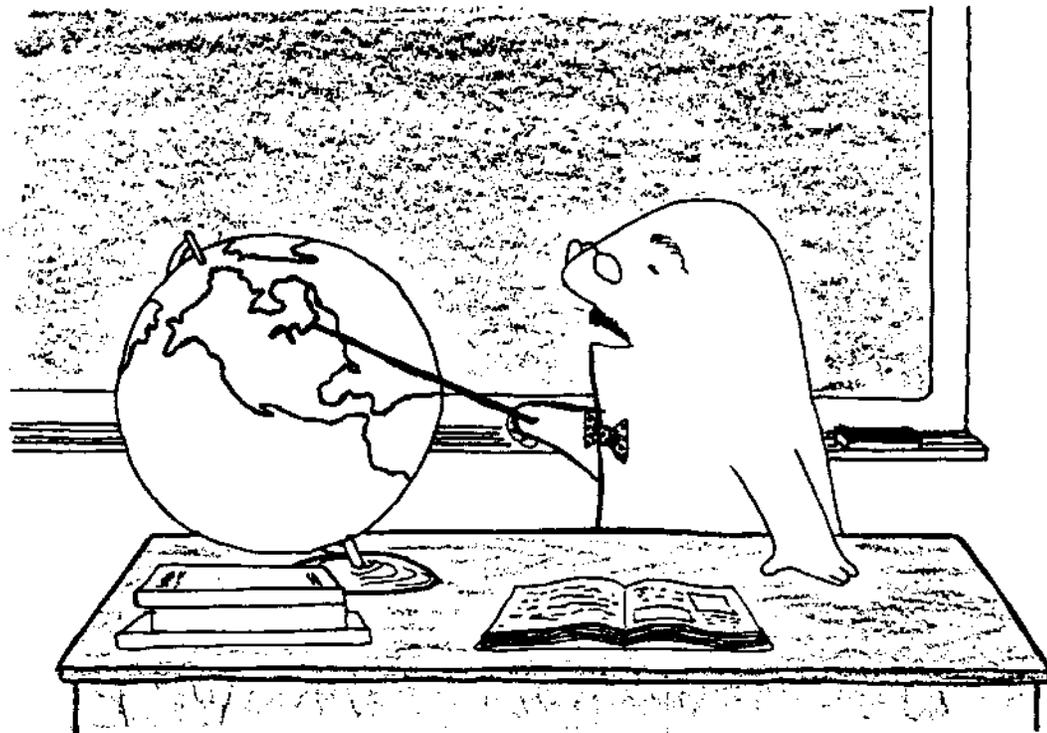*Ohio Sea Grant*

GEOGRAPHY OF THE GREAT LAKES

by
Joyce L. Timmons
and
Rosanne W. Fortner, The Ohio State University

TEACHER GUIDE

OEAGLS-Oceanic
Education
Activities
for
Great
Lakes
Schools

OEAGLS Investigation #14
Completed July 1980
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TEACHER GUIDE

GEOGRAPHY OF THE GREAT LAKES
TEACHER GUIDE

by

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and
Rosanne W. Fortner, The Ohio State University
Ohio Sea Grant Education

OVERVIEW

In Activity A students study the geography of the Great Lakes area including positions of the lakes and the major cities on the shores of the lakes. This is accomplished by examining a map of the United States and by determining distances and directions on a map to locate cities.

Activity B considers the geography of the entire St. Lawrence Seaway and uses the basic map skills applied in Activity A.

In Activity C students determine perimeter and area of the lake by using basic math skills. Distance, rate and time problems are also introduced.

In Activity D students study volume through a measurement exercise and an activity using water displacement.

PREREQUISITE STUDENT BACKGROUND:

Students should be able to read maps and perform basic math operations. They should be aware of what is meant by "squaring" a number.

MATERIALS:

For each student: classroom map of the United States, metric ruler, string, pencils.

For each lab group: two plastic containers of different sizes (lake and overflow); a third container that can be easily measured for volume such as a small milk carton (See Figure 5); graduated cylinder.

OBJECTIVES:

When students have completed this investigation, they should be able to:

1. Name the Great Lakes and locate them on a map.

2. Locate the major cities on the shores of the Great Lakes.

3. Tell what waterway ships use to go from the Great Lakes to the ocean.

4. Use basic math skills to determine distance, area, volume and perimeter.

5. Use water displacement as a measure of volume.

SUGGESTED APPROACH

Activities A, B and C should be done by individual students.

Activity D should be done in groups of three. One student should read the instructions, one operate the equipment and the third observe and report the data.

Introduce the investigation by a discussion with your students related to points raised in the Introduction to the Student Guide. Additional information can be obtained from the appendix included at the end of this guide. The reference at the end of this guide will also provide additional information. You should also conduct a discussion after the investigation is completed. Be sure that the points included at various places in the Student Guide are understood.

A set of three filmstrips and audio tapes is available from Hawkhill Associates, Inc., 125 E. Gilman St., Madison, Wisconsin 53703. The filmstrips provide an excellent introduction to the Lakes and Seaway, their history, economic importance, their climate, and general geography. This would be an effective way to begin or end the investigation.

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

GEOGRAPHY OF THE GREAT LAKES

by

Joyce L. Timmons and Rosanne W. Fortner
Ohio Sea Grant Education Program

INTRODUCTION

Do you know where the Great Lakes are? Have you ever been there? What are the major cities on the Great Lakes? Can you name the lakes? When grade school students were asked questions like these they often said they did not know the answers. The Great Lakes have played a large part in the development of Ohio and the American Midwest, and they continue to be important economically as shipping and recreation centers.

ACTIVITY A: WHAT IS THE GEOGRAPHY OF THE GREAT LAKES AREA?

MATERIALS: Classroom map of the United States, metric ruler.

PROCEDURE

> In this activity students learn the position of the Great Lakes, the major cities around the Great Lakes and some of the distances involved in Great Lakes travel.

The Great Lakes were formed by glaciers during the Ice Age. The glaciers took away earth and rock from the area as they moved over, creating deep basins. When the glaciers melted, the basins filled with water and the Great Lakes were formed.

1. Figure 1 is a map of the Great Lakes area. List the names of the Great Lakes in the lettered spaces that match the letters on the map. Your teacher will provide a map of the United States that you can use to find the names. Put all answers on your work sheet.

More than a century ago, the Chippewa Chief Kichwiski paddled a canoe from Duluth to Buffalo and then walked on to Washington, D.C., to attend a conference on Indian affairs. When the conference was over he walked back to Buffalo and paddled the 1640 km back to Duluth, using the lakes as a natural highway. The settlers of the midwest also used the Great Lakes as highways for shipments and travel. Large cities have developed along the shores of the lakes. Ohio has two of these major cities along Lake Erie. Toledo is at the western end of Lake Erie, and Cleveland is approximately 155 km east of Toledo.

2. Locate Toledo and Cleveland on Figure 1 and list them below the figure in the spaces having the same numbers.

Pennsylvania has one large port on the shore of Lake Erie. This port is called Erie.

3. Find Erie on Figure 1 and list it in the proper space under Great Lakes cities.

4. One hundred fifty-five kilometers northeast of Erie, Pennsylvania, is Buffalo. In what state is Buffalo? Add Buffalo to your list below Figure 1.

> T4. Buffalo is in the state of New York.

There is one large Canadian city on Lake Ontario. It is called Toronto and is in the province of Ontario. Canadian Provinces are similar to states in the United States.

