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Pollution in Lake Erie: An Introduction

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TEACHER GUIDE

OEAGLS-Oceanic
Education
Activities
for
Great
Lakes
Schools

OEAGLS Investigation #8

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TEACHER GUIDE

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TEACHER GUIDE

POLLUTION IN LAKE ERIE: AN INTRODUCTION

by
Carole P. Basehore and Rosanne Fortner
Ohio Sea Grant Education Program

OVERVIEW

Activity A is designed to present factual information about the types of water pollution in Lake Erie and their general effects. At the same time, information is given on how to read materials skillfully in order to benefit most from them. Students practice a given reading strategy and then test their new skill by answering questions based on the material read. In Activity B students analyze reading materials to try to determine the truthfulness and possible value of what is read.

PREREQUISITE STUDENT BACKGROUND

Reading ability on level of grade 5 or above.

MATERIALS: Articles "So Long, Lake Erie" and "Lake Erie" (both included in Student Guide), pencil or pen.

OBJECTIVES

When students have completed these activities they should be able to:

1. Read science articles more skillfully by
 - a. recognizing the main topic discussed,
 - b. recognizing the subtopics discussed, and
 - c. organizing under each subtopic the details relating specifically to it.
2. Read science materials critically by
 - a. determining who wrote the article and when,
 - b. separating facts from opinions,
 - c. recognizing emotional or persuasive language, and
 - d. weighing evidence for conclusions.
3. Identify major sources of pollution in Lake Erie.

4. Determine how Lake Erie's polluted water has affected plants, wildlife and people who depend on it.

SUGGESTED APPROACH

Activities A and B are most effective if done by individual students and then followed by class discussion of results.

There are two good 16 mm films that relate to this topic. Either could serve as an effective introduction or follow-up, but because of overlapping content, the use of only one film is recommended. The Aging of the Lakes (13min., Encyclopedia Britannica Films, 1971) defines and documents the myriad pollution problems faced by lakes in general. The generalizations about lake problems are brought home to the Great Lakes in such examples as the description of Chicago's efforts to combat pollution, and the mention of thermal pollution, especially on Lake Michigan. This is a short, factual introduction to pollution problems without a "gloom and doom" approach. The Great Cleanup (54 min., U.S. Environmental Protection Agency/Environment Canada, 1976) provides a brief history of events leading up to the agreement between U.S. and Canada to clean up the Great Lakes. It presents the pollution problems and shows what is possible by way of solutions. The film comes on two reels and may be too long for classroom use.

Note: Information to teachers is enclosed in boxes in this guide.



POLLUTION IN LAKE ERIE: AN INTRODUCTION

by
Rosanne Fortner and Carole P. Bashore
Ohio Sea Grant Education Program

INTRODUCTION

Lake Erie has always been a valuable resource for the State of Ohio. Within the past 20 years there has been concern that the lake may be dying because of the effect of human activities. Could we lose this resource one day because of pollution?

In this activity you will study problems associated with water pollution in Lake Erie. The activity will also help you develop strategies for reading science articles skillfully and critically.

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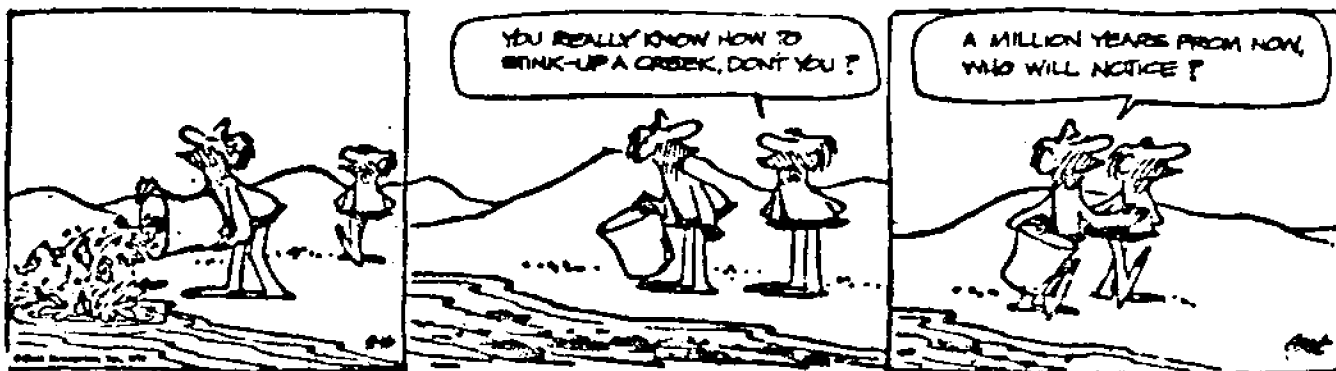
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By Johnny Hart



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and Field Enterprises, Inc.

OBJECTIVES: When you have completed these activities, you should be able to:

1. Read science articles more skillfully by
 - a. recognizing the main topic,
 - b. recognizing the subtopics, and
 - c. organizing related information under each subtopic.

ACTIVITY A: HOW SKILLFULLY CAN YOU READ A SCIENCE ARTICLE?

Keywords: pollution, eutrophication

The following article introduces you to the sources of pollution in Lake Erie. For the article to accomplish its task, however, you must be sure to read the material skillfully.

Here is a tip to help you develop a strategy for reading.

A. The article discusses three major ideas. You can identify these ideas by picking out key terms in paragraphs 1, 6 and 9. Paragraph 1, for example, could be condensed into the main idea "People and Industries Killing Lake Erie." That gives you a clue about what to look for in the first section -- HOW are people and industries killing the lake?

B. See if you can condense the first sentence of Paragraph 6 and all of Paragraph 9 so that you have the main ideas for the sections that follow those paragraphs. Answer on your worksheet.

For younger students it may help to have the class as a group identify the main ideas in paragraphs 1, 6 and 9.

- A. Paragraph 1 is used as an example, condensing it to say "People and Industries Killing Lake Erie."
- B. Paragraph 6 introduces the effects of pollutants on the lake.
- C. Paragraph 9 begins a section on what is being done about the problems.

C. Read the entire article with the ideas of each section in mind. Try to find explanations for and details about the key statements you have found.

D. When you finish reading and feel confident that you have grasped the major ideas, turn to page 5 answer the questions. This is a way of self-checking your reading skills.

With the three sub-headings in mind, students should be able to read skillfully enough to at least know where to find the answers to the questions given. Many questions are rather specific, so allow the students to look back at the article if they need to.

QUESTIONS

After reading the article, you should have an idea of the major sources and types of pollution in Lake Erie and the general effects these have on the lake and its inhabitants. Before going on, be sure you have understood the major ideas in the article. Test yourself by answering the following questions on your worksheet.

1. List ten major sources of pollution for Lake Erie's waters.

T1. Ten major sources of pollution in Lake Erie:

1. sewage
2. poisonous chemicals from agriculture, industry
3. soil from erosion
4. power plants (thermal pollution)
5. spoil from dredging
6. industries (toxic materials, oil, acids)
7. boat wastes
8. trash
9. radioactive materials from atomic power plants
10. phosphates from fertilizers and detergents

2. The authors of the article "So Long, Lake Erie," noted that approximately 360 industrial companies discharge their wastes into the lake. From the article, identify the types of substances that make up industrial waste. You may use some of the same answers you found for question 1.

T2. Industrial wastes include acids, oil, cyanide, iron, phenol, toxic metals and poisonous chemicals from pesticides and from plastics and chemical industries.

3. List six ways that pollution in Lake Erie has decreased the lake's value.

T3. The lake's value had decreased in these ways: using up oxygen in the water, stimulating the growth of water plants, killing organisms, preventing sunlight from penetrating the water, causing fishing industry to decline, and making people sick. Students may infer other effects or offer personal experiences that should be discussed as additional answers to this question.

TRUE MURDER STORIES

SO LONG, LAKE ERIE

The killing of Lake Erie is a mob job - the combined efforts of some 11 million people who live near its shores and along the rivers and tributaries that empty into it. They are being aided and abetted by 360 industrial companies that discharge their wastes into the water.

Nine million people in the area are served by sewers and sewage treatment plants, but more than half of the plants give only primary treatment; that is, they strain out the solids and sludge, and then pump out the rest of the liquid without further treatment into the nearest waterway. Two million people live without sewers at all and discharge their raw wastes directly into the rivers and the lake. Thus sewage is one of the main sources of pollution in Lake Erie.

