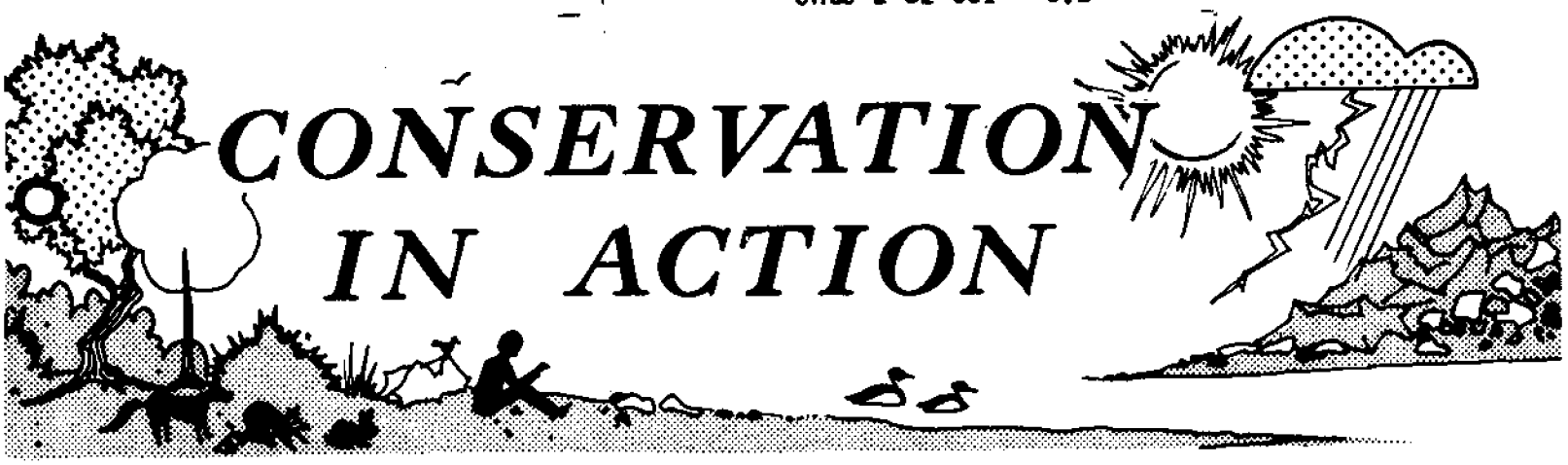

Teaching About the Great Lakes

By ROSANNE FORTNER and VICTOR J. MAYER
The Ohio State University and Ohio Sea Grant

Ohio Sea Grant, Dr. C. E. Herdendorf, Director, is funded by the National Oceanic and Atmospheric Administration and The Ohio State University. Dr. Mayer, Professor of Science Education and Geology, The Ohio State University, is Coordinator of the Education Component and principal investigator of OEAGLS. Dr. Fortner, an Assistant Professor of Natural Resources, The Ohio State University, is co-principal investigator on the OEAGLS project.

THE UNITED STATES has found in the ocean and its Great Lakes sources of wealth and culture, a means of transportation and trade, and a setting for recreation and reflection. More than half of all Americans live within an hour's drive of the sea, but interest in our maritime heritage has waned while American thought and enterprise have largely focused on the land.

This is especially a problem in the interior states. How many Ohioans, for example, remember that the famous Naval battle cry "Don't Give up the Ship" was first used by Commodore Perry here in Ohio, during the Battle of Lake Erie in the War of 1812?

Curriculum Found Lacking

School curricula tend to reflect this focus upon the land. What is done to kindle an interest in and knowledge of the 70% of the earth's surface that is covered by water?

A survey of students in Ohio's secondary schools conducted by The Ohio State University in 1976 revealed that many students lacked knowledge regarding the physical and biological processes in the oceans, the maritime heritage of our country, causes of pollution in the marine environment, and art and literature related to the sea.

To participate knowledgeably in decision-making, environmental management, and to enhance the quality of our leisure activities, a high level of marine and aquatic awareness among the general public is necessary.

Since the survey results indicated a definite need for marine education in Ohio schools, they stimulated planning which eventually led to the funding of an Educational Component of Ohio Sea Grant.

Teacher Workshops

The Columbus Council of the Navy League of the United States assisted the faculty of the College of Education in preparing for involvement in a Sea Grant Program by providing funds to support a series of teacher workshops during the summers of 1976, '77 and '78.

The workshops were designed to provide

(Continued next page)

TEACHING ABOUT THE GREAT LAKES

(Continued from page 1)

teachers with background in marine concepts, information relating to Lake Erie and knowledge of teaching materials relating to the oceans and the Great Lakes.

In addition to sessions held on the Ohio State campus, field trips were offered in each of the summers. During the 1978 workshop the field trip lasted 10 days and took teachers along the southern shore of Lake Erie from the Toledo port facilities to Niagara Falls and the Welland Canal. Similar workshops are planned for the future, both in the summer and during the in-service year.