5. Find Toronto on Figure 1 and list it.

Ships pass between Lake Erie and Lake Ontario by way of the Welland Canal. Water moves from one lake to another through the canal and also through the Niagara River. Niagara Falls is located on this river.

2
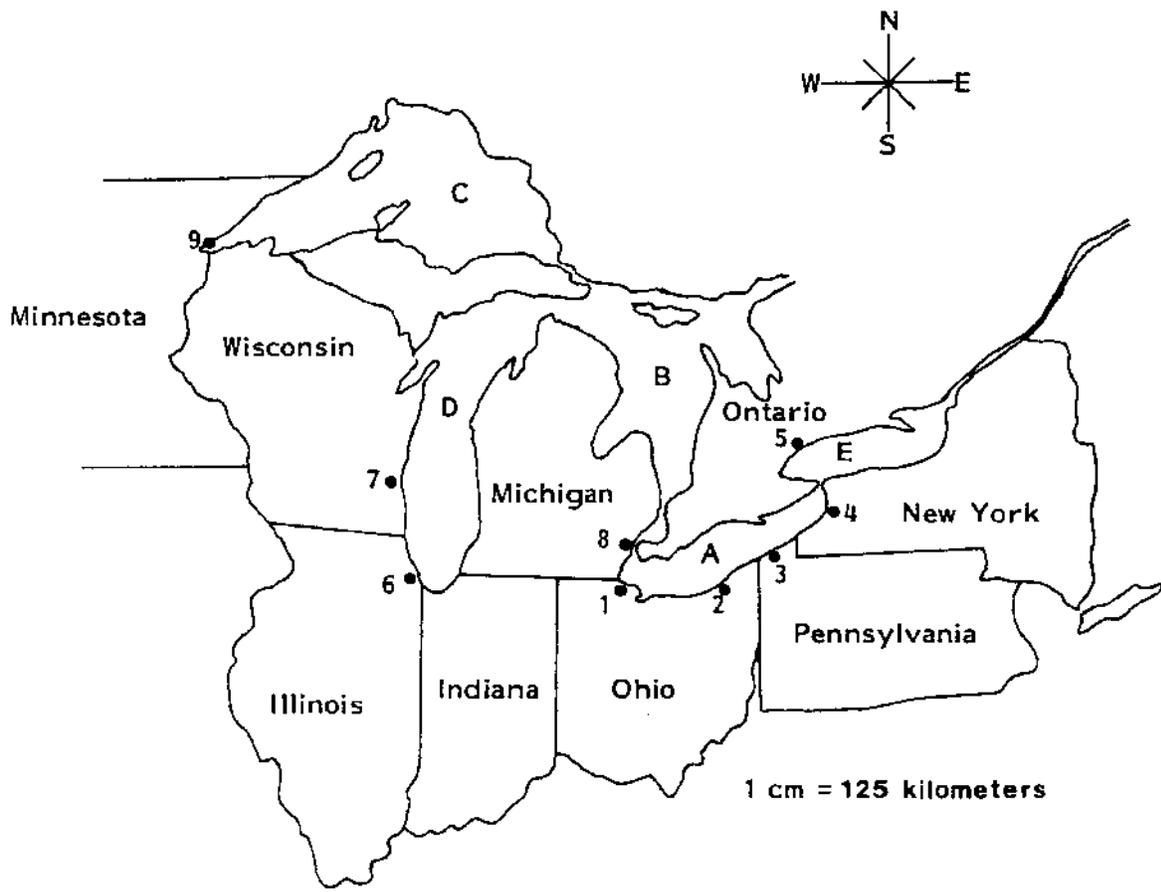
Figure 1: The Great Lakes Area

Major Great Lakes Cities

Great Lakes

a. _____ Lake Erie _____

b. _____ Lake Huron _____

c. _____ Lake Superior _____

d. _____ Lake Michigan _____

e. _____ Lake Ontario _____

1. _____ Toledo _____

2. _____ Cleveland _____

3. _____ Erie _____

4. _____ Buffalo _____

5. _____ Toronto _____

6. _____ Chicago _____

7. _____ Milwaukee _____

8. _____ Detroit _____

9. _____ Duluth _____

3

Three hundred ninety kilometers due west of Toledo is the second largest city in the United States, Chicago.

6. In what state is Chicago? On which lake is the port of Chicago? List Chicago below Figure 1.

> T6. Chicago is in Illinois. Its port is on Lake Michigan.

North of Chicago on the same lake is Milwaukee, Wisconsin. Milwaukee is well known for the beer that it produces.

7. Find Milwaukee on Figure 1 and list it under Great Lakes cities.

Eighty kilometers north of Toledo is Detroit, Michigan. Detroit is the center of the U.S. auto industry.

Detroit is not situated on one of the Great Lakes. It is on the Detroit River, which along with the St. Clair River and Lake St. Clair, forms a connecting waterway between Lake Huron and Lake Erie.

8. List Detroit in the proper space below Figure 1.

Passage through Lake Huron can take a ship either into Lake Michigan or Lake Superior. Ships going to Lake Michigan pass through the Straits of Mackinac. Ships move from Lake Huron to Lake Superior by going through the Soo Locks on the St. Mary's River.

At the extreme western tip of Lake Superior is Duluth, Minnesota.

9. Using the map scale in Figure 1, how far is Duluth from Buffalo by air? By water? Label Duluth below Figure 1.

> T9. From Duluth to Buffalo is about 1200 km by air, or about 1600-1640 km by water.

Duluth is near the Mesabi Range where much of our iron ore comes from. It is a major port for shipping iron ore to the steel mills in Indiana and Ohio.

Cities on the Seaway

A. _____Kingston_____

B. _____Montreal_____

C. _____Quebec_____

D. _____Sept-Iles_____

Gulf of
St. Lawrence

D.

CANADA

C.

Quebec

B.

Ontario

A.

N

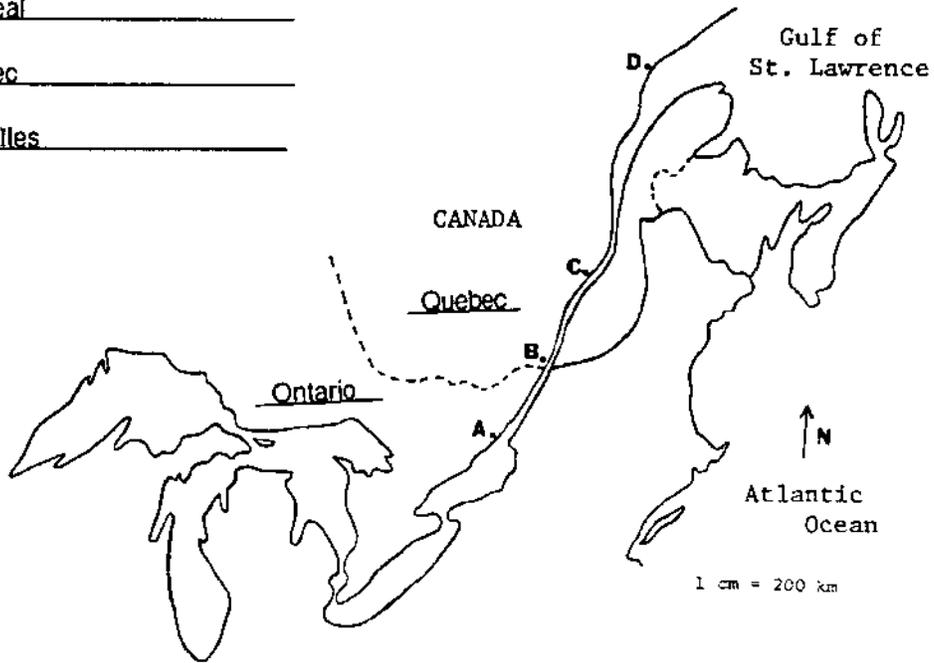Atlantic
Ocean

1 cm = 200 km

Figure 2: The St. Lawrence Seaway

5

ACTIVITY B: WHAT IS THE ST. LAWRENCE SEAWAY?