Giant industries discharge 9.6 billion gallons of water a day into the lake and its rivers, much of it contaminated with dangerous and filthy pollutants. These include acids, oil, cyanide, iron, phenol, and toxic metals such as copper, cadmium, chromium, lead, nickel, zinc, and iron. Poisonous chemicals enter the water from pesticides off agricultural land and from plastics and chemical industries. Phosphates pour in from fertilizers and detergents.

Also, power plants contribute thermal pollution to the water. And the radioactive content of the lake is rising, partly from the increasing numbers of atomic power plants being built along the shores.

Other pollutants in the lake include oily wastes, fish entrails, and human excrement from commercial and pleasure boats. In addition, spoil from harbor dredging - 6 million cubic yards each year - is dumped into the middle of the lake. Soil particles picked up from eroded land areas and from highway and urban development also clog the water. Trash and debris are widespread at all depths of the lake.

All of these pollutants have varied effects on Lake Erie. Some use up the oxygen in the water when they decay. Others overstimulate the growth of the underwater plants, leading to accelerated eutrophication, so that even more oxygen is lost. Some pollutants are poisonous, killing plant life, microorganisms, and the fish that feed upon them. And the decay of all this matter causes even more decomposition and loss of oxygen. Other pollutants color and obscure the water so that the sunlight cannot get through, causing the death of organisms that depend on sunlight. The inevitable result, if the pollution of Lake Erie continues, is a dead lake - water that is of no value to man or animal.

Eighty-seven beaches on Lake Erie were closed down by 1968. Commercial and sport fishing declined disastrously, and now there are restrictions on the sale of fish caught in Lake Erie because they are so contaminated. Some species of fish have disappeared altogether. Ships are prohibited by the Public Health Service from taking drinking water out of the lake unless they are equipped to give it full cleansing treatment. In Cleveland, the inadequate sewage treatment system is allowing raw sewage to contaminate the residents' own drinking water. A doctor in the area made tests which showed that there were dangerous germs in water that had sat in the pipes overnight. He regularly treats patients for vomiting and diarrhea after they have drunk water or eaten food out of the lake.

Erie is a tough little lake. Because it receives a high volume of good quality water from Lake Huron and empties out vigorously over Niagara Falls, it has a rapid flush-out time. This helps to replace the polluted water with cleaner water. But the attacks upon Lake Erie are now so strong and so unceasing that little hope remains for its survival.

The forces of law and conservation are making rumbling noises, threatening to take action against the industries and cities that are the major polluters. But they are going to have to move fast, enforce the spending of vast amounts of money, and do a major clean-up in record time if Lake Erie is to be saved.

In 1970 federal investigators reported that most cities and some industries were falling far behind pledges they had made earlier to clean the water that flows into Lake Erie. The federal government also was accused of failing to provide the money it had promised and of failing to clean the waste waters under its own control.

From POLLUTION: THE WATERS OF THE EARTH by Claire Jones, Steve J. Gadler, and Paul H. Engstrom, © 1970 by Lerner Publications Company, Minneapolis, Minnesota. Used by permission of the publisher.

4. From your understanding of what you read in the article, describe the water of Lake Erie and the conditions of life within the lake.

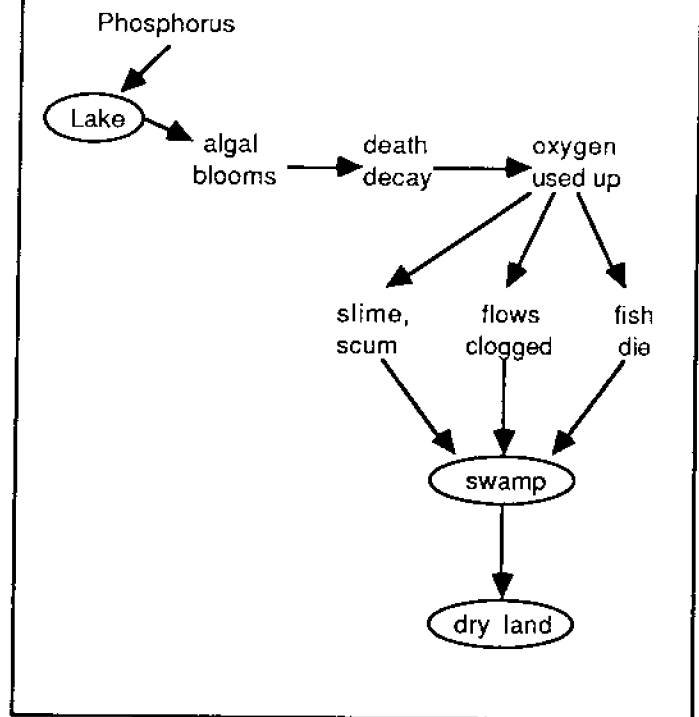
T4. Answers will vary based on student maturity and understanding of the materials. Be accepting and discuss all possibilities with the class.

The article mentioned that one of the major effects of pollution on Lake Erie was "eutrophication." To better understand eutrophication, read the next paragraph from the book Water Wasteland, by David Zwick and Marcy Benstock. Remember to first identify the general statement that will give you a clue as to what kind of information to expect in the reading.

"Phosphorus stimulates the growth of algae and aquatic weeds in fresh-water lakes and rivers. Sudden and massive algal growth (called blooms) appear in many American waterways in early spring and summer. They are ugly growths, but the problem is not solely aesthetic. These blooms age a body of water as they die and decay. Oxygen and other resources are exhausted in the oxidation of large amounts of dead organic matter. Slime and scum appear, flows are clogged, and the water is unable to support fish or other normal life forms. This natural aging process, by which lakes and rivers turn to swamps and then dry land over the course of centuries, is called eutrophication. When phosphorus and other nutrients for algal growth pour into our lakes and rivers from municipal and industrial wastewater and from urban and agricultural runoff, the natural aging process is speeded up, often many hundreds or thousands of times. Lakes and rivers "die" an early death from over-enrichment, overblooms, and what might be called overkill in the algal life cycle."

5. Using the information from this paragraph, construct a chart which shows the events, in order, which take place in eutrophication.

- T5. Eutrophication chart (may vary in form, but should include all major parts):



6. From the chart and the article, do you think that Lake Erie is dead? Explain your answer.

T6. From this chart, it appears that Lake Erie is not dead. It supports life, does not have large amounts of slime and scum, its flows are not clogged and it does not show evidence of turning into a swamp. The lake is, however, living much too rapidly.

ACTIVITY B: HOW CAN YOU BECOME A CRITICAL READER?

Young readers tend to accept what they read in the news media or see on television as being completely true. Conflicting accounts are confusing to them, because they often lack the ability to discriminate between facts, exaggerations, and falsehoods. They have little experience upon which to base their judgements, so they accept the opinions of "experts."

Do you believe everything you hear or read? Certainly not. You probably have some sources of information that you trust completely, though--the television news reporter, the front page headlines, or maybe a teacher who seems to know a great deal about a lot of things. You feel that what these sources report must be true.

Whenever you read or hear something, you react to it in some way. Whether you are aware of it or not, you make a decision about accepting or rejecting the information. You may also decide, based on how important or interesting the information seems to be, whether to try to remember it.

Speakers and writers sometimes take advantage of people by trying to make them react in a certain way. By using certain words or tones of voice, they try to persuade us that what they are saying is true. For instance, the article "So Long, Lake Erie" paints a bleak picture of Lake Erie's future. While scare tactics are not really an approved method of getting people's attention, sometimes they do just that. In the late 1960's for example, WBBM-TV in Chicago aired a special called "Too Thick to Navigate, Too Thin to Cultivate," exposing Great Lakes pollution problems. NBC News followed with a special documentary on "Who Killed Lake Erie?" Coming as they did during a growing environmental movement, these and other doomsday reports served to draw our country's attention to lake problems.

Under public pressure, some industries and communities eventually corrected some of the bad things they were doing to the lakes. The Great Lakes still need help, but those who accuse are expected to offer suggestions along with their criticisms.

PROCEDURE

In order to become a critical reader, one who can determine the truthfulness and possible value of what is read, you have to look carefully at every word of the writer. You should try to:

- avoid quick judgements,
- sort out arguments and
- weigh evidence.

Look back at the "So Long, Lake Erie" article and answer these questions on your worksheet.

The questions for article analysis were taken from Thomas and Robinson's "Check List on Critical Evaluation" (see Robinson reference, page 12.)

For students to answer the questions it will be necessary to supplement the Student Guide with your own guidance and information from the Teacher Guide.