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IN THIS ISSUE:

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New Teaching Materials Developed

The first Sea Grant funding was provided during the 1977-78 academic year for the development of supplementary oceanic education materials for use in schools in the Great Lakes region. The project, entitled Oceanic Education Activities for Great Lakes Schools (OEAGLS), is developing materials intended for use at the middle and junior high school level in science and social studies classes.

Before being made available to teachers, the materials are tested in schools and assessed for content accuracy by scientists from the Center for Lake Erie Area Research, university faculty or experts from the Ohio Department of Natural Resources.

The first sets of materials have been released for use by teachers. The topics developed so far relate to the climate of the Lake Erie region, shore processes and fish populations in the lake. Whenever possible, investigations relate the topic under consideration to the world's oceans and to practical applications in Ohio.

This issue of *Conservation In Action* contains excerpts from several of the investigations. A total of nine student investigations and teacher guides are now available for distribution to teachers. Their titles are listed on the order blank that appears on page 12. Any teacher can receive a single free copy of each desired investigation by completing the order blank and sending it to the Ohio Sea Grant Education Office.

Additional materials are being developed on the War of 1812, Ohio canals, shipping on the Great Lakes, freshwater estuaries, the Indian history of the Lake Erie region, and the disasters that have occurred in the Great Lakes region. A quarterly newsletter, *Middle Sea*, announces the availability of new investigations. A subscription is available free by writing to the Education Office. *Middle Sea* also contains information on a wide range of teaching resources in marine and aquatic education, helpful hints and tips for teachers and announcements of teacher workshops.

The following excerpts from five investigations provide a sample of the kinds of materials being developed by the OEAGLS project. If you are interested in using any of them with your students, we would recommend that you order the complete investigation and teacher guide from the Education Office. They contain additional background information and suggestions on conducting the activity. Information for ordering investigations is included at the end of this article.

Erosion Along Lake Erie

This investigation involves changes in the Lake Erie shoreline in Lake County, Ohio. You will determine how erosion has occurred in the area and how much sand and clay have been removed by the waves and currents of the lake. You will be using the photographs appearing on page 5. They were taken by an airplane flying over the area at two different times, once in 1954 and again 19 years later in 1973. Both photos represent the same area of the shoreline.

Activity A — How Fast Can a Shoreline Change?

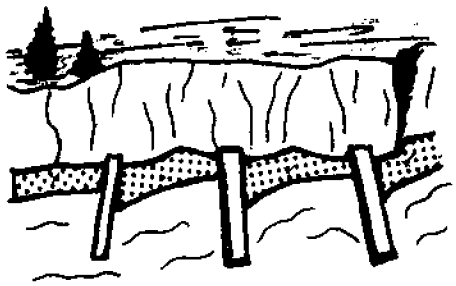
Cover the 1954 photo with a sheet of tracing paper and secure it with paper clips. Starting at the left border of the photo, draw eight parallel N-S lines at 1-inch intervals. Label the lines "*A*" through "*H*", starting at the left-hand line.

Using a pencil, trace the base of the bluff on the paper. Label this line "1954." Draw in and label the groins. Outline several major road intersections. These will help you to position the paper on the other photo.

Now place the tracing paper on the 1973 photo. Match the road intersections. Using a different colored pencil, trace in the base of the bluff. Label this line "1973." Draw in and label the groins. Notice that you have two different shorelines. Lightly shade in the area between the two shorelines.

The two shorelines are the result of erosional processes and the consequent retreat of the shoreline to the south. The shaded area represents land removed by erosion. A greater amount of erosion has taken place to the east.

The groins protected the portion of the shoreline they were connected to. Groins will cause deposition on their upcurrent side, and increased erosion on the downcurrent side. Therefore, it appears that the predominant direction of the longshore currents is from west to east.



Activity B — How Much Land Has Been Lost?

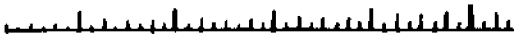
With the scale shown below, measure the distance between the two traced shorelines along each of the lines *A* through *H*. Record your measurements in line *Q* of the worksheet which follows this activity (page 4).

Lines *A* through *D* are west of the groins. Average the distances for these four lines and enter them in line *R*. Now determine the average distance between shorelines for the other four lines and enter it in the worksheet. You are now ready to determine the *recession rate* for this section of shoreline. The recession rate is the average distance the shoreline has been eroded away per year.

(Continued on next page)

Horizontal Distance Scale in feet

400 200 0 200 400



EROSION ALONG LAKE ERIE

(Continued from page 3)

Divide each average distance in line *R* by 19 years, the length of time between the taking of the two photos. Enter in line *S*.

The eastern part of the shoreline has the higher recession rate. This means that the bluffs retreat southward more rapidly in this area. The best place to own shoreline property would be behind the groins in that that is where the recession rate is the least.