> This is an extension of Acitivity A, designed to show the geographic relationship of the Great Lakes to North America and the Atlantic Ocean.

The St. Lawrence River begins at the foot of Lake Ontario and flows generally in a northeasterly direction. The river is at least 3 kilometers wide along its entire length. When it widens to 125 kilometers it becomes the Gulf of St. Lawrence.

MATERIALS: Map of North America, pencil or pen, metric ruler.

PROCEDURE

1. Using the large map your teacher provides, find the Canadian provinces through which the St. Lawrence River flows. Label the provinces on the map on your worksheet. Which province is divided by the river?

> T1. Quebec is divided by the river.

2. The St. Lawrence River begins at the foot of Lake Ontario opposite the Canadian city of Kingston. Find Kingston on your map and label it next to the proper letter above the map.

3. Two-hundred fifty kilometers further north along the river is Montreal. In what province is Montreal?

> T3. Montreal is located in the province of Quebec.

Montreal is Canada's oldest town and is called the "White City" because of the large amount of light grey limestone used as building material. The St. Lawrence River is navigable for seagoing vessels to Montreal. In order for ships to move on up the river to the Great Lakes, a series of canals and locks have been built. These locks make up the St. Lawrence Seaway.

4. The city of Quebec is 280 kilometers north of Montreal. Find Quebec on your map and label it in the space given.

Quebec is the capital of the province of Quebec. The name "Quebec" comes from one of Cartier's followers, the French traders who first explored the St. Lawrence. When the follower saw the huge cliff face rising from the water where the city is, he exclaimed, "Que bec!" ("What a beak!" in French) and the name stuck.

5. The river flows north for another 800 kilometers until it widens into the Gulf of St. Lawrence at Sept-Iles. Find Sept-Iles on your map and label it in the proper space.

6. What is the length of the St. Lawrence Seaway from Kingston to Sept-Iles?

> T6. From Kingston to Sept-Iles is about 3000 kilometers.

7. How far would a ship have to travel to go from Sept-Iles, Quebec, to Duluth, Minnesota?

> T7. From Sept-Iles to Duluth is about 3000 kilometers.

8. Assume that a ship is going from Sept-Iles to Duluth. Fill in the names of the rivers, lakes and "connectors" you have learned about in Activities A and B. The list is in the order which a ship would follow from east to west.

> T8. Sept-Iles, Quebec
>
> __St. Lawrence__ River to Kingston, Ontario
>
> Lake __Ontario__
>
> __Welland__ Canal
>
> Lake __Erie__
>
> __Detroit__ River
>
> Lake __St. Clair__ at Detroit
>
> __St. Clair__ River
>
> Lake __Huron__
>
> __Soo__ Locks
>
> Lake __Superior__
>
> Duluth, Minnesota

ACTIVITY C: WHAT ARE THE SURFACE DIMENSIONS OF LAKE ERIE?

The purpose of Activity C is to introduce dimensions such as area and perimeter, to solve distance, rate and time problems and to relate them specifically to Lake Erie.

Lake Erie lies along Ohio's northern border. The lake, fourth in size of the Great Lakes, is the eleventh biggest body of fresh water in the world. The word "Erie" is from the Iroquois Indian word "Erige," meaning cat or panther. This was the name of a tribe of Iroquois living on the southern shore of the lake.

MATERIALS: String, metric ruler.

PROCEDURE

PERIMETER

1. Perimeter is the distance around an object. To find the perimeter of a square you would measure all four sides and add the measurements together. To find the perimeter of an irregular shape is more difficult. How would you find the perimeter of this shape?
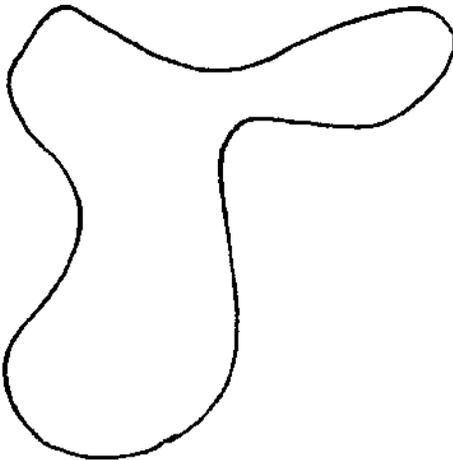
T1. Perimeter may be found by dividing the distance around the object into segments and adding up the segment lengths. Or, a string may be placed around the edge of the object and then measured. Some students may know of the map reader's tolo that rolls along the paper to calculate distances or perimeters.

One way you can approximate the perimeter is to space dots around the irregular object, connect the dots with lines, and then measure each of the segments and find their total length.
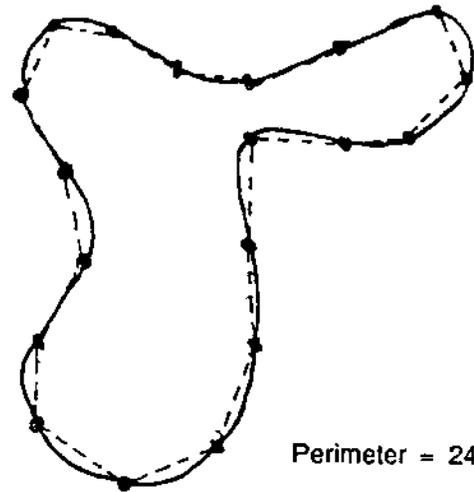
Perimeter = 24 cm

2. The more dots you use, the more accurate your measurement will be. Determine the perimeter of Lake Erie in kilometers using this method and the map in Figure 3.

T2. The perimeter is about 1180 km. This will vary slightly from student to student because of differences in measuring.
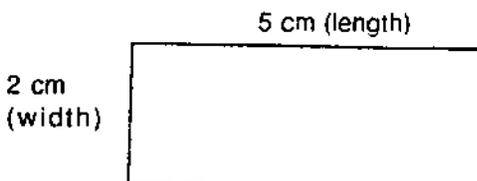
3. A closer approximation of perimeter may be found using a piece of string. The string is laid along the outside of the shape you are measuring, then the amount of string is measured. Use this method to determine the perimeter of Lake Erie in kilometers.

T3. Perimeter measured this way is about 1400 km. This too will vary.

When geographers measure the perimeter of Lake Erie, they include the perimeter of the islands. The perimeter of Lake Erie including the islands is about 1350 km.

AREA

The area of any regular shape can be found by multiplying the length times the width (L X W = AREA). The figure below has an area of 10 square centimeters.

5 cm (length)

2 cm (width)

5 cm x 2 cm = 10 cm^2

7

4. This method can be used to form a very rough approximation of the area of Lake Erie. If the approximate length of Lake Erie is 375 kilometers, the width is approximately 89 kilometers, what is the area?

5. Another way to find area is by using a grid. See Figure 3 on page 6. Each square on the grid of Lake Erie measures one-half centimeter per side. Count the number of one-half centimeter squares that lie completely within the lake. Put that number in the chart under I on your worksheet.