1. When was it published? What was happening in this country at that time? Have conditions changed since then?

T1. 1970. The article was a part of the "alarmist" phase of environmental protection. People were actively pointing out how bad the conditions of the environment had become. NBC's "Who Killed Lake Erie" came in late 1969, for example. Conditions have improved greatly since then. Recognizing its mistakes, society has determined to correct many of its abuses to the environment.



Read "About the Authors" below.

About the Authors

Pollution: The Waters of the Earth is one of eight books on pollution written by Claire Jones, Steve J. Gadler, and Paul H. Engstrom. This volume was a cooperative effort, each person contributing his or her own knowledge and experience with the final result a kind of "literary synergism."

Paul H. Engstrom is a minister, a lawyer, and a family counselor, as well as president and cofounder of the Minnesota Environmental Control Citizens' Association. Under his leadership, MECCA has worked for preservation of Lake Superior and the Mississippi watershed, reduction of radioactive pollution, reuse of materials in solid waste, and many other environmental goals to improve the quality of life. Thus Rev. Engstrom's major contribution to this series of books on pollution was a social and legal perspective resulting from direct experience.

Steve J. Gadler also is experienced in the fight to save the environment; he is a registered professional engineer who was an environmentalist long before pollution became a national issue. A retired Air Force Colonel, Mr. Gadler has for many years been asking pertinent, revealing questions about the damage caused by our industrial society. He has been especially concerned about radioactivity, which is an invisible but deadly threat to life itself. In 1967, the governor of Minnesota appointed him as a member of the state's Pollution Control Agency. Mr. Gadler's technical expertise is apparent in each book in the series.

Claire Jones is an experienced writer who first became aware of the dangers of pollution in 1956, when she lived through one of the famous London killer smogs. Teaming up with Rev. Engstrom and Mr. Gadler gave her an excellent way to express her concern over the condition of the environment. However, her contribution had been more than a concerned citizen's point of view and a crisp, sparkling writing style. A native of England, Mrs. Jones brings a special international outlook to this series. None of the problems of pollution can be seen as less than worldwide, and this important perspective gives *The Waters of the Earth* added value.

2. Who wrote the article? What qualifies the authors to write about the subject?

T2. The authors were mainly concerned citizens. Their professional training did not involve any preparation for serving as water pollution experts.

3. Does the article state opinions or facts? How did you decide?

T3. It appears that the article states facts. There are no words that indicate an opinion is being stated, like "it seems," "probably," and such.

There are some parts of the article that have no basis in fact. For instance, radioactive materials have never been a problem in Lake Erie, and the number of nuclear power plants along the shore is not increasing. Since the article does not have a list of references at the end, it is impossible to discover where such ideas originated.

4. What are the writers' conclusions? Does the article have evidence that supports the conclusion?

T4. From Paragraph 8 --"the attacks upon Lake Erie are now so strong the little hope remains for its survival." The article has evidence that points to this conclusion. There are glimmers of hope, as in Paragraph 9, but they are quickly extinguished by more pessimistic reports.

5. Does the article use words designed to persuade your thinking? If so, list three or four of these words or groups of words.

T5. Yes. Some persuasive terms used are: disasterously, raw wastes, dangerous and filthy, a mob job, and so forth.

6. Is there information that conflicts with what this writer has said? What is the source of the conflicting information?

T6. Yes. See the James Barry article. Barry is a respected writer on Great Lakes topics. The article is published as an official statement from the Ohio Environmental Protection Agency.

The following article is a shortened form of a booklet prepared by the Ohio Environmental Protection Agency in March 1980. Read this section skillfully and critically, then look back at your answer to Question 6 above.

LAKE ERIE

by

James P. Barry*

Introduction

Lake Erie is one of the best known bodies of water in the country. It is well known in a negative way--nearly everyone has heard that the lake is badly polluted. That is certainly true. But many things that have been written or said about Lake Erie are not true. The lake is not a swamp, it is not dying, it is not without fish. There are places where it is beautiful, there are places where you can go swimming, and the fish catch is reaching record proportions. At the same time, the lake has many problems. This article will tell you what some of them are, how they developed, and what we can do and are doing about them.

What Happened to the Lake

As our country grew, all the things that people did on the land also affected the lake. When forests were cleared for farming, the land itself often washed into the lake; The Maumee River which flows into the western end of Lake Erie carries silt all the way from Indiana farmlands and piles it on the bottom. And as cities grew around the lake, their sewage and factory wastes were usually piped directly into it or into the rivers flowing to it.

By 1970 nearly everyone saw what bad condition the lake was in. It had many problems caused by oil and industrial chemicals. But the worst problems were caused by sewage, by fertilizer that washed off fields, by other material acting as nutrients to the algae and other tiny plants in the water causing them to grow. Eutrophication is the process of aging and it is speeded up if people pollute or partly fill in a lake of normal size. People have certainly polluted Lake Erie, and in a sense they have partly filled it in by causing silt and sediments to wash into it. This action has caused the kinds of plants and fish to change and the numbers of them to increase. So to some extent, Lake Erie has been affected by this aging process of eutrophication. This fact has caused some people to say that the lake is dying, but Lake Erie is so large that the rules pertaining to smaller lakes do not fully apply to it. If we continue polluting the lake over a long period, eutrophication could pose a serious threat. But today many of the ways we have damaged the lake can still be corrected, and a number of things are now being done to correct them.

What Is Being Done

The material that causes the most trouble in Lake Erie is phosphorus, for it is the phosphorus in sewage, in fertilizer washing in from the fields, and in other sources that feeds the algae and makes them grow. (Sewage contains phosphorus both in human wastes and in the great amount of detergents that we use for washing and then drain into our sewage systems.) Perhaps the next biggest problem comes from bacteria that can cause disease. When they are in water, swimming can be dangerous and beaches must be closed.

Much of the phosphorus and most of the dangerous bacteria come from sewage, and so the first thing that was done to help the lake was to build more sewage treatment plants and to make the old plants better. Hundreds of millions of dollars in federal grants (administered in Ohio by the Ohio EPA) were given to towns and cities for their treatment plants. Cleveland, for example, has a treatment system that serves over 1,280,000 people in Cuyahoga County and that was first built many years ago to take care of far fewer people. There are three treatment plants in Cleveland. Both the network of sewer lines and tunnels running to these plants, and the plants themselves, are being rebuilt and improved. The work will continue over several years and will cost about \$500 million. Similar programs are going on in towns and cities all around Lake Erie. The main purpose of all this work is to keep phosphorus and disease germs out of the lake now and in the future.

Another important kind of pollution comes from toxic substances. These range from pesticides that were used on farms and orchards and then washed into the lake to chemicals drained into the lake by industry. These substances can kill or deform fish, birds, and other animals, and also can be carried in the flesh of animals that seem healthy. A person who eats such a fish or bird or muskrat can absorb some of the poison and may be affected by it. Most of the dangerous pesticides have now been banned by law. Another poison, mercury, is no longer being drained into the lake and may, in time, gradually disappear from it.

There are other poisons in the water and in the mud on the bottom, but the chemicals called PCBs seem to cause the most problems today. They have been used in making a great number of items for the past forty years, and so they not only are in the bottom mud but also, things made of them are at many locations around the shore, where rain and snow can wash over them and carry PCBs to the lake. And PCBs are still used in some manufacturing. Ways of controlling them are being studied, and the U.S. and Canadian governments have passed or are in the process of passing laws that limit their use.

The Situation Today

Lake Erie is still polluted, but the flow of pollution into the lake is slowing. Today the lake is at a point of balance; in years when the water level is high and more water flows through the lake, diluting and washing out the pollutants, it gets better, but in other years it does not. At certain places around the shore, however, the water is definitely better than it was. There are places where new or better sewage treatment plants have been built, or where other local action has been taken to stop pollution. As one result, most of the beaches that were closed because of pollution have been opened again. And walleye, one of the preferred kinds of fish, is coming back to the delight of hundreds of sport fishermen. But we must keep working to repair the damage we have done to the lake. There are still significant problem areas that remain to be corrected. The cost of cleaning it up is not great if we think in individual terms. Experts believe that to clean up the lake it would cost each person living on its shore, each year, about the same amount as a carton of cigarettes or a day's food. That is a price we can afford to pay for Lake Erie. What we must do now is get together and do the job.

*James P. Barry is an author and photographer who specializes in Great Lakes subjects. He made his first voyage on a lake freighter at the age of eight, graduated from The Ohio State University with distinction, and has written ten books, half of them dealing with various aspects of the Lakes.