Place your map over the piece of graph paper on page 3. Locate the easternmost of the two prominent groins appearing on the 1973 photo. Count the number of squares in the shaded area to the east of the groin and enter in line *T*. Also count the number of squares to the west of the groin and enter on line *T*.

Each square represents 160 square feet of surface area. Calculate the total surface area eroded away and enter in line *U*. To determine the total volume of material removed, you will need to know its depth as well as its surface area. The depth of material will be roughly equivalent to the average height of the bluffs. To the east of the groins, the bluffs are about 30 feet high. To the west, they are 50 feet high.

Calculate the total volume of material removed by erosion by multiplying the average height of the bluffs times the total surface area removed. Enter in line *W*.

Determine the average yearly loss of material by dividing the total volume removed by 19 years. Enter on line *X*.

Review

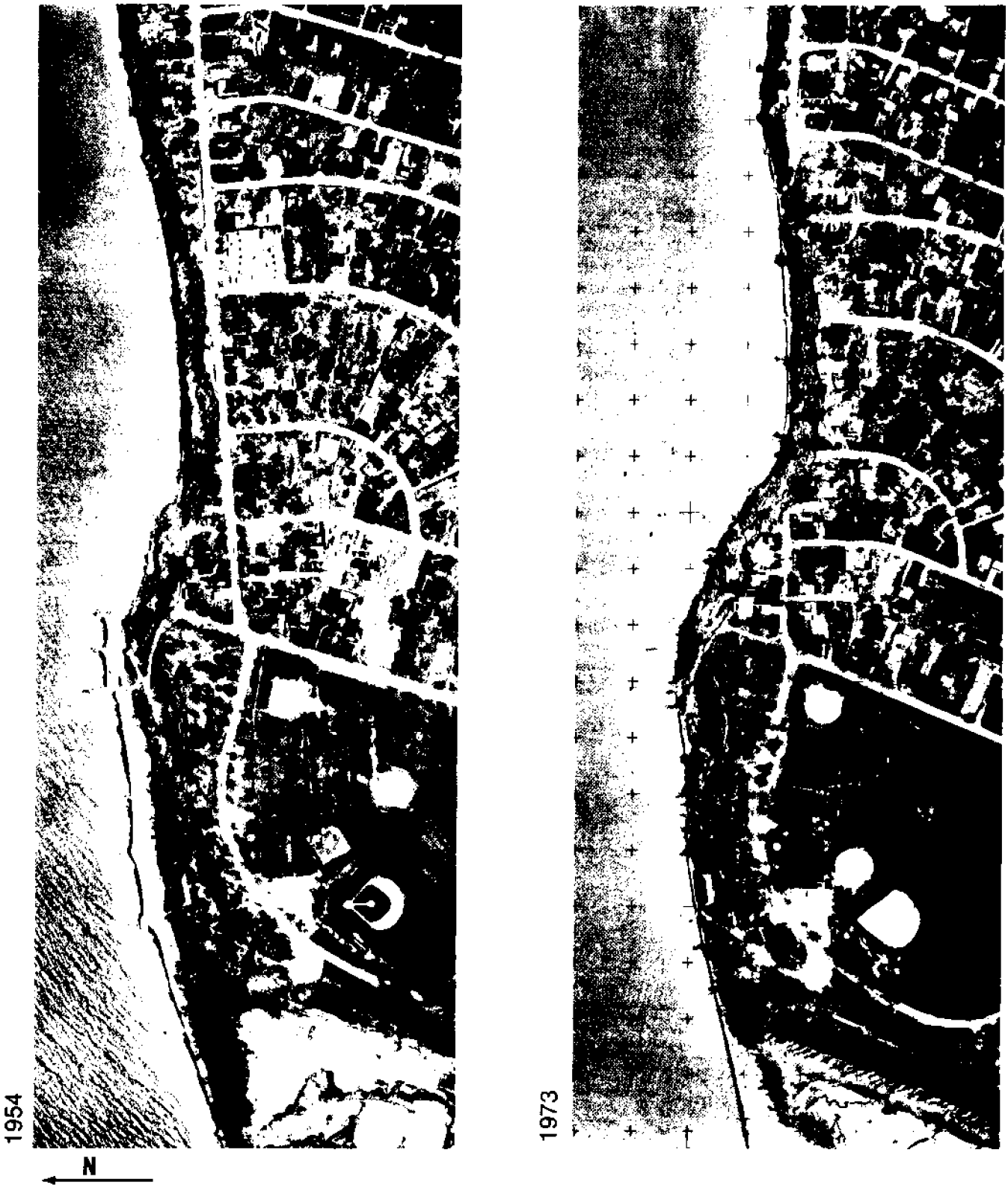
1. Describe what is likely to happen when a groin is built along a section of shoreline.