6. Now count the number of partial squares around the perimeter of the lake. Put this number in the chart under II. Divide this number by 2. This converts partial squares to whole square equivalents.

7. Add I and II together and put the total in III. This gives you an estimate of the area of the small map in square one-half centimeters.
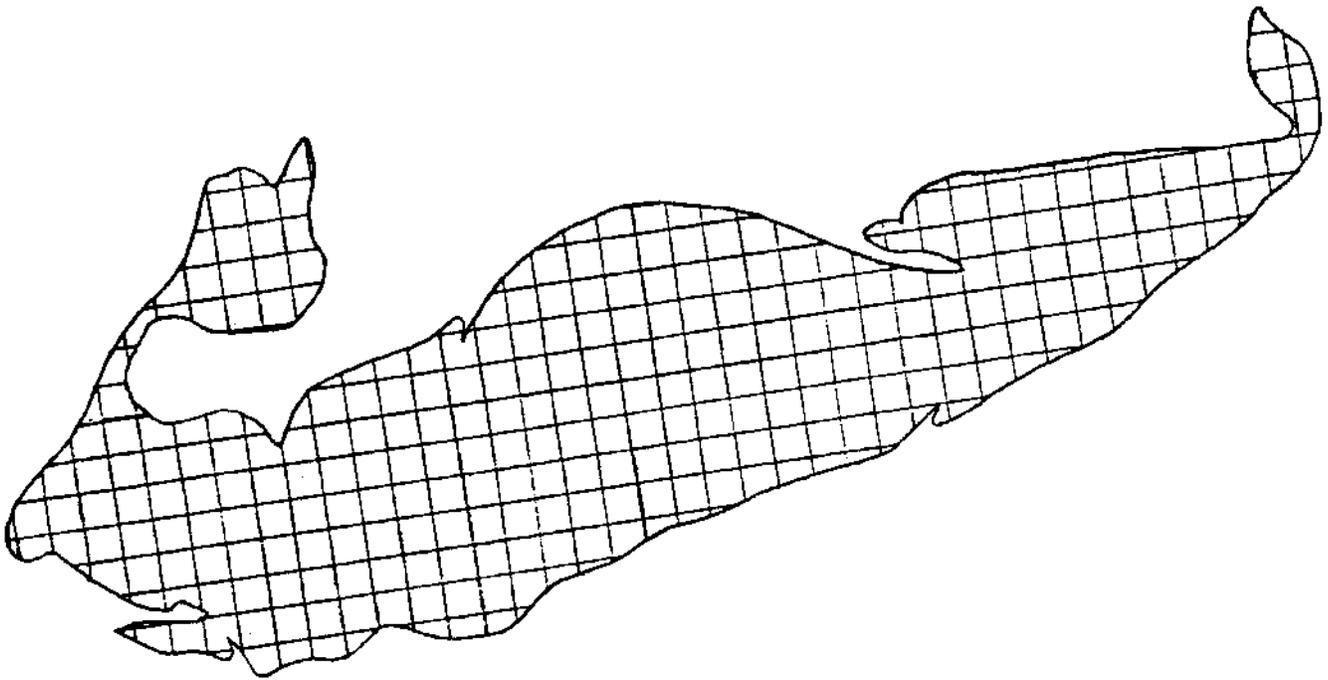
Figure 3. Area map of Lake Erie

I	II	III	IV	V
Number of complete squares:	Number of partial squares 126 divided by 2:	Add results in I and II:	Area in cm^2 (III ÷ 4):	Area of Lake Erie in km^2 (IV x 20^2):
210	63	273	68	27,200

8

8. To convert the area from square one-half centimeters to square kilometers, divide the number in III by 4. This will give you the area in square centimeters. Put the area in cm² in the table under IV.

Four squares 1/2 cm on a side have an area of one square centimeter (1 cm²).

A square is a shape that has four equal sides. If you know the length of one side of a square, you can find the area by multiplying the side by itself. This is called "squaring." For example, if one side of a square has a length of 3 centimeters, its area would be 9 cm².

9. On our map one centimeter in length is equal to about 20 kilometers. What _area_ does one _square_ centimeter represent?

T9. One cm² = 20 km x 20 km = 400 km².

10. Multiply this number by the number of square centimeters in column IV. This is the approximate area of Lake Erie in square kilometers. Put this value in column V in the table.

The actual surface area of Lake Erie is about 25,370 km².

APPLYING WHAT YOU KNOW:
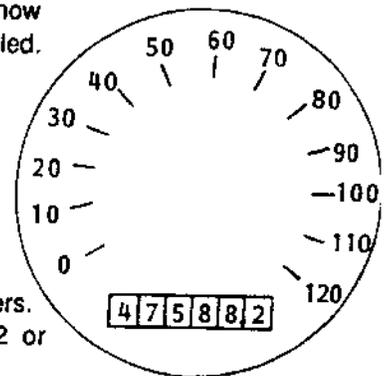
DISTANCE, RATE AND TIME PROBLEMS

The Great Lakes are used to ship heavy bulk products such as iron ore. They are well suited for this purpose because they are deep enough for very large ships to be used. Is travel by waterway the fastest way for people to travel?

Problems that deal with distance, time needed to go from place to place, and speed are called "distance, rate, and time" problems. There is a formula that can be used to compute these values.

$$\text{RATE} = \frac{\text{DISTANCE}}{\text{TIME}} \quad R = \frac{D}{T} \qquad \text{TIME} = \frac{\text{DISTANCE}}{\text{RATE}} \quad T = \frac{D}{R}$$

DISTANCE = RATE X TIME (D = RT)

An odometer indicates how far a vehicle has traveled. This odometer reads, "forty seven thousand, five hundred eighty-eight point two kilometers," or forty seven thousand, five hundred eighty-eight and two tenths kilometers. It is written: 47,588.2 or 47,588 2/10.

You can determine how far you have gone by subtracting your odometer reading at the beginning of your journey from the reading at the end of the journey. If when you start out your odometer reads 12,583.1 and when you reach your destination it reads 12,621.8, you have traveled 38.7 kilometers.

$$\begin{array}{r} 12,621.8 \\ - \underline{12,583.1} \\ 38.7 \text{ kilometers} \end{array}$$

11. A ship sets sail for Buffalo from Toledo going 40 km/hr. The ship reaches Buffalo 10 hours later. How far is it from Toledo to Buffalo by water? (Show all your work on you work sheet.)

T11. D = R x T
= 40 km/hr x 10 hr
= 400 km

12. At the same time a man on a motor bike leaves Toledo following routes 2 and 90. The odometer on the man's motor bike reads 28,749.1 km when he leaves Toledo and 29,229.1 km when he reaches Buffalo. How far has he traveled?