This article was adapted from a pamphlet prepared for the Ohio Environmental Protection Agency, March 1980.

7. Turn back to the Procedure. On your answer sheet, answer Questions 7a-f, this time about the James Barry article.

T7. Answers will vary. Discuss reasons for different answers.

8. Which article do you place more confidence in? Why?

T8. Students should place more confidence in the Barry article because of its recency and its sponsorship by the Ohio Environmental Protection Agency. Also, it is written in a less dramatic and more factual tone. It is no less impressive in its message, but it is much more rational.

9. Summarize what you believe to be the present condition of Lake Erie.

T9. Answers will vary. The present condition of the lake is much improved in this decade, and continued improvement is expected, especially in phosphorus levels.

10. One of the most valuable things you can do to become a skillful critical reader is to read widely from all kinds of books, magazines and newspapers. Why?

T10. If the students had read only the first article they would have a distorted impression of the Lake's condition. Only by exploring many views on a problem can a person build an informed opinion.

NOTE: The appendix to this guide is a fact sheet from Ohio Sea Grant. It will help bring you up to date on Lake Erie's condition.

By this time students should be able to discuss how public opinion can be swayed by one-sided arguments and how important it is to not only read skillfully but interpret carefully. You may want to use the following editorial cartoon as a focus for such a discussion.



Dead Sea Scrolls

JUST FOR FUN
(ANSWERS)

T H E R M A L
P O I S O N S
I N D U S T R I E S
S U N L I G H T
C O P P E R

Riddle: "That's EUTROPHICATION."

REVIEW QUESTIONS

1. Historically, what are the major sources and types of pollution in Lake Erie?

R1. (Any four or five of the following should suffice.) Sewage, poisonous chemicals, soil, hot water, dredge spoil, industries, boat wastes, trash, radioactive materials, and phosphates pollute Lake Erie.

2. How have some of these problems been handled?

R2. People have recognized the problems and taken steps to clean up the lake and prevent more damage to it. Sewage treatment plants have been improved, and laws now prevent the dumping of industrial wastes.

EVALUATION

This activity is not designed to teach facts about pollution, but rather to develop particular reading skills. For this reason, no objective questions have been developed as an evaluation mechanism. Instead, we recommend that if specific evaluation is needed, you may use the actual answers students fill into the Student Guide blanks, especially in the Review Questions.

FOR FURTHER INVESTIGATION

Numerous references and activity guides about water pollution are available and most biology and life science textbooks include sections related to this topic. Take care to select recent works for accurate presentation of the ideas.

If interest in water pollution is high, consider making a study of a nearby lake or stream during the course of a year. Basic physical and biological characteristics can be determined using standard equipment available in most school laboratories, and water analysis can become fairly sophisticated if you use a test kit such as those marketed by scientific companies.

For reviews of historic water pollution incidents, consult the Reader's Guide to Periodic Literature. Some references you may be interested in for their photographs and general information are:

Keerdoja, E. "Pollution postscripts" (Minamata disease and Kepone poisoning) Newsweek 89:12. April 4, 1977.

Mitchell, J. G. "Corporate responsibility in Silver Bay" (Reserve mining company's pollution of Lake Superior), Audbon 77:46-61. March 1975.

3. Was Lake Erie dead? What is the present condition of the Lake?

R3. Lake Erie was never dead. The present condition of the lake is much improved. Beaches are open, fishing has improved, and phosphorus levels are down. Pollution input has slowed, but careful monitoring and continued concern are still needed.

4. List three things you should look for in something you read to tell if it is worth believing.

R4. Look for opinion words and persuasive language, determine who wrote the article and when, and examine the evidence for conclusions that are drawn.

Smith, W. E. and A. Smith. "Mercury pollution ravages a Japanese village," Life 72:74-81. June 2, 1972.

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Lake Erie: Phosphorus and Eutrophication

by Jeffrey M. Reutter, Frank R. Lichtkoppler and Charles E. Herdendorf

Background

Lake Erie is biologically the most productive of the Great Lakes because it is the shallowest, the warmest and contains the most nutrients. Man's activities, however, have increased the rate at which these nutrients enter the lake, thereby accelerating the natural aging process known as eutrophication. This aging process, an evolutionary cycle that lakes go through, is a process by which lakes become marshes, then bogs, and finally, dry land.

Nitrogen and phosphorus, the most frequently discussed of all nutrients, enter the lakes from many sources. These nutrients within the lake act in the same fashion as fertilizers on lawns. The three major nutrients in fertilizer that help grass to grow are nitrogen, phosphorus, and potassium. Similarly, these nutrients in the water cause phytoplankton (microscopic plants or algae) to grow. This is important since phytoplankton represents the base of the food chain in lakes: zooplankton (microscopic animals) eat phytoplankton; small fish eat the zooplankton; and, large fish eat the smaller fish. The growth of algae or phytoplankton is often called primary productivity because it is the first step in the biological productivity of a lake. To a degree, the more algae produced, the more productive a lake will be. However, there are limits beyond which algal growth becomes detrimental to other aquatic life.

In addition to nutrients, all living things consume oxygen through respiration (i.e., breathing) and give off carbon dioxide. Through photosynthesis, a process which requires light, green plants are able to reverse this process by taking in carbon dioxide and produce more oxygen than they require to live. However, in the absence of light, photosynthesis stops.

Like other green plants, algae, in the presence of light, produce more oxygen than they consume. An algae population in a lake is important in at least two ways: they are the primary food source for other lake life and they produce oxygen which other lake life need to survive. At night, however, photosynthesis stops; and if an algae population is too large, it will use all the oxygen in the water through its own respiration. Algae can also indirectly cause a reduction in the amount of oxygen when they die because the bacteria which decomposes the dead algae require oxygen to accomplish this task.

Lake Erie has become enriched with nutrients such as phosphorus. As a result, these nutrients have caused huge blooms (sudden population explosions) of floating, blue-green algae and the attached green alga, *Cladophora* sp. These blooms often roll onto beaches in large mats resembling green steel wool. The blooms, reducing the amount of light penetrating the lake, also reduce oxygen production by photosynthesis and can cause severe oxygen depletion when they die and decompose.

Phosphorus has been shown to be a major nutrient in controlling the growth of algae. Phosphorus in Lake Erie is often the "limiting factor"--the nutrient in shortest supply. Since algae require all the basic nutrients for growth, their growth can be controlled by limiting any one of the nutrients. Phosphorus is the nutrient over which we have the greatest control.

Sources of Phosphorus

The entry of phosphorus into Lake Erie is usually categorized as being from point sources or non-point sources. Point sources are pipes, culverts or similar single points from which phosphorus is released. Non-point sources are just the opposite. Here the phosphorus enters lakes and streams from large, poorly defined areas such as agricultural fields, highways and parking lots. Point sources of phosphorus arise from the discharge of municipal and industrial wastewater. The major non-point sources are urban runoff, agricultural runoff, shoreline erosion and atmospheric deposition (precipitation).

Phosphorus enters Lake Erie in many different forms, not all of which are usable by phytoplankton. Therefore, reducing total phosphorus input is not as important as reducing the input of usable (bio-available or soluble reactive) phosphorus. It is also known that detergents, sewage and agricultural fertilizers are major sources of phosphorus in a form capable of stimulating the growth of algae.

Physical Description of Lake Erie

Lake Erie is surrounded by four states and two countries and is approximately 240 miles long and 57 miles wide. It is divided into three separate basins: a shallow western basin with an average depth of 24 feet and containing that water west of an imaginary line from Cedar Point to Pelee Point; a deep eastern basin at a maximum depth of 210 feet and containing all water east of an imaginary line from Erie, PA to Long Point; and a central basin with an average depth of 60 feet and containing all the water between the western and eastern basins.

Each summer, the warmer water rises and the cooler, heavier water settles to the bottom. Eventually the lake stratifies and two distinct layers of water form: an upper, warm layer called the "epilimnion" and a cool, bottom layer called the "hypolimnion." The narrow band of rapid temperature change between the two layers is called the "thermocline." The western basin is too shallow to allow two layers to form so there usually is no thermocline there. However, a strong thermocline does develop in the central and eastern basins usually at a depth of approximately 45 feet.

Once the thermocline is established, the two layers will not mix until the upper layer cools to the temperature of the lower layer in the fall. During this time of stratification, new oxygen cannot get to the lower layer because it is too deep to be affected by the wave action or to be penetrated by light (allowing photosynthesis and oxygen production to occur). Stratification is a natural occurrence in many lakes and usually only presents problems in eutrophic (very fertile) lakes.