2. Would you prefer to own property on the upcurrent or downcurrent side of a groin? Why?

3. Describe how you would determine the recession rate of a section of the Atlantic Coast.

WORKSHEET

LINE		WEST A	B	C	D	EAST E	F	G	H
Q	Distance		–	–	– =		+	+	+ =
R	Average Distance Q ÷ 4								
S	Recession Rate R ÷ 19 yr								
T	Squares								
U	Surface area T x 160 sq ft								
V	Cliff height								
W	Volume U x V								
X	Yearly loss W ÷ 19 yr								



Aerial photos of a portion of the Lake Erie shoreline in Lake County, Ohio.

What Would Be the Result of Regulating Lake Erie?

Materials: Three plastic containers (lakes), a fourth container (precipitation device), and another to catch outflow.

Procedure: To reduce the problems of erosion, some people have suggested that the level of Lake Erie be lowered and maintained at a constant level.

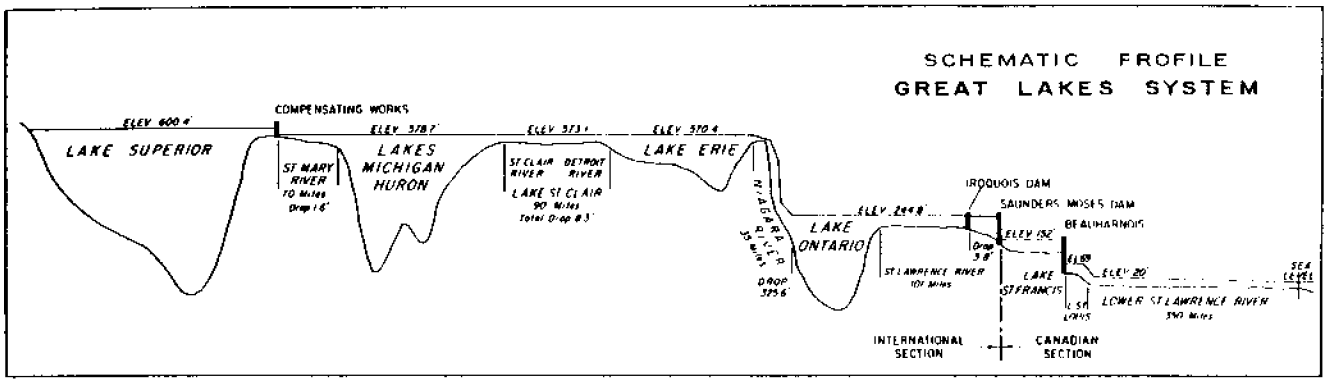
The flow of water into and out of Lake Erie could be controlled (regulated) through the use of dams and other devices. In this activity, you will study the effect of regulating the levels of the lakes both upstream and downstream from Lake Erie.

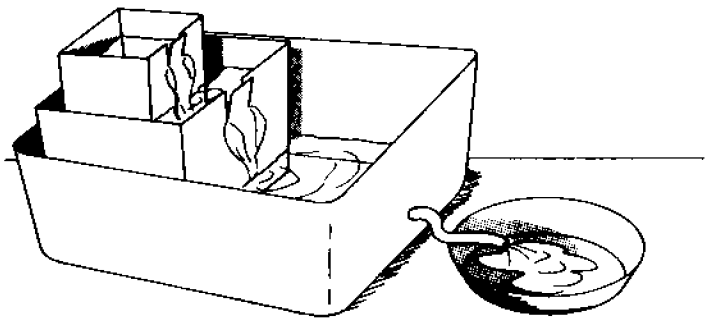
1. Set up your apparatus as shown below. The tall plastic container will represent Lake Huron which is upstream from Lake Erie. The cut in the side of the container represents the outlet of the lake. Note that a piece of plastic has been left covering the slit. This can be either opened or closed, thus controlling the flow out of Lake Huron and into Lake Erie. Lake Erie is represented by a larger but lower container. It, too, has a slit in the side representing the outlet of the lake. Lake Erie is sitting in an even larger container which represents Lake Ontario. The three containers together represent a model of the three Great Lakes.

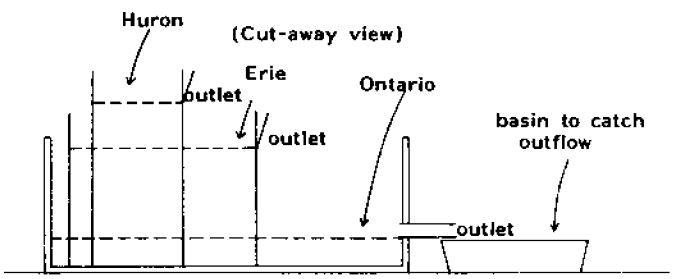
2. Fill each of the lakes with water, then wait until the lake level in each lake no longer changes. Mark this level on the outside of each container.

The level you marked is the level that would occur if no water ever entered or left any of the lakes. Of course this does not occur in nature. The level of each of the lakes at a given time will be determined by the amount of water entering the lakes and any variations in the rate of flow of this water through the lake system.