T12. 29,229.1
- 28,749.1
480.0 km

13. If the man traveled at 40 km/hr, how long did he ride?

```
T13.  T = D
          R

      = 480 km
        40 km per hour

      = 12 hours.
```

14. If you had a choice of going from Toledo to Buffalo by a car traveling at 88 km/hr or a ship traveling at 40 km/hr, which would you choose if:

a) You wanted to get to Buffalo the shortest way?

```
T14a.  The shortest route is by ship.
```

b) You wanted to get to Buffalo the fastest way?

```
T14b.  The fastest way is by car.
```

15. What speed would you have to drive in order to arrive at Buffalo at the same time the ship arrives?

```
T15.  R = D
          T

      = 480 km
        10 hours

      = 48 km per hour
```

Figure 4. The Lake Erie Region

1 centimeter = 20 kilometers
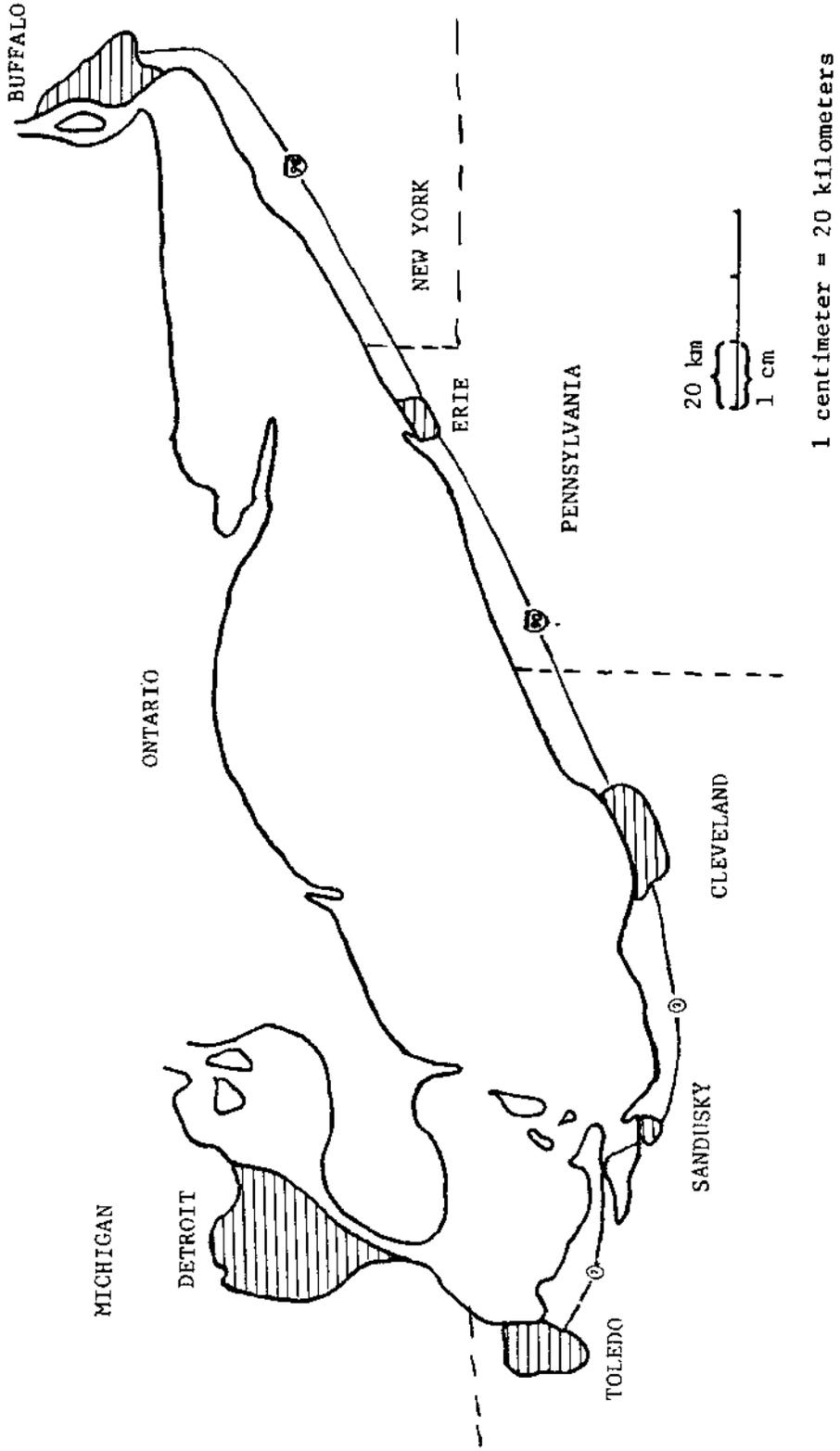
20 km
1 cm

ACTIVITY D: HOW CAN WE FIND THE VOLUME OF A LAKE OR OTHER CONTAINER?

In Activity D students measure volume in two different ways. First, basic math measurements are used. Displacement is then introduced.

If you set up the apparatus ahead of time, be sure the lake container is _completely_ full.

MATERIALS: Two plastic containers; an easily measured container such as a small, clean milk carton; a metric ruler; and a graduated cylinder.

PROCEDURE

One half of all the fresh water in the world is in the Great Lakes. Lake Erie is the shallowest of the Great Lakes.

Volume is a measure of the amount of liquid, air, etc., a container will hold. To find the volume of a container you multiply the length times width times height. The units used to measure volume are called cubic measurements, such as cubic centimeters (cm^3).

1. What is the volume of the container pictured below?
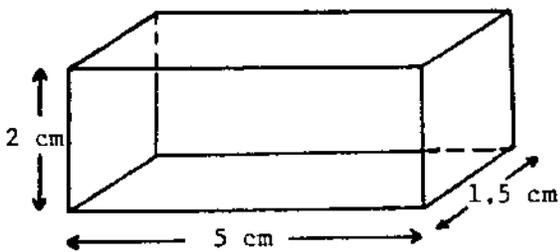
$$V = L \times W \times H$$

T1. Volume of the rectangular solid:

5 cm x 1.5 cm x 2 cm = 15 cm^3

Geographers measure the surface area of Lake Erie to be 25,370 km^2. The depth of the lake varies from east to west and north to south, so it is necessary to average several numbers to find a depth to use for calculating volume.

2. The depths of the parts of Lake Erie are shown below. Add up the average depths for the basins and divide by three to get an average depth for the whole lake. (This gives only a rough estimate, since the three basins are not all the same size and shape.)

T2. Average depth of Lake Erie:

```
   7 m
  18              49 ÷ 3  =  16.3 meters
+ 24
  49 m
```

3. Now that you know the area (L x W) and the depth (H), you can find the volume of the lake. (Don't forget to convert meters to kilometers! There are 1000 meters in one kilometer.)
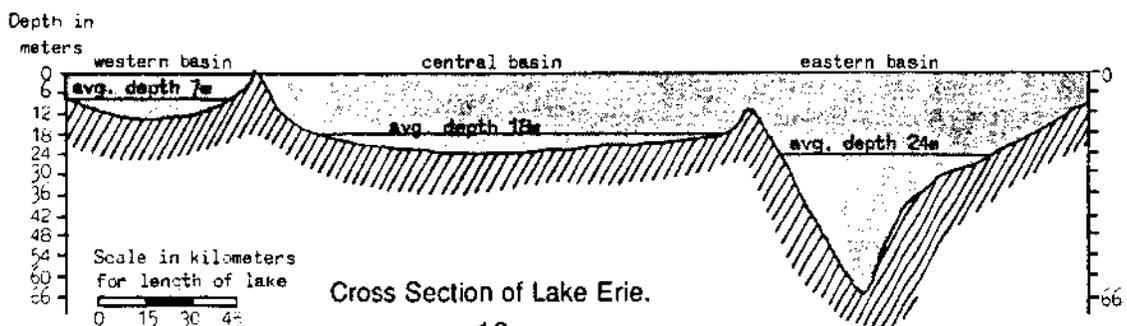
T3. Volume of Lake Erie:

Conversion of meters to kilometers.

$$\frac{16.3 \text{ meters}}{1000 \text{ meters/km}} = \text{about } .02 \text{ kilometers deep}$$

$$V = L \times W \times H$$
$$= 25,370 \text{ km}^2 \times .02 \text{ km}$$
$$= 507.4 \text{ km}^3$$

NOTE: If students use the more exact .016 km for depth, the resulting volume will be 405.9 km^3.