Effect of Phosphorus on Lake Erie

Nutrients, primarily phosphorus, cause the huge algae blooms. As the algae dies and sinks to the bottom and is decomposed by bacteria, oxygen is consumed. During the summer, new oxygen cannot get to the cold, bottom water below the thermocline in the central basin because wave action does not reach deep enough and light cannot penetrate to these depths to allow photosynthesis. As a result, by the end of the summer, all the oxygen which was originally present in the spring and early summer has been used up by bacteria to decompose algae. As much as 90% of the bottom water in the central basin of Lake Erie becomes anoxic (devoid of oxygen) each summer. This has increased from approximately 10% in 1930. It was in these cold, bottom waters that the cisco and lake trout once lived. The loss of oxygen kills many of the aquatic organisms which live in the bottom sediment and are normally eaten by fish. The loss of oxygen also causes bottom-dwelling species, such as yellow perch, to move shoreward in search of more oxygen and food. This water remains anoxic until the upper layer of warm water cools in the autumn to the temperature of the cool, bottom water and then surface and bottom mixing occurs.

Most experts agree that by reducing the amount of available phosphorus entering the lake, algae populations would be reduced and the oxygen problem in the central basin would be slowly eliminated.

What is Being Done?

Efforts to reduce the amount of phosphorus entering Lake Erie are proceeding on three fronts: improved sewage treatment plants; no-till or reduced-till farming; and, the implementation of detergent phosphate bans.

Sewage Treatment. Increased capacity and improved sewage treatment is an ongoing effort throughout the Great Lakes states and Canada. A 1.0 milligram per liter (mg/l) phosphorus effluent target limitation has been established for municipal sewage treatment plants discharging more than one million gallons per day. Since 1967, Ohio treatment plants have reduced their average effluent concentration from 7.0 mg/l to about 1.5 mg/l.

No-Till Farming. No-till or reduced-till farming involves reduced cultivation (plowing) of the fields which reduces runoff and erosion. This practice requires the use of special equipment to seed the fields and to distribute herbicides for weed control. However, on certain soil types, some of which are present in northwest Ohio, this method is more economical than traditional cultivation. The use of this practice is currently increasing in 22 northwestern Ohio counties.

Detergent Phosphorus Bans. In the United States, all the Great Lakes states except Ohio, Illinois and Pennsylvania have legislative controls limiting the phosphorus content of laundry detergents to 0.5 percent by weight. Although Ohio and Illinois do not have state-wide bans, the cities of Akron and Chicago have local bans. Presently, Canada's limit is 2.2 percent. In areas without bans, detergent manufacturers have reduced phosphorus from 10.8 percent to an average of 5.5 percent by weight.

In the states limiting detergent phosphorus to 0.5 percent by weight, the results have been amazing with reductions of up to 60 percent in the amount of phosphorus entering lakes and streams. In Ohio, the International Joint Commission (1980) estimates that detergent phosphorus accounts for 20 to 35

percent of the phosphorus in municipal discharges, or 490 to 850 tons per year. The international Joint Commission (IJC) is an international agency (Canadian and American) which collects information on the compliance of Canada and the U.S. to the 1972 and 1978 Great Lakes Water Quality Agreements. It has investigative, quasi-judicial and surveillance functions.

In July 1980, the Phosphorus Management Strategies Task Force of the IJC stated that "detergent phosphorus controls have helped reduce the rate of eutrophication of the Great Lakes" and the Task Force pointed out the "extension of controls to uncontrolled areas should have a positive effect on the Great Lakes while municipal wastewater facilities are being brought into compliance with phosphorus reduction requirements." Recommendation No. 4 of the Task Force specifically states that "existing laws and regulations to control the phosphorus content of detergents in the Great Lakes basin be retained and that controls be extended immediately to Ohio." If phosphorus levels in detergent were decreased to 2.2 percent by weight in Ohio, the amount of phosphorus discharged by municipal sewage treatment plants could be reduced by 170 tons per year. If levels were decreased to 0.5 percent, the amount discharged could be reduced by up to 730 tons per year. Phosphorus from municipal discharges is primarily soluble orthophosphate which is one of the forms which is readily available for algal productivity (IJC,1980).

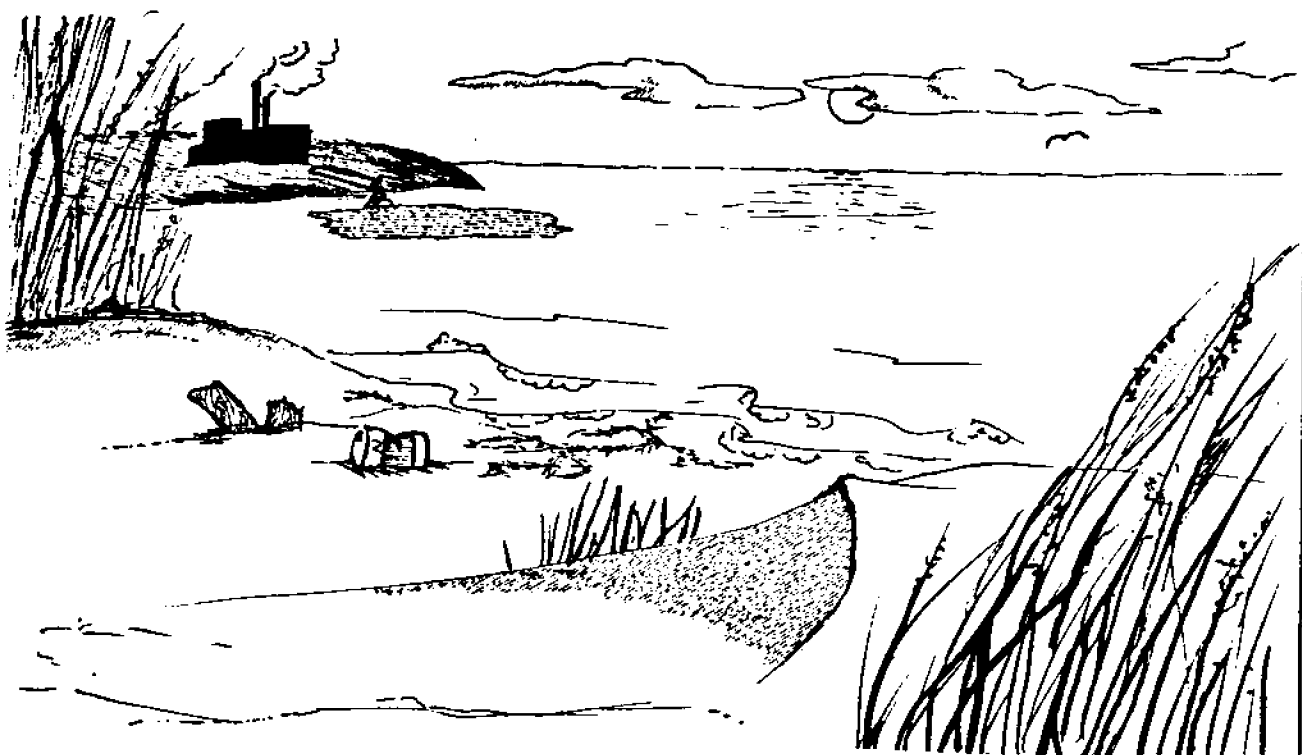
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Pollution in Lake Erie: An Introduction

by
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OEAGLS-Oceanic
Education
Activities
for
Great
Lakes
Schools

OEAGLS Investigation #8

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POLLUTION IN LAKE ERIE: AN INTRODUCTION

by
Rosanne Fortner and Carole P. Bashore
Ohio Sea Grant Education Program

INTRODUCTION

Lake Erie has always been a valuable resource for the State of Ohio. Within the past 20 years there has been concern that the lake may be dying because of the effect of human activities. Could we lose this resource one day because of pollution?

In this activity you will study problems associated with water pollution in Lake Erie. The activity will also help you develop strategies for reading science articles skillfully and critically.