3. Be sure that the outlets of Lakes Huron and Erie are in the closed position. Some water should still be able to pass through the outlet. This position represents the way the lakes are naturally. The levels are not controlled by dams. Fill the precipitation container with water. The water in this container represents the fall of rain and snow (precipitation) into the lakes and the rivers that feed them. Pour this water into Lake Huron as rapidly as possible without having any overflow the side of the lake. Mark the maximum lake level on the side of each container.







Model of three lakes. Dotted lines in lower right cut-away view represent minimum lake levels.

4. Is the maximum (highest) lake level in all three lakes reached at the same time? Discuss.

5. Fill the precipitation container again. Pour the water into Lake Huron more slowly than you did in Step 3. This represents a lower rate of precipitation than in Step 3. Mark the maximum lake level for each lake. Do the lakes reach as high a level when the rate of precipitation is less? Discuss.

6. Open the outlet of Lake Huron keeping Lake Erie closed. Repeat the procedure for the two different rates of precipitation. Describe what happens to the lake levels in Huron and Erie.

7. Now open the outlet of Lake Erie keeping Lake Huron open also and repeat the procedure for the same two rates of precipitation. Describe what happens to the lake levels of Huron and Erie.

8. What happens when only one lake at a time is regulated?

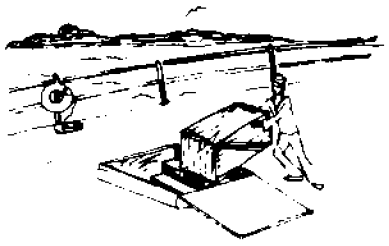
9. How would you design a regulation system that could keep Lake Erie's water level from raising or lowering too much or too fast?

Changes in lake level are thought to be due primarily to changes in the amount or rate of precipitation. These changes follow a yearly pattern. There also seems to be a longer term cycle of high and low lake levels.

In this activity you used a model of the lakes to investigate the effects of adding precipitation to lakes upstream from Lake Erie. The flow-through of that precipitation changed lake levels downstream. In nature, the situation is more complicated because precipitation will be added to all of the lakes directly through run-off from rivers and streams entering the lakes. Any program to regulate the level of Lake Erie must take into account all sources of water and their possible effects on lake level.

(From "Lake Erie and Changing Lake Levels.")

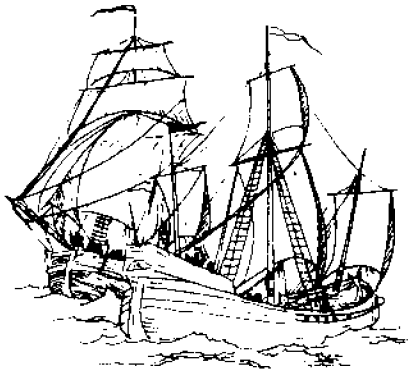
How Have Ships and Sailors Influenced Our Language?



Some expressions that originated at sea are now a part of our everyday language. A person who "knows the ropes" today, for example, is an expert who knows what to do. In early sailing days the new sailor usually did not know much about the ship's rigging. By the time his training voyage was over, though, his discharge papers could be marked "knows the ropes."

Procedure: Listed below are some common expressions that had their beginnings at sea. Think about what each one might have referred to on an early sailing ship. Then try to match the saying with the picture that shows its meaning. Write a sentence under each picture to tell what the saying means in our modern language.

1. Making ends meet.
2. Skyscraper.
3. Down the hatch.
4. Stand by.



To Harvest a Walleye

A WALLEYE is a large, good-tasting fish that is also a good fighter when it is caught. Because of these characteristics, the walleye is a favorite of fishermen. In 1978, sport fishermen caught 1,652,000 walleyes in Lake Erie.

Lake Erie is considered by many to be the best walleye lake in North America. What does it take for a lake to produce a walleye? Why can't we catch as many walleyes in Lake Erie as we can some smaller fish?

How to Play: The object of the game is to end at the block labeled "Harvest" with at least one kilogram (kg) of fish. You will keep track of kilograms of organisms on a "Biomass Record," similar to the one started below. The game is best played by 2-4 individuals.

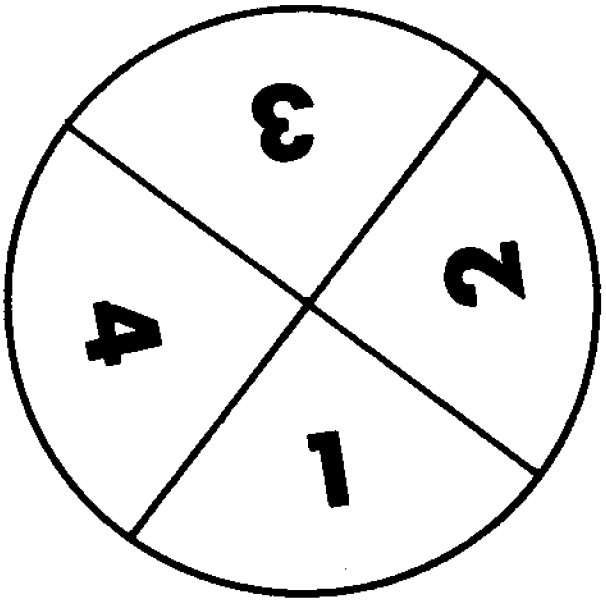
(Continued on next page)