Cross Section of Lake Erie.

Another way to measure volume is by **displacement**. Displacement is the word used to describe the amount of water that has to move to another place when anything with some weight is added to the water. You can see the effects of displacement when you sit in a bath tub full of water and the water level rises. Your body takes up the space where the water was. Ships are weighed by the amount of water they displace when they float.

4. Set up your apparatus as in Figure 5. The milk carton will represent a ship. The inner plastic container represents Lake Erie and the outer container is to catch overflow.
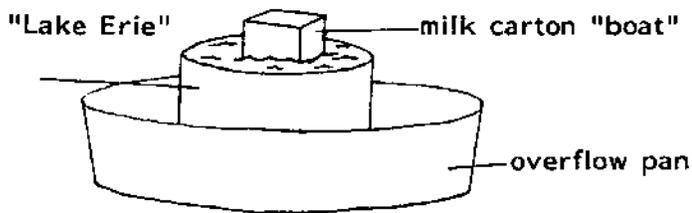

Figure 5. Model of a Ship on Lake Erie.

5. Fill the inner plastic container that represents Lake Erie with as much water as it will hold. The water must be all the way up to the top. Float your empty "ship" in the container. Discuss what happens.

> T5. Some (very little) water should spill over. The "ship" may not be heavy enough to displace enough water to break the surface tension.

6. Fill your ship container with water. Carefully float it in the lake container. You may have to steady it to keep it from tipping over. When water stops spilling from the lake into the overflow basin, remove both the ship and the lake containers from the overflow basin, being careful not to spill any more water. Pour the water from the overflow basin into the graduated cylinder and measure it. How much water was displaced by the ship container?

> T6. This will vary with the ship container used.

7. Discard the water in the ship container. Pour the water from the graduated cylinder into the ship container. Is it the same amount of water? Discuss why this happens.

8. Measure the volume of the ship container by using a centimeter scale. Is the volume in cubic cm the same as the volume in milliliters?

> T7-8. The ship should displace the same volume of water that it contained. This is the basis for the definition of displacement.

In this activity you measured the water that spilled out of your model lake. In nature, the lake is so large that the displacement of water by large ships cannot be detected.

REVIEW QUESTIONS

1. What are the names of the Great Lakes?

> R1. The Great Lakes are Erie, Huron, Ontario, Superior and Michigan.

2. What is the name of the lake along the northern border of Ohio?

> R2. Lake Erie forms part of the northern border of Ohio.

3. What are the names of five of the large cities along the shores of the Great Lakes?

> R3. The following are large cities on the Great Lakes: Duluth, Toledo, Detroit, Chicago, Cleveland, Erie, Toronto, Milwaukee, and Buffalo. Students should list any five of them.

4. What waterway is used by ships going from the ocean to the Great Lakes?

> R4. The St. Lawrence Seaway is used by boats going from the ocean to the Great Lakes.

5. How do you find the area of an object?

> R5. Area = Length x Width. Grids may also be used.

6. What other way besides measuring with a ruler is used to determine volume?

> R6. The amount of water displaced by an object is equal to its volume.

7. What is the distance around an object called?

> R7. Perimeter is the distance around an object.

EVALUATION ITEMS

1. How were the Great Lakes made?

   a. Paul Bunyan dug them looking for gold.
   b. Land sank and rain filled the basins.
   c. Earthquakes cracked the earth's surface.
   *d. Glaciers carved basins and ice melted.

2. Which city on the Great Lakes is the center of the U.S. auto industry?

   a. Cleveland
   *b. Detroit
   c. Toledo
   d. Erie

3. Which of the Great Lakes lies entirely within United States boundaries?

   *a. Lake Michigan
   b. Lake Erie
   c. Lake Ontario
   d. Lake Superior

4. Which large Canadian city borders the Great Lakes on Lake Ontario?

   a. Victoria
   b. Duluth
   *c. Toronto
   d. Buffalo

5. Milwaukee is a well-known beer producing city. In which state is Milwaukee located?

   a. Illinois
   *b. Wisconsin
   c. Minnesota
   d. Michigan

6. Which Canadian province is divided by the St. Lawrence River?

   a. New Brunswick
   b. Newfoundland
   *c. Quebec
   d. Ontario

7. Which waterway connects the Great Lakes to the Atlantic Ocean?

   a. Gulf Stream
   *b. St. Lawrence Seaway
   c. Lake Ontario
   d. Mississippi River

8. What is the perimeter of an object?

   a. The amount of material an object can hold.
   b. Half the distance across it.
   c. The distance across it.
   *d. The distance around it.

You may use a calculator to find the answers to the remaining questions.

A boat traveled from Sept-Iles to Duluth. Odometer readings (in km) at the beginning and end of the trip were as follows:

| 3 | 6 | 4 | 8 | 9 . | 0 |

Odometer reading at Sept-Iles

| 4 | 0 | 5 | 0 | 9 . | 0 |

Odometer reading at Duluth

9. The non-stop trip took 102 hours to complete. The boat's speed was about

   a. 55 km per hour.
   *b. 40 km per hour.
   c. 25 km per hour.
   d. 10 km per hour.

Use the following information to answer questions 10 and 11.

   A lake's average length is 300 km.
   Its average width is 250 km.
   Its average depth is 0.8 km.

10. What is the surface area of this lake?

   a. 93,750 square km
   *b. 75,000 square km
   c. 60,000 square km
   d. 550.8 square km

11. What is the volume of this lake?

   a. 93,750 km^3
   b. 75,000 km^3
   *c. 60,000 km^3
   d. 550.8 km^3

REFERENCE

Fortner, R. W. and V. J. Mayer, eds. The Great Lake Erie. Columbus: The Ohio State University, 1987.

Appendix

From Great Lakes Notebook, Fourth Coast Facts and Issue. International Joint Commission, Great Lakes Regional Office, P.O. Box 32869, Detroit, MI 48232-2869 Phone: (313) 226-2170

Lake Erie is the fourth largest of the Great Lakes, but the twelfth largest freshwater lake in the world. Once called a "dying lake," it is making a steady recovery with the help of research, regulations, and care.

Lake Erie Watershed

Extends from the south central portion of the Michigan thumb near Port Huron, Michigan, south to northwestern Ohio and eastern Indiana, east along Lake Erie through Ohio and Pennsylvania to Niagara Falls, then northwest to Sarnia, Ontario. The water provided by Lake Erie for waterborne commerce, navigation, manufacturing, power production, and recreation has led to intensive industrial development along its shores.