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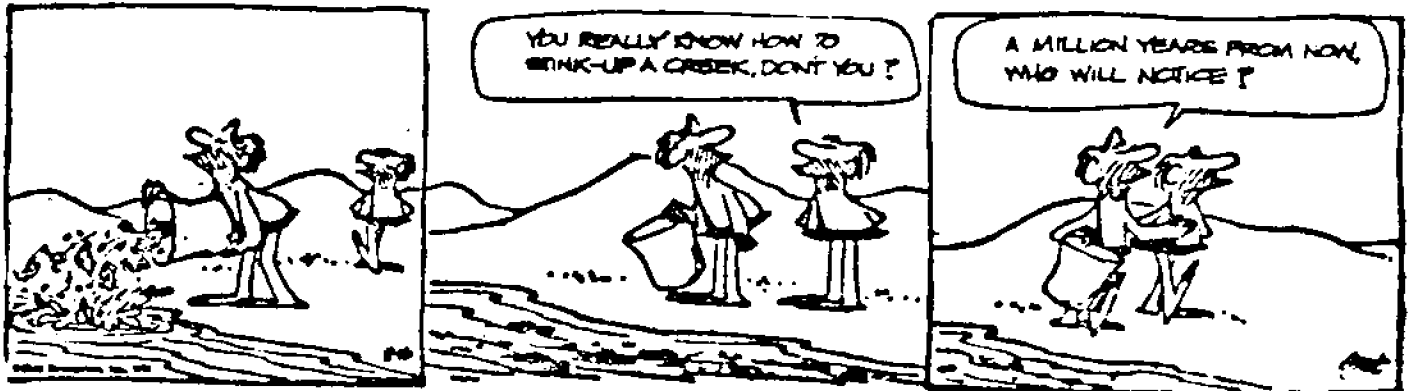
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By Johnny Hart



B.C. by permission of Johnny Hart
and Field Enterprises, Inc.

OBJECTIVES: When you have completed these activities, you should be able to:

1. Read science articles more skillfully by
 - a. recognizing the main topic,
 - b. recognizing the subtopics, and
 - c. organizing related information under each subtopic.

2. Read science articles critically by
 - a. examining the qualifications of the author(s),
 - b. determining when the article was written,
 - c. separating facts from opinions,
 - d. recognizing emotional or persuasive language, and
 - e. weighing evidence for conclusions.
3. Identify the major sources of pollution in Lake Erie.
4. Determine how Lake Erie's polluted water has affected the plants, wildlife and people which depend on it.

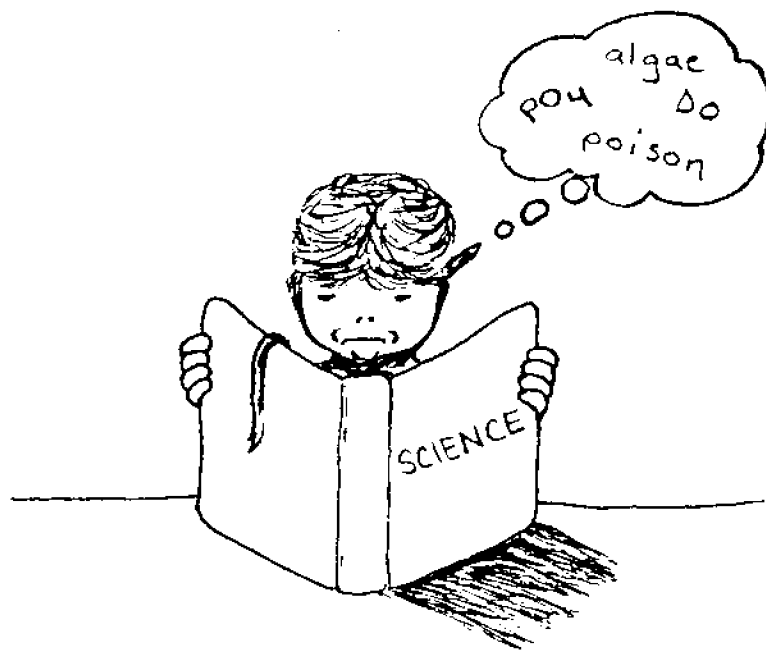
ACTIVITY A: HOW SKILLFULLY CAN YOU READ A SCIENCE ARTICLE?

The following article introduces you to the sources of pollution in Lake Erie. For the article to accomplish its task, however, you must be sure to read the material skillfully.

Here is a tip to help you develop a strategy for reading.

- A. The article discusses three major ideas. You can identify these ideas by picking out key terms in paragraphs 1, 6 and 9. Paragraph 1, for example, could be condensed into the main idea, "People and Industries Killing Lake Erie." That gives you a clue about what to look for in the first section --HOW are people and industries killing the lake?
- B. See if you can condense the first sentence of Paragraph 6 and all of Paragraph 9 so that you have the main ideas for the sections that follow those paragraphs. Answer on your worksheet.

- C. Read the entire article with the ideas of each section in mind. Try to find explanations for and details about the key statements you have found.
- D. When you finish reading and feel confident that you have grasped the major ideas, turn to page 5 and answer the questions. This is a way of self-checking your reading skills.



RJ 5-87

TRUE MURDER STORIES

SO LONG, LAKE ERIE

The killing of Lake Erie is a mob job - the combined efforts of some 11 million people who live near its shores and along the rivers and tributaries that empty into it. They are being aided and abetted by 360 industrial companies that discharge their wastes into the water.

Nine million people in the area are served by sewers and sewage treatment plants, but more than half of the plants give only primary treatment; that is, they strain out the solids and sludge, and then pump out the rest of the liquid without further treatment into the nearest waterway. Two million people live without sewers at all and discharge their raw wastes directly into the rivers and the lake. Thus sewage is one of the main sources of pollution in Lake Erie.

Giant industries discharge 9.6 billion gallons of water a day into the lake and its rivers, much of it contaminated with dangerous and filthy pollutants. These include acids, oil, cyanide, iron, phenol, and toxic metals such as copper, cadmium, chromium, lead, nickel, zinc, and iron. Poisonous chemicals enter the water from pesticides off agricultural land and from plastics and chemical industries. Phosphates pour in from fertilizers and detergents.

Also, power plants contribute thermal pollution to the water. And the radioactive content of the lake is rising, partly from the increasing numbers of atomic power plants being built along the shores.

Other pollutants in the lake include oily wastes, fish entrails, and human excrement from commercial and pleasure boats. In addition, spoil from harbor dredging - 6 million cubic yards each year - is dumped into the middle of the lake. Soil particles picked up from eroded land areas and from highway and urban development also clog the water. Trash and debris are widespread at all depths of the lake.

All of these pollutants have varied effects on Lake Erie. Some use up the oxygen in the water when they decay. Others overstimulate the growth of the underwater plants, leading to accelerated eutrophication, so that even more oxygen is lost. Some pollutants are poisonous, killing plant life, microorganisms, and the fish that feed upon them. And the decay of all this matter causes even more decomposition and loss of oxygen. Other pollutants color and obscure the water so that the sunlight cannot get through, causing the death of organisms that depend on sunlight. The inevitable result, if the pollution of Lake Erie continues, is a dead lake - water that is of no value to man or animal.

Eighty-seven beaches on Lake Erie were closed down by 1968. Commercial and sport fishing declined disastrously, and now there are restrictions on the sale of fish caught in Lake Erie because they are so contaminated. Some species of fish have disappeared altogether. Ships are prohibited by the Public Health Service from taking drinking water out of the lake unless they are equipped to give it full cleansing treatment. In Cleveland, the inadequate sewage treatment system is allowing raw sewage to contaminate the residents' own drinking water. A doctor in the area made tests which showed that there were dangerous germs in water that had sat in the pipes overnight. He regularly treats patients for vomiting and diarrhea after they have drunk water or eaten food out of the lake.

Erie is a tough little lake. Because it receives a high volume of good quality water from Lake Huron and empties out vigorously over Niagara Falls, it has a rapid flush-out time. This helps to replace the polluted water with cleaner water. But the attacks upon Lake Erie are now so strong and so unceasing that little hope remains for its survival.

The forces of law and conservation are making rumbling noises, threatening to take action against the industries and cities that are the major polluters. But they are going to have to move fast, enforce the spending of vast amounts of money, and do a major clean-up in record time if Lake Erie is to be saved.

In 1970 federal investigators reported that most cities and some industries were falling far behind pledges they had made earlier to clean the water that flows into Lake Erie. The federal government also was accused of failing to provide the money it had promised and of failing to clean the waste waters under its own control.

From POLLUTION: THE WATERS OF THE EARTH by Claire Jones, Steve J. Gadler, and Paul H. Engstrom, © 1970 by Lerner Publications Company, Minneapolis, Minnesota. Used by permission of the publisher.