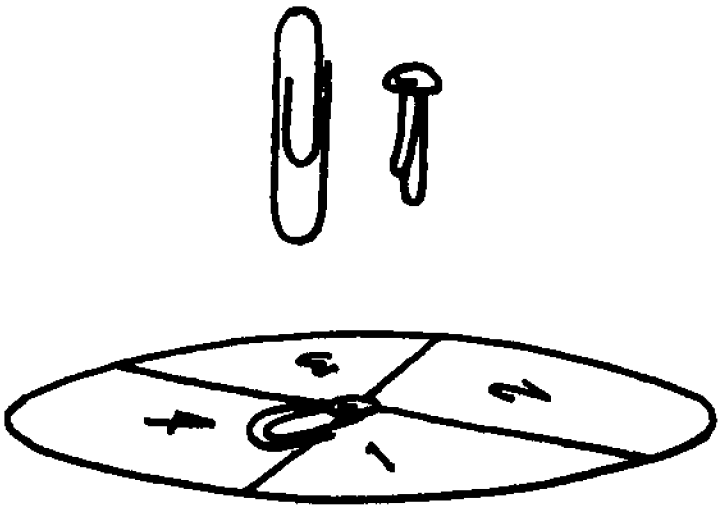
BIOMASS RECORD

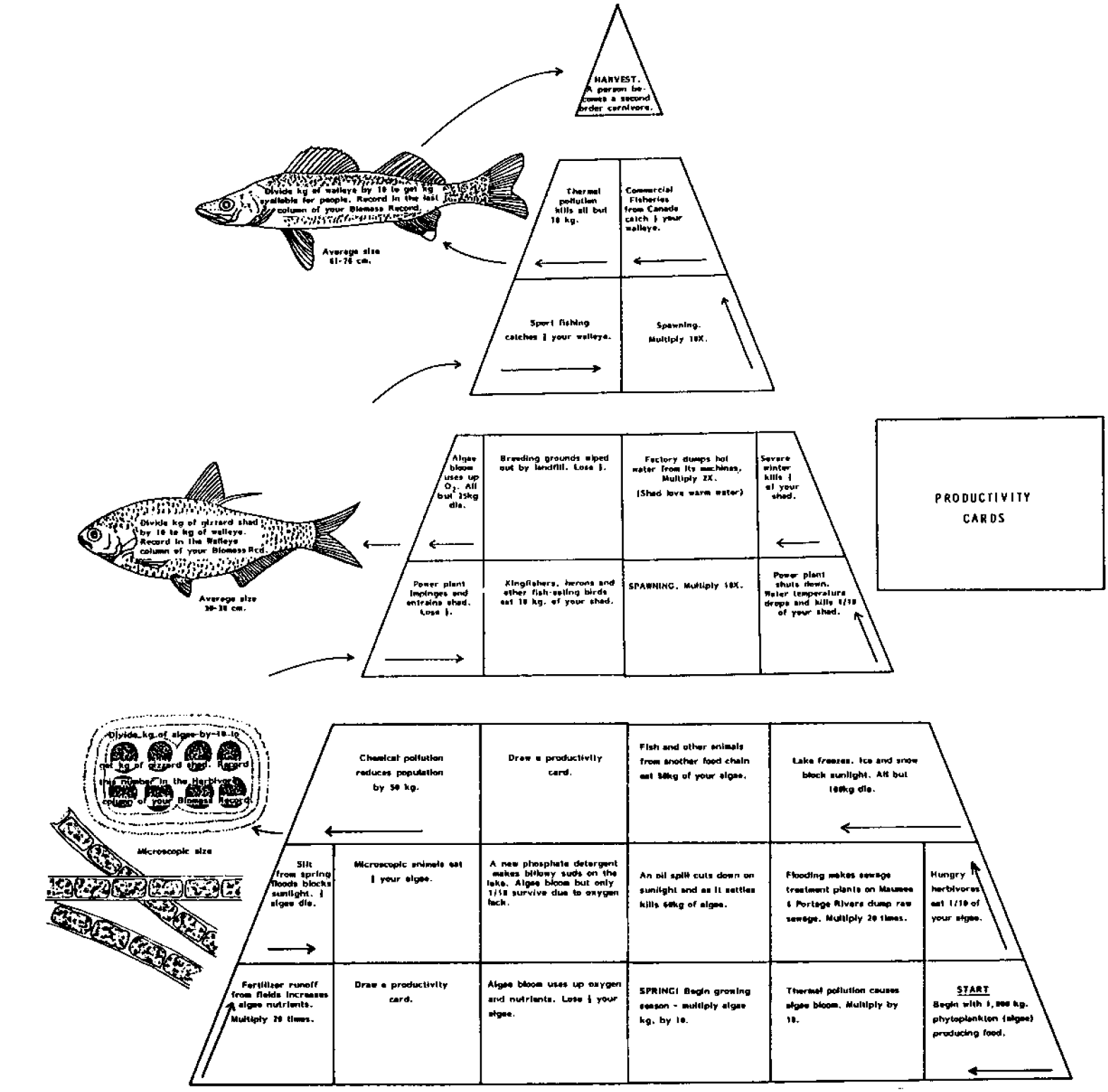
PRODUCERS (ALGAE)	HERBIVORES (GIZZARD SHAD)	1ST ORDER CARNIVORES (WALLEYE)	2ND ORDER CARNIVORE (PERSON)

SPINNER

Cut out and paste on cardbord. Assemble with a paper clip and fasten as shown.







1. Begin at "START" with 100 kg of algae. Spin the spinner to see who moves first. The player with the highest number will move first. Play then goes around the board to the left.

2. Move through each level of the pyramid by moving your marker the number of spaces shown on the spinner. Change your number of kilograms

(Continued on next page)

TO HARVEST A WALLEYE

(Continued from page 9)

as the board directs. Record the new number of kg on your Biomass Record each time the mass changes.

3. Some sections of the board require you to divide the mass of the organisms by some number. Drop any fractions that you get in your answers. (Half of an organism would have a hard time surviving!)

4. At the end of each level, it is assumed that all organisms are captured by organisms of the next level. You must change columns on the Biomass Record and divide by 10 whenever you pass the algae or fish pictures, even if you *don't* land on them.

5. If at anytime you have less than 1 kg left, you must return to "START" and begin again.

6. The winner of the game is the first player to land at the triangle labeled "Harvest."

7. At the end of the game, compare the results on your Biomass Record with those of the other players. Compare the kg of biomass that you had at the beginning of each level of the pyramid.

8. Discuss some of the disasters that occurred to your organisms and how they affected your populations as you progressed through the game.

PRODUCTIVITY CARDS

Land fill. Breeding grounds are destroyed. Lose all organisms. Go back to "START" and begin with 1,000 kg algae.	Grass carp (herbivorous fish from another food chain) are introduced into Lake Erie. They eat ½ of your algae.	Save this card until you need it. Coast Guard saves the day and cleans up the oil spill. You lose only ½ your algae.
Algae that died in another bloom start to decay and release nutrients into the water. Add 50 kg.	Army Corps of Engineers stops dumping dredging spoils into the lake. Add 50 kg.	A power plant dumps hot water, killing all except blue green algae. Lose 200 kg.
Eutrophication speeds up in the Western Basin of lake. Lack of oxygen kills all but 100 kg.	Pollution from the Cuyahoga River enters the lake. Lose 100 kg organisms.	ORGANISMS DOUBLE!!
Tanker grounds on shoal dumping sulfuric acid. Lose 1,000 kg.	Oil spill. Lose all organisms. Go back to "START"; begin with 1,000 kg algae.	Sewage treatment plant opened with better cleaning equipment. Lower nutrient levels result because there is less sewage pollution. Lose 50 kg.

What Happened Aboard the Edmund Fitzgerald?

Introduction: On November 10, 1975, the Great Lakes ore freighter *Edmund Fitzgerald* sank in Lake Superior. Though its wreckage was found, no members of the ship's crew were ever recovered. The sinking thus became not only a new piece of the triangle's mystery; it became a human story as well.

Strong emotions are often expressed more effectively through artistic creation than spoken words. A violent painting or a joyful dance can communicate feelings that anyone can understand. The deep sorrow felt in the lakes country when the *Edmund Fitzgerald* sank was expressed in a haunting ballad by a Canadian singer, Gordon Lightfoot.

Materials: Recording of Gordon Lightfoot's "*The Wreck of the Edmund Fitzgerald*," words to that song, pencil or pen.

Procedure:

1. Listen to the recording. How does it make you feel?

For each of the following factors about the song, tell how it helps to produce this general feeling:

(A) The singer's voice

(B) The tempo (how fast the song is)

(C) The instrument being played

(D) Sounds in the background

(E) The words (list words or phrases that help create the feeling)

2. Imagine that you are aboard the *Fitzgerald* on the night of the storm. The darkness and the cold rain are uncomfortable, but until now no one has doubted that you will reach your destination.

The song reports that "at 7 p.m. a main hatchway caved in." Write a one-page description of what you might have witnessed aboard the ship as it sank. This can be done as if you are recording events in a diary or writing a last letter to a friend. Since you have probably decided for yourself what must have happened that night, this is a way of providing the world an "eye-witness" account of the events.

(From OEAGLS Investigation #11: The Great Lakes Triangle.)