Lake Erie Facts

LENGTH: .... 241 mi (387 km)
BREADTH: .... 57 mi (91 km)
DEPTH: .... 62 ft (18 m) average, 210 ft (64 m) maximum
VOLUME: ....116 cubic miles (484 cubic km)
WATER SURFACE: ....9,910 sq. mi. (25,666 sq. km)
TOTAL AREA: (land & water): ... 33,500 sq. mi (86,765 sq km)
SHORELINE LENGTH: .... 856 mi (includes islands) (1,377 km)
OUTLET: .... Niagara River and Falls
DETENTION TIME: .... 2.6 yrs. (shortest of the lakes)

Geography

COUNTRIES: .... Canada and United States
SURROUNDING STATES: .. Michigan, Pennsylvania, Indiana, Ohio, New York
MAJOR CITIES: .... Detroit, MI; Buffalo, NY; Cleveland, Toledo, OH; Erie, PA; Windsor, ONT
MAJOR PORTS: .... Detroit, MI; Buffalo, NY; Ashtabula, Cleveland, Conneaut, Lorain, Sandusky, Toledo, OH; Erie, PA
POPULATION: .... 11,347,500 (US); 1,515,445 (Canada)
RECREATION: .... Major recreation areas: Bass Islands, OH; Presque Isle, PA; Niagara Falls, NY. NATIONAL RECREATION AREA: Cuyahoga Valley, OH. NATIONAL WILDLIFE REFUGE: Ottawa, OH. FRESHWATER ESTUARINE WILDLIFE REFUGE: Ottawa, OH. FRESHWATER ESTUARINE SANCTUARY: Old Woman Creek, OH. Many state and provincial parks provide a variety of outdoor recreation opportunities including boating, fishing, swimming, canoeing, hiking.

How Water is Used

AGRICULTURE: .... 41 million gallons per day (mgd)
POWER PRODUCTION: ....9,697 mgd
MANUFACTURING: ....5,783 mgd
DOMESTIC: ....1,492 mgd
MINING: .... 198 mgd
COMMERCIAL: .... 403 mgd
WATERBORNE COMMERCE, FISHERY, RECREATION: .. instream uses of water
(does not withdraw or divert water from its natural source)

Land Uses (US only)

AGRICULTURE:	50.5%
FOREST:	18.1%
URBAN/INDUSTRIAL:	11.4%
OTHER:	2.6%

Shoreline Uses (US only)

RESIDENTIAL:	47.0%
AGRICULTURE:	16.0%
RECREATION:	15.0%
COMMERCIAL:	12.0%
OTHER:	20.0%

Economic Importance of Region

MANUFACTURING:
* part of the U.S. "industrial crescent"
* produces 66% of U.S. cars
* a principal steel producing area
* glass manufacturing & ship building

AGRICULUTURE :
* economy along western shore is based on agriculture
* major products: soybeans, vegetables, wheat, dairy products, grapes and orchard fruit

SHIPPING:
* eleven ports serve as major distribution center for iron ore, coal & manufactured goods

MINING:
* sand and gravel for construction
* limestone and gypsum

FISHERY:
* commercial fishery valued at $10,554,174 in 1977
* second largest Great Lakes sports fishery valued at $50 million annually. Major species: carp, catfish, white bass, wallete, yellow perch

Resource Problems

Problem	Source	Effects
Phosphorus loadings	Agricultural runoff, combined sewer overflows, inadequate wastewater treatment, use of phosphate detergents, industrial discharges	Eutrophication (overfertilizes water which causes excessive plant growth)
Toxic Substances (PCBs, mercury)	Industrial discharges, leaching from hazardous waste disposal sites and sediments	Fish contamination, human health risks, economic impacts
Organic Pollution, coliform bacteria	Inadequate wastewater treatment	Human health risks, taste and odor problems
Heavy metals (zinc, iron)	Industrial dishcharges (steel and auto principally), airborne pollutants	Turbidity (decreases recreational and aesthetic enjoyment), fish contamination, human health risks

IMPROVEMENTS

*Significant reductions in phosphorus loadings from improved controls
*Mercury levels in fish have declined because of upstream industrial controls

Prepared by the Great Lakes Basin Commission, Box 999, Ann Arbor, MI 48104 10/15/79

Lake Ontario's the smallest of the Great Lakes. It is bordered by Niagara Falls to the west and the beautiful Thousand Islands to the east.

Lake Ontario Watershed

Extends from the Niagara River, southeast through northern New York, to the point where the St. Lawrence River forms the international border between the United States and Canada, then west through soutehrn Ontario, through Hamilton, Ontario to Niagara Falls.

The Lake Ontario watershed is largely rural, with many scenic resort areas, and a few large urban areas located on the Canadian portion of the shore.

Lake Ontario Facts

LENGTH:................................193 mi (310 km)
BREADTH:................................. 53 mi (85 km)
DEPTH:..... 283 ft (86 m) average, 802 ft (243 m) maximum
VOLUME:..................393 cubic miles (1,637 cubic km)
WATER SURFACE:............7,340 sq. mi. (19,010 sq. km)
TOTAL AREA: (land & water):... 32,100 sq. mi (83,139 sq km)
SHORELINE LENGTH:.... 726 mi (includes islands) (1,168 km)
OUTLET:..............St. Lawrence River to the Atlantic Ocean
DETENTION TIME:.................................. 6 yrs.

Geography

COUNTRIES:.............Canada and United States
SURROUNDING STATES:...New York
MAJOR CITIES: . . . Rochester, Utica-Rome, Syracuse, NY; Hamilton, Kitchener-Waterloo, Toronto, Kingston, Ontario
MAJOR PORTS:..........Oswego, NY; Toronto, Hamilton, Ontario
POPULATION: .... 2,090,300 (US); 14,035,364 (Canada)
RECREATION:...........POINTS OF INTEREST: Niagara Falls, Thousand Islands, Genesee Gorge, Adirondacks Mountains, Finger Lakes, NY; St. Lawrence Islands National Park, Ontario. The lake and its tributaries provide a variety of outdoor recreation opportunities including fishing, swimming, boating, hiking, canoeing.

How Water is Used

AGRICULTURE:...................... 24 million gallons per day (mgd)
POWER PRODUCTION:....................................1,771 mgd
DOMESTIC:..197 mgd
MINING:... 59 mgd
MANUFACTURING:.......................................339 mgd
COMMERCIAL AND INDUSTRIAL:............................ 59 mgd
WATERBORNE COMMERCE, FISHERY, RECREATION:.. instream uses of water
(does not withdraw or divert water from its natural source)

Land Uses (US only)

FOREST:	64.3%
AGRICULTURE:	20.4%
OTHER:	11.8%
URBAN/INDUSTRIAL:	3.5%

Shoreline Uses (US only)

RESIDENTIAL:	40.0%
AGRICULTURE:	33.0%
INDUSTRIAL AND COMMERCIAL:	8.0%
OTHER:	7.0%

Economic Importance of Region

AGRICULUTURE :
* fruit, vegetables, livestock and dairy products
* grape and wine producing area

INDUSTRY:
* 62% of Canada's steel is produced here
* Canada's leading commerical, industrial and population center located here
* machinery, electrical goods, transportation equipment, printing and publishing industries
* world leader in production of photographic, optical and scientific equipment in Rochester, NY

TOURISM:
* several scenic resort areas including Niagara Falls, Finger Lakes, Adirondack Mountains support an important tourist industry

FISHERY:
* commercial fishery valued at $850,000 in 1977
* Major species: yellow perch, white perch, sunfish, bullhead, smelt

Resource Problems

Problem	Source	Effects
Coliform bacteria	Combined sewer overflows, inadequate wastewater treatment	Human health problems, taste and odor problems
Phenols	Industrial discharges especially from steel and petroleum industry	Human health problems, taste and odor problems
Toxic Substances (PCBs, mirex)	Industrial discharges, leaching from hazardous waste disposal sites into groundwater	Human health problems, fish contamination, economic losses
Phosphorus loadings	Land runoff, inadequate wastewater treatment, airborne pollutants	Eutrophication (over fertilizes water causing excessive plant growth)
Heavy metals (zinc, iron)	Mining operations	Fish contamination, human health risks

IMPROVEMENTS

*Reduction in phosphorus loadings due to regulatory controls

Prepared by the Great Lakes Basin Commission, Box 999, Ann Arbor, MI 48104 10/15/79

Lake Huron is the second largest Great Lake and the fifth largest freshwater lake in the world. Seventy-two percent of the watershed is still covered with forest.