QUESTIONS

After reading the article, you should have an idea of the major sources and types of pollution in Lake Erie and the general effects these have on the lake and its inhabitants. Before going on, be sure you have understood the major ideas in the article. Test yourself by answering the following questions on your worksheet.

1. List ten major sources of pollution for Lake Erie's waters.
2. The authors of the article "So Long, Lake Erie," noted that approximately 360 industrial companies discharge their wastes into the lake. From the article, identify the types of substances that make up industrial waste. You may use some of the same answers you found for question 1.
3. List six ways that pollution in Lake Erie has decreased the lake's value.
4. From your understanding of what you read in the article, describe the water of Lake Erie and the conditions of life within the lake.

The article mentioned that one of the major effects of pollution on Lake Erie was "eutrophication." To better understand eutrophication, read the next paragraph from the book Water Wasteland, by David Zwick and Marcy Benstock. Remember to first identify the general statement that will give you a clue as to what kind of information to expect in the reading.

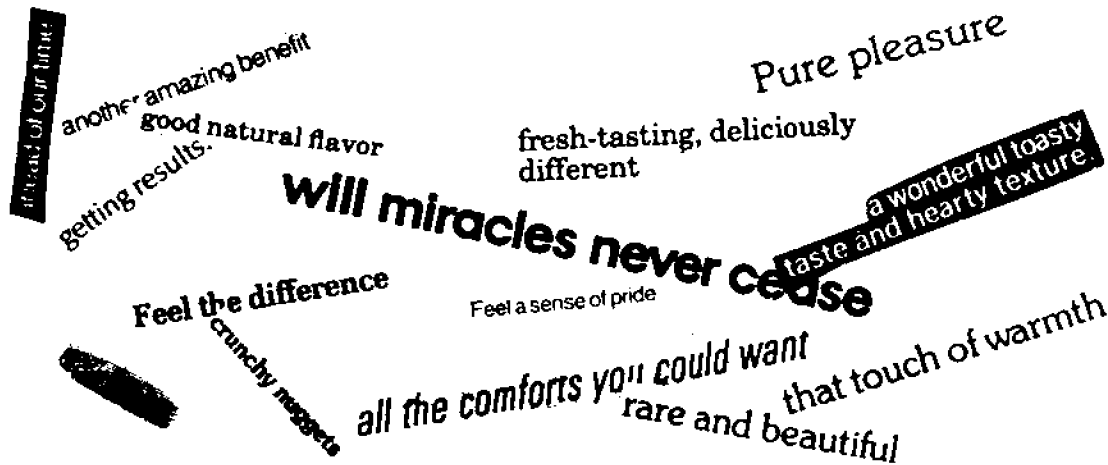
"Phosphorus stimulates the growth of algae and aquatic weeds in fresh-water lakes and rivers. Sudden and massive algal growths (called blooms) appear in many American waterways in early spring and summer. They are ugly growths, but the problem is not solely aesthetic. These blooms age a body of water as they die and decay. Oxygen and other resources are exhausted in the oxidation of large amounts of dead organic matter. Slime and scum appear, flows are clogged, and the water is unable to support fish or other normal life forms. This natural aging process, by which lakes and rivers turn to swamps and then dry land over the course of centuries, is called eutrophication. When phosphorus and other nutrients for algal growth pour into our lakes and rivers from municipal and industrial wastewater and from urban and agricultural runoff, the natural aging process is speeded up, often many hundreds or thousands of times. Lakes and rivers "die" an early death from over enrichment, overblooms, and what might be called overkill in the algal life cycle."

5. Using the information from this paragraph, construct a chart which shows the events, in order, which take place in eutrophication.
6. From the chart and the article, do you think that Lake Erie is dead? Explain your answer.

ACTIVITY B: HOW CAN YOU BECOME A CRITICAL READER?

Do you believe everything you hear or read? Certainly not. You probably have some sources of information that you trust completely, though--the television news reporter, the front page headlines, or maybe a teacher who seems to know a great deal about a lot of things. You feel that what these sources report must be true.

Whenever you read or hear something, you react to it in some way. Whether you are aware of it or not, you make a decision about accepting or rejecting the information. You may also decide, based on how important or interesting the information seems to be, whether to try to remember it.



Speakers and writers sometimes take advantage of people by trying to make them react in a certain way. By using certain words or tones of voice, they try to persuade us that what they are saying is true. For instance, the article "So Long, Lake Erie" paints a bleak picture of Lake Erie's future. While scare tactics are not really an approved method of getting people's attention, sometimes they do just that. In the late 1960's for example, WBBM-TV in Chicago aired a special called "Too Thick to Navigate, Too Thin to Cultivate," exposing Great Lakes pollution problems. NBC News followed with a special documentary on "Who Killed Lake Erie?" Coming as they did during a growing environmental movement, these and other doomsday reports served to draw our country's attention to lake problems.

Under public pressure, some industries and communities eventually corrected some of the bad things they were doing to the lakes. The Great Lakes still need help, but those who accuse are expected to offer suggestions along with their criticisms.

PROCEDURE

In order to become a critical reader, one who can determine the truthfulness and possible value of what is read, you have to look carefully at every word of the writer. You should try to:

- avoid quick judgements,
- sort out arguments and
- weigh evidence.

Look back at the "So Long, Lake Erie" article and answer these questions on your worksheet.

- When was it published? What was happening in this country at that time? Have conditions changed since then?

Read "About the Authors" below.

About the Authors

Pollution: The Waters of the Earth is one of eight books on pollution written by Claire Jones, Steve J. Gadler, and Paul H. Engstrom. This volume was a cooperative effort, each person contributing his or her own knowledge and experience with the final result a kind of "literary synergism."

Paul H. Engstrom is a minister, a lawyer, and a family counselor, as well as president and cofounder of the Minnesota Environmental Control Citizens' Association. Under his leadership, MECCA has worked for preservation of Lake Superior and the Mississippi watershed, reduction of radioactive pollution, reuse of materials in solid waste, and many other environmental goals to improve the quality of life. Thus Rev. Engstrom's major contribution to this series of books on pollution was a social and legal perspective resulting from direct experience.

Steve J. Gadler also is experienced in the fight to save the environment; he is a registered professional engineer who was an environmentalist long before pollution became a national issue. A retired Air Force Colonel, Mr. Gadler has for many years been asking pertinent, revealing questions about the damage caused by our industrial society. He has been especially concerned about radioactivity, which is an invisible but deadly threat to life itself. In 1967, the governor of Minnesota appointed him as a member of the state's Pollution Control Agency. Mr. Gadler's technical expertise is apparent in each book in the series.

Claire Jones is an experienced writer who first became aware of the dangers of pollution in 1956, when she lived through one of the famous London killer smogs. Teaming up with Rev. Engstrom and Mr. Gadler gave her an excellent way to express her concern over the condition of the environment. However, her contribution had been more than a concerned citizen's point of view and a crisp, sparkling writing style. A native of England, Mrs. Jones brings a special international outlook to this series. None of the problems of pollution can be seen as less than worldwide, and this important perspective gives *The Waters of the Earth* added value.

2. Who wrote the article? What qualifies the authors to write about the subject?
3. Does the article state opinions or facts? How did you decide?
4. What are the writers' conclusions? Does the article have evidence that supports the conclusions?
5. Does the article use words designed to persuade your thinking? If so, list three or four of these words or groups of words.

6. Is there information that conflicts with what this writer has said? What is the source of the conflicting information?

The following article is a shortened form of a booklet prepared by the Ohio Environmental Protection Agency in March 1980. Read this section skillfully and critically, then look back at your answer to Question 6 above.

LAKE ERIE

by

James P. Barry*

Introduction

Lake Erie is one of the best known bodies of water in the country. It is well known in a negative way--nearly everyone has heard that the lake is badly polluted. That is certainly true. But many things that have been written or said about Lake Erie are not true. The lake is not a swamp, it is not dying, it is not without fish. There are places where it is beautiful, there are places where you can go swimming, and the fish catch is reaching record proportions. At the same time, the lake has many problems. This article will tell you what some of them are, how they developed, and what we can do and are doing about them.

What Happened to the Lake

As our country grew, all the things that people did on the land also affected the lake. When forests were cleared for farming, the land itself often washed into the lake; The Maumee River which flows into the western end of Lake Erie carries silt all the way from Indiana farmlands and piles it on the bottom. And as cities grew around the lake, their sewage and factory wastes were usually piped directly into it or into the rivers flowing to it.