THE WRECK OF THE EDMUND FITZGERALD

The legend lives on from the Chippewa on down
Of the big lake they call "Gitche Gumee."
The lake, it is said, never gives up her dead
When the skies of November turn gloomy.
With a load of iron ore twenty-six thousand tons more
than the Edmund Fitzgerald weighed empty,
That good ship and true was a bone to be chewed
when the "Gales of November" came early.

The ship was the pride of the American side
coming back from some mill in Wisconsin.
As the big freighters go it was bigger than most
with a crew and good captain well seasoned,
Concluding some terms with a couple of steel firms
when they left fully loaded for Cleveland.
And later that night when the ship's bell rang
could it be the north wind they'd been feelin'?

The wind in the wires made a tattle-tale sound
and a wave broke over the railing.
And ev'ry man knew as the captain did too
'twas the witch of November come stealin'.
The dawn came late and the breakfast had to wait
when the Gales of November came slashin'.
When afternoon came it was freezin' rain
in the face of a hurricane west wind.

When suppertime came the old cook came on deck
sayin', "Fellas, it's too rough t' feed ya."
At 7 PM a main hatchway caved in;
he said, "Fellas, it's been good t' know ya!"
The captain wired in he had water comin' in
and the good ship and crew was in peril.
And later that night when 'is lights went outta sight
came the wreck of the Edmund Fitzgerald.

Does anyone know where the love of God goes
when the words turn the minutes to hours?
The searchers all say they'd have made Whitefish Bay
if they'd put fifteen more miles behind 'er.
They might have split up or they might have capsized;
they may have broke deep and took water.
And all that remains is the faces and the names
of the wives and the sons and the daughters.

Lake Huron rolls, Superior sings
in the rooms of her ice water mansion.
Old Michigan steams like a young man's dreams;
the islands and bays are for sportsmen.
And farther below Lake Ontario
takes in what Lake Erie can send her,
And the iron boats go as the mariners all know
with the Gales of November remembered.

In a musty old hall in Detroit they prayed,
in the "Maritime Sailors' Cathedral."
The church bell chimed 'til it rang twenty-nine times
for each man on the Edmund Fitzgerald.
The legend lives on from the Chippewa on down
of the big lake they call "Gitche Gumee."
"Superior," they said, "never gives up her dead
when the Gales of November come early!"

OEAGLS Investigations: A Summary

The OEAGLS investigations have several characteristics in common. They are activity oriented, involving either manipulation of graphic information or of pieces of inexpensive equipment. They teach interdisciplinary concepts about the world ocean using Lake Erie as a local example. They have been tested in classrooms for educational value and suitability, and checked by content experts for accuracy. Each investigation comes with a teacher guide so that teachers need no previous training to use the materials. Nor is any elaborate equipment required. Most are structured so that students work independently or in small groups.

The topics of material now available for distribution (free to educators) are described below:

The Effect of Lake Erie on Ohio's Temperature

A laboratory exercise compares the relative abilities of land and water to absorb and release heat. Map studies show how land temperatures are affected by the lakes and oceans.

The Effect of Lake Erie on Climate

A demonstration of how land and sea breezes form leads to a study of climate differences near the lakes and oceans. The effects on agriculture are discussed.

Ancient Shore of Lake Erie

Beach ridges along shores give evidence of higher lake levels related to glacial history. The ridges are mapped, profiles drawn and man's use of ridges studied.

Lake Erie and Changing Lake Levels

Graph interpretation of lake level changes is followed by a laboratory demonstration of methods and effects of regulating lake levels.

Erosion Along Lake Erie

A condensed version is included in this issue of *Conservation In Action.*

Coastal Processes and Erosion

A laboratory activity compares resistance of different shoreline materials. Diagrams show how shorelines may be protected.

Yellow Perch In Lake Erie

A board game about survival of perch populations gives information for use in a role-play activity in which a fisheries management policy is established.

Evidence of Ancient Seas in Ohio

Laboratory studies of rocks and rock-forming processes are followed by geologic map interpretation. Ohio's rocks indicate presence of ancient seas over the state.

To Harvest A Walleye

The board game illustrated in *Conservation In Action* is followed by the other food web considerations.

ORDER FORM

Please send copies of the following OEAGLS materials (check):

_____ *Middle Sea* Newsletter
_____ The Effect of Lake Erie on Ohio's Temperature
_____ The Effect of Lake Erie on Climate
_____ Ancient Shores of Lake Erie
_____ Lake Erie and Changing Lake Levels
_____ Erosion Along Lake Erie
_____ Coastal Processes and Erosion
_____ Yellow Perch in Lake Erie
_____ Evidence of Ancient Seas in Ohio
_____ To Harvest A Walleye

Name: _____

Address: _____

(Mail to: Ohio Sea Grant Education Office, The Ohio State University, 283 Arps Hall, 1945 North High Street, Columbus, OH 43210.)