Lake Huron Watershed

Extends from Port Huron, Michigan, northwest through the thumb area of Michigan's Lower Peninsula, then through the Straits of Mackinac, to Sault Ste. Marie, east through the Province of Ontario bordering Georgian Bay, then southwest again to Sarnia, Ontario.

The Lake Huron watershed is seventy-two percent forested, sparsely populated, scenically beautiful, and economically dependent on its rich natural resources.

Lake Huron Facts

LENGTH:.................................206 mi (331 km)
BREADTH:................................183mi (294 km)
DEPTH:......195 ft (59 m) average, 750 ft (228 m) maximum
VOLUME:..................849 cubic miles (3536 cubic km)
WATER SURFACE:...........23,000 sq. mi. (59,570 sq. km)
TOTAL AREA: (land & water): ...74,800 sq. mi (193,732 sq km)
SHORELINE LENGTH: .. 3,180 mi (includes islands) (5,116 km)
OUTLET:........................St. Clair River to Lake Erie
DETENTION TIME:...............................22.6 yrs.

Geography

COUNTRIES:..............Canada and United States
SURROUNDING STATES: ....Michigan
MAJOR CITIES:......Bay City, Saginaw, Detroit, Port Huron, Midland, Alpena, Cheboygan, MI; Sudbury, London, Sarnia, Ontario
MAJOR PORTS:......Detroit, Port Huron, Alpena, Saginaw, Sault Ste. Marie, Port Dolomite, Presque Isle, MI; Goderich, Depot Harbor, Ontario
POPULATION:.........1,321,000 (US); 937,769 (Canda)
RECREATION:.........PLACES OF INTEREST: AuSable, Carp, Titibawasee Rivers, Mackinac Island, MI; Bruce Peninsula, Georgian Bay, Patogannissing Bay Islands, Ontario.
NATIONAL FORESTS; Huron and Hiawatha, MI. More than 400,000 acres of national forests, scenic rivers, beaches, state and provincial parks provide year-round outdoor recreation. Activities include: boating, fishing, swimming, winter sports, canoeing, hiking.

How Water is Used

AGRICULTURE:.......................15 million gallons per day (mgd)
POWER PRODUCTION:..................................1,100 mgd
DOMESTIC:... 93 mgd
MINING:.. 73 mgd
MANUFACTURING:....................................... 679 mgd
COMMERCIAL:...31 mgd
PUBLIC LANDS:... 1 mgd
WATERBORNE COMMERCE, FISHERY, RECREATION:... instream uses of water
(does not withdraw or divert water from its natural source)

Land Uses (US only)

AGRICULTURE:	48.4%
FOREST:	25.7%
OTHER:	22.5%
URBAN/INDUSTRIAL:	3.5%

Shoreline Uses (US only)

RESIDENTIAL:	42.0%
FOREST:	32.0%
AGRICULTURE:	15.0%
RECREATION:	4.5%
COMMERCIAL AND INDUSTRIAL:	3.4%
OTHER:	3.1%

Economic Importance of Region

RECREATION AND TOURISM:
* important source of income for regional economy
* 27,000 seasonal homes along the shore

INDUSTRY:
* $143 million forest industry
* one of largest U.S. chemical producers located along southern shoreline

MINING:
* major cement producer
* 17% of free world's uraninum reserves
* 43% of free world's nickel reserves
* copper, platinum, silver, and gold deposits found here

AGRICULUTURE :
* 1/3 U.S. field bean crop grown here
* hay, corn, winter wheat, sugar, soybeans, fruits

FISHERY:
* commercial fishery at over $3.5 million in 1977
* major species: whitefish, yellow perch, catfish, chub, yellow pickerel

Resource Problems

Overall, the water quality of Lake Huron is excellent. However, water quality problems have been identified in Saginaw Bay and certain nearshore areas.

Problem	Source	Effects
Suspended solids	Dishcharges from pulp and paper industry, agricultural runoff	Turbidity (reduces aesthetic quality and recreational use) disturbs aquatic systems
Phosphorus	Inadequate wastewater treatment, combined sewer overflows, agricultural and commercial forest runoff, airborne pollutants	Eutrophication (overfertilizes water which causes excessive plant growth)
Toxic Substances (PCBs, dioxin)	Industrial discharges from chemical industry	Fish contamination, human health risks, economic losses
Radium	Uranium mining	Human health risks
Inadequate public access to shoreline	Private development	Limits public recreational use and tourist revenues

Prepared by the Great Lakes Basin Commission, Box 999, Ann Arbor, MI 48104 10/15/79

Lake Superior is the largest of the 5 Great Lakes and the largest freshwater lake in the world.

Lake Superior Watershed

The Lake Superior watershed extends from northeastern Minnesota through northwest Wisconsin, the upper peninsula of Michigan, and northwestern Ontario. The area is rich in natural resources and scenic beauty, sparsely populated and economically dependent on its natural resources.

Lake Superior Facts

LENGTH: . . . . 350 mi (563 km)
BREADTH: . . . . 160 mi (257 km)
DEPTH: . . 489 ft (148 m) average, 1,333 ft (405 m) maximum
VOLUME: . . . . 2,935 cubic miles (12,034 cubic km)
WATER SURFACE: . . . . 31,700 sq. mi. (81,152 sq. km)
TOTAL AREA: (land & water): . . 31,000 sq. mi (207,318 sq km)
SHORELINE LENGTH: . . 2,980 mi (includes islands) (4,798 km)
OUTLET: . . . . St. Marys River to Lake Huron
DETENTION TIME: . . . . .191 yrs.

Geography

COUNTRIES: . . . . Canada and United States
SURROUNDING STATES: . . Michigan, Minnesota, Wisconsin
MAJOR CITIES: . . . . Duluth, MN; Marquette, Sault Ste. Marie, MI; Thunder Bay, Sault Ste. Marie, ONT; Ashland Superior, WI
MAJOR PORTS: . . . . Duluth, Taconite Harbor, Silver Bay, MN; Marquette, MI; Thunder Bay, ONT; Superior, WI
POPULATION: . . . . 558,100 (US); 147,914 (Canada)
RECREATION: . . . . NATIONAL PARKS: Isle Royale, MI; Voyageurs, MN; Pukaskwa, ONT. 2 NATIONAL LAKESHORES: Apostle Ils, WI; Pictured Rocks, MI. NATIONAL FORESTS: Superior, MN; Chequamegon, WI; Ottawa, MI; Hiawatha, MI. In addition, there are many state and provincial parks which provide a variety of outdoor recreation opportunities including winter sports, hiking, fishing, hunting, swimming, boating, canoeing.

How Water is Used

AGRICULTURE: . . . . 2 million gallons per day (mgd)
POWER PRODUCTION: . . . . 448 mgd
DOMESTIC: . . . . 37 mgd (provides drinking water for 19 communities)
MINING: . . . . 219 mgd (metals such as iron, copper)
MANUFACTURING: . . . . 264 mgd (chemicals, paper, food processing)
COMMERCIAL: . . . . 14 mgd
FISH HATCHERIES: . . . . 13 mgd
PUBLIC LANDS: . . . . 4 mgd
WATERBORNE COMMERCE, FISHERY, RECREATION: . . instream uses of water
(does not withdraