works well. Turn the pantyhose leg inside out over a large sheet of white paper, spread out the remains and examine them with a magnifying glass.

Step 4: Discuss the debris that has traveled into your water supply. Are there natural and human-made products in this water? Are there pollutants in the water? How could the water supply be affected? Discuss how it might affect a large body of water. Try placing the bucket near a busy street or near the exhaust fan for the school. What did you discover? Did the debris change?

Particulate Pollution

Objectives: Students will learn how airborne particulates from industry and motor vehicles can travel over large areas and be deposited in lakes, rivers, streams, forests and wetlands.

To Do:

Step 1: Take an empty paper towel roll and an empty toilet paper roll, cover one end of each with a piece of aluminum foil.

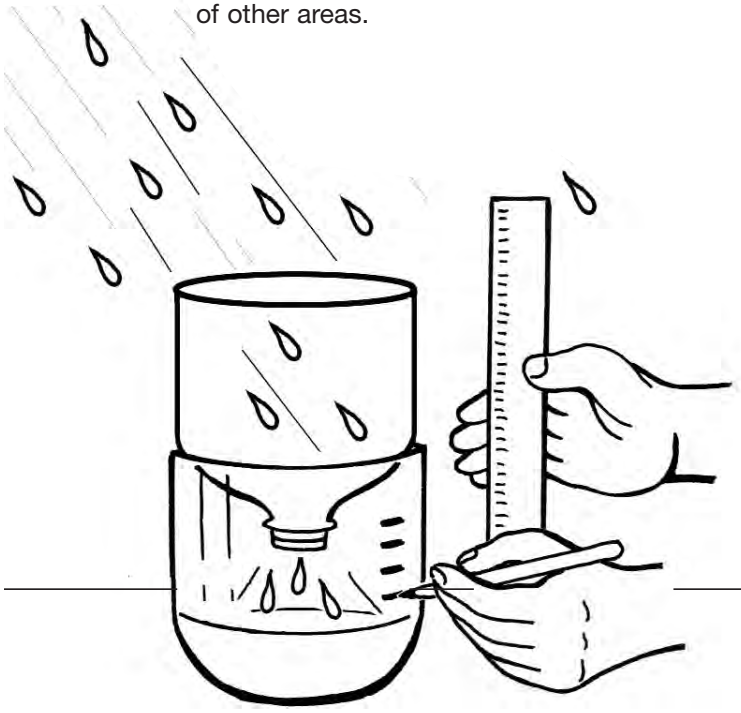
Step 2: Stand them on their uncovered end atop a large sheet of dark-colored fabric or paper. The tubes represent smoke stacks from industry.

Step 3: Place a teaspoon of flour on top of each stack in turn and blow the flour off of the stack.

Step 4: Discuss how the height of the stacks affects the distribution of the pollution. Did it vary? Discuss your results. Why is it important for industry to install emission control devices? What would happen to surrounding communities?

Rain Gauge

Objectives: Students will achieve a better understanding of rainfall amounts in your area. They will also be able to compare the rain amounts collected in your area to those of other areas.



To Do:

Step 1: Cut an empty two-liter plastic soda bottle into two pieces. The base should measure seven inches in height.

Step 2: Using a ruler and a permanent marker indicate each ¼ inch measurement up the side of the base of the bottle.

Step 3: Invert the second piece of the bottle and place it inside of the base, so that it resembles a funnel (the funnel helps reduce evaporation). Place it outside and measure rainfall over a period of time.

Step 4: Discuss the difference in precipitation levels in other seasons. How might seasonal changes affect lake levels?

Glossary of Terms

Acid Rain: A form of precipitation that has a pH lower then 5.7. Acid rain may be in the form of rain, as the name implies, but acidic snow is also possible. Acid rain may be caused by a variety of man-made sources, particularly the burning of fossil fuels, or by natural sources, including sulfur emissions from volcanoes and geysers.

Algal Bloom: Very high densities of algae in areas of high concentrations of nitrogen-containing compounds, primarily untreated agricultural runoff.

Aquifer: A subsurface zone that yields economically important amounts of water. An aquifer may be porous rock, unconsolidated gravel, fractured rock or cavernous limestone.

Basin: A depression in the Earth's surface filled with water and drained by rivers and their tributaries.

Biodiversity: A measure of distinct characteristics, qualities or elements of different species of plant and animal life in a defined area.

Biomagnification: The process of certain substances such as pesticides or heavy metals in rivers or lakes increasing in concentration within the internal tissues and organs of aquatic life.

Brownfields: Abandoned, idled or under-used industrial or commercial facilities where expansion, redevelopment or reuse is complicated by possible environmental contamination.

Climate: Weather that is experienced by a geographic location over a long period of time.

DDT: Dichloro-diphenyl-trichloroethane – an insecticide used widely after World War II to kill flies, aphids, mosquitoes, and a variety of lice. DDT may build up in the fatty tissue of mammals and birds negatively affecting reproduction and was banned in the United States in 1973.

Dead zones: Oxygen-poor areas of lakes with sparse plant and animal life.

Ecosystem: A complex system composed of a community of organisms interacting with each other and the environment.

Endangered Species: Any species of wildlife naturally occurring in a designated area whose prospects of survival are affected negatively due to a loss of habitat, over utilization or other natural or man-made factors.

Eutrophication: The natural aging process of lakes where water becomes enriched in dissolved nutrients. This stimulates the overgrowth of aquatic plant life and results in the depletion of dissolved oxygen. This process can be accelerated by agricultural runoff.

Groundwater: Water beneath the Earth's surface, often between saturated soil and rock, that supplies wells and springs. See also aquifer.

Indigenous: Native plants and animals in a particular environment or region.

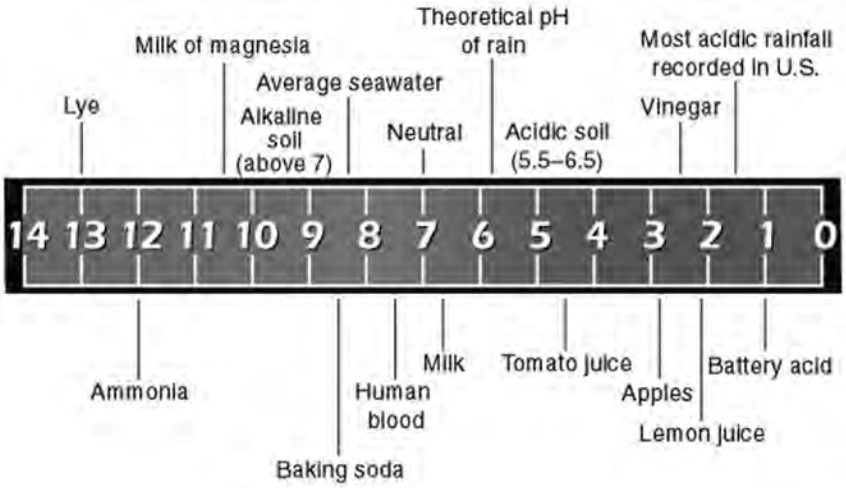
Isostatic Adjustment: Up- or down-warping of the Earth's lithosphere to accommodate for mass being added or removed.

Nonindigenous: Plants and animal life that are not native to a particular area. See also indigenous.

Particulate Matter: Material suspended in a fluid, such as air or water, in the form of minute solid particles or liquid droplets, especially when considered as a pollutant.

PCBs: Polychlorinated biphenyls – chemical compounds having various industrial applications that are poisonous environmental pollutants which tend to accumulate in animal tissues. The Toxic Substances Control Act (TOSCA) banned the manufacture, processing and distribution of PCBs.

pH: A number used in expressing acidity or alkalinity of a substance. The number represents the hydrogen ion concentration by inverse* logarithm** on a scale 0 to 14 with 7 being neutral. High hydrogen ion concentrations are found in strong acids, and low concentrations are found in strong bases (alkali).



The pH of various common substances. Image found at http://sjr.state.fl.us/

**Because the scale is inversed, numbers of decreasing pH represent increasing concentration of hydrogen ions, and therefore increasing acid strength/decreasing base strength. The pH numbers 0-6 represent acids, and the numbers 8-14 represent bases.*

***Because the scale is logarithmic, each number step represents a 10x change in concentration. A pH of 6 represents 10x the concentration of hydrogen ions as a pH of 7. A pH of 0 represents an acid that is 10,000,000x stronger then a neutral solution.*

Glossary of Terms (Cont.)

Phytoplankton: Photosynthetic, microscopic, aquatic plant life.

Pollution: The contamination of soil, water, or the atmosphere by the discharge of harmful substances. Also, something that pollutes.

RAP: **R**emedial **A**ction **P**lan – a guide to restoration and protection efforts within a specific *AOC* (Area of Concern) in the Great Lakes Region.

Sediment: Fragments of organic and inorganic material derived from erosion and weathering of soil and rock materials transported by wind, ice, and water.

TFM: 3-trifluoromethyl 4-nitrophenol – a selective lampricide used to suppress sea lamprey populations in the Great Lakes.

Tributary: A stream or river flowing into a larger stream, river or lake.

Water cycle: The circulation of water in nature. Moisture evaporates from bodies of water, condenses, precipitates, and eventually returns. Also called the hydrologic cycle.

Watershed: A region of land that is crisscrossed by rivers, creeks, and streams that flow into a larger body of water.

Wetland: A vegetated ecosystem where water is a dominant factor in its development and existence such as swamps, bogs, fens, marshes and estuaries. Wetlands protect the shorelines of rivers and lakes from erosion and help control and reduce flooding.

Zooplankton: Floating and drifting microscopic aquatic animal life.

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Web Sites

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U.S. Environmental Protection Agency
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Great Lakes Commission www.glc.org

Great Lakes Fishery Commission
www.glfc.org

Center for Great Lakes Environmental Education
www.greatlakesed.org

TEACH Great Lakes the Education and Curriculum Homesite
www.great-lakes.net/teach

Illinois-Indiana Sea Grant College Program www.iisgcp.org

International Joint Commission
www.ijc.org

The Great Lakes Historical Society Inland Seas Maritime Museum
www.inlandseas.org

Ontario Federation of Anglers and Hunters www.invadingspecies.com

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