By 1970 nearly everyone saw what bad condition the lake was in. It had many problems caused by oil and industrial chemicals. But the worst problems were caused by sewage, by fertilizer that washed off fields, by other material acting as nutrients to the algae and other tiny plants in the water causing them to grow. Eutrophication is the process of aging and it is speeded up if people pollute or partly fill in a lake of normal size. People have certainly polluted Lake Erie, and in a sense they have partly filled it in by causing silt and sediments to wash into it. This action has caused the kinds of plants and fish to change and the numbers of them to increase. So to some extent, Lake Erie has been affected by this aging process of eutrophication. This fact has caused some people to say that the lake is dying, but Lake Erie is so large that the rules pertaining to smaller lakes do not fully apply to it. If we continue polluting the lake over a long period, eutrophication could pose a serious threat. But today many of the ways we have damaged the lake can still be corrected, and a number of things are now being done to correct them.

What Is Being Done

The material that causes the most trouble in Lake Erie is phosphorus, for it is the phosphorus in sewage, in fertilizer washing in from the fields, and in other sources that feeds the algae and makes them grow. (Sewage contains phosphorus both in human wastes and in the great amount of detergents that we use for washing and then drain into our sewage systems.) Perhaps the next biggest problem comes from bacteria that can cause disease. When they are in water, swimming can be dangerous and beaches must be closed.

Much of the phosphorus and most of the dangerous bacteria come from sewage, and so the first thing that was done to help the lake was to build more sewage treatment plants and to make the old plants better. Hundreds of millions of dollars in federal grants (administered in Ohio by the Ohio EPA) were given to towns and cities for their treatment plants. Cleveland, for example, has a treatment system that serves over 1,280,000 people in Cuyahoga County and that was first built many years ago to take care of far fewer people. There are three treatment plants in Cleveland. Both the network of sewer lines and tunnels running to these plants, and the plants themselves, are being rebuilt and improved. The work will continue over several years and will cost about \$500 million. Similar programs are going on in towns and cities all around Lake Erie. The main purpose of all this work is to keep phosphorus and disease germs out of the lake now and in the future.

Another important kind of pollution comes from toxic substances. These range from pesticides that were used on farms and orchards and then washed into the lake to chemicals drained into the lake by industry. These substances can kill or deform fish, birds, and other animals, and also can be carried in the flesh of animals that seem healthy. A person who eats such a fish or bird or muskrat can absorb some of the poison and may be affected by it. Most of the dangerous pesticides have now been banned by law. Another poison, mercury, is no longer being drained into the lake and may, in time, gradually disappear from it.

There are other poisons in the water and in the mud on the bottom, but the chemicals called PCBs seem to cause the most problems today. They have been used in making a great number of items for the past forty years, and so they not only are in the bottom mud but also, things made of them are at many locations around the shore, where rain and snow can wash over them and carry PCBs to the lake. And PCBs are still used in some manufacturing. Ways of controlling them are being studied, and the U.S. and Canadian governments have passed or are in the process of passing laws that limit their use.

The Situation Today

Lake Erie is still polluted, but the flow of pollution into the lake is slowing. Today the lake is at a point of balance; in years when the water level is high and more water flows through the lake, diluting and washing out the pollutants, it gets better, but in other years it does not. At certain places around the shore, however, the water is definitely better than it was. There are places where new or better sewage treatment plants have been built, or where other local action has been taken to stop pollution. As one result, most of the beaches that were closed because of pollution have been opened again. And walleye, one of the preferred kinds of fish, is coming back to the delight of hundreds of sport fishermen. But we must keep working to repair the damage we have done to the lake. There are still significant problem areas that remain to be corrected. The cost of cleaning it up is not great if we think in individual terms. Experts believe that to clean up the lake it would cost each person living on its shore, each year, about the same amount as a carton of cigarettes or a day's food. That is a price we can afford to pay for Lake Erie. What we must do now is get together and do the job.

*James P. Barry is an author and photographer who specializes in Great Lakes subjects. He made his first voyage on a lake freighter at the age of eight, graduated from The Ohio State University with distinction, and has written ten books, half of them dealing with various aspects of the Lakes.

7. Turn back to the Procedure. On your answer sheet, answer Questions 1-6 again, this time about the James Barry article.

8. Which article do you place more confidence in? Why?

9. Summarize what you believe to be the present condition of Lake Erie.

10. One of the most valuable things you can do to become a skillful critical reader is to read widely from all kinds of books, magazines and newspapers. Why?

JUST FOR FUN

Here is a puzzle you can solve on your own paper using words related to the Lake Erie environment.

1. Unscramble these five words. The hints beside each scrambled word will help you.
2. Write each unscrambled word in the boxes beside it. Put one letter to each box.
3. Unscramble the circled letters to find the answer to the picture riddle.

A type of pollution caused by heat.

MARLET



Toxic chemicals.

SNOPOSI



In 1970, 360 of these polluted Lake Erie.

RUDINSSITE



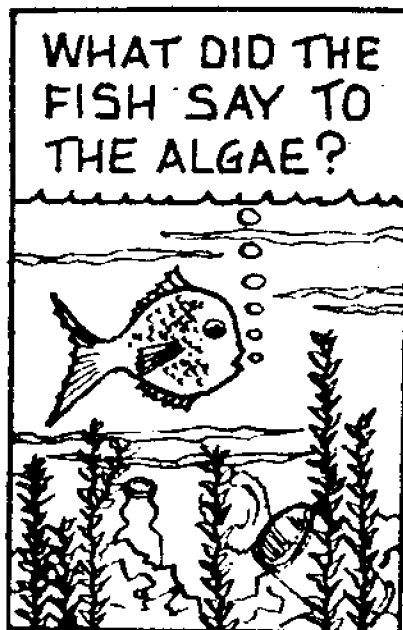
Murky water won't let this through.

GLISTHUN



A metal that poisons animals.

PROCEP



his lake is too rich in nutrients.

hat's _____."
 adapted from "Environmental Activities News Bulletin,"
 inuary, 1972.)

REVIEW QUESTIONS

1. Historically, what are the major sources of pollution in Lake Erie?
2. How have some of these problems been handled?
3. Was Lake Erie dead? What is the present condition of the Lake?
4. List three things you should look for in something you read to tell if it is worth believing.

Name _____

Pollution In Lake Erie Worksheet

ACTIVITY A

- A. Pick out the main ideas in paragraphs 1, 6 and 9.
- B. Condense the first sentence of Paragraph 6 and all of Paragraph 9 so that you have the main ideas for the sections that follow those paragraphs.

Paragraph 6 _____

Paragraph 9 _____

C. Read the entire article with the ideas of each section in mind.

D. No answer needed.

1. List ten major sources of pollution for Lake Erie's waters.

- | | |
|----------|-----------|
| 1. _____ | 6. _____ |
| 2. _____ | 7. _____ |
| 3. _____ | 8. _____ |
| 4. _____ | 9. _____ |
| 5. _____ | 10. _____ |

2. From the article, identify the types of substances that make up industrial waste.

3. List six ways that pollution in Lake Erie has decreased the lake's value.

Describe the water of Lake Erie and the conditions of life within the lake.

Construct a chart which shows the events, in order, which take place in eutrophication.

From this chart and the article, do you think that Lake Erie is dead? _____ Explain your answer.

ACTIVITY B

When was "So Long, Lake Erie" published? _____ What was happening in this country at that time? _____

Have conditions changed since then? _____

Who wrote the article? _____ What qualifies the authors to write about the subject? _____

Does the article state opinions or facts? _____ How did you decide? _____

4. What are the writers' conclusions? _____

Does the article have evidence that supports the conclusion? _____

5. Does the article use words designed to persuade your thinking? _____ If so, list three or four of these words or groups of words. _____

6. Is there information that conflicts with what this writer has said? _____ What is the source of the conflict information? _____

7. Answer these questions about the James Barry article.

a. When was it published? _____ What was happening in this country at that time?

Have conditions changed since then? _____

b. Who wrote the article? _____ What qualifies the author to write about the subject? _____

c. Does the article state opinions or facts? _____ How did you decide? _____

d. What are the writer's conclusions? _____

Does the article have evidence that supports the conclusion? _____

e. Does the article use words designed to persuade your thinking? _____ If so, list three or four of these words or groups of words. _____

f. Is there information that conflicts with what this writer has said? _____ What is the source of the conflicting information? _____

8. Which article do you place more confidence in? _____
Why? _____

9. Summarize what you believe to be the present condition of Lake Erie. _____

10. One of the most valuable things you can do to become a skillful critical reader is to read widely from all kinds of books, magazines and newspapers. Why? _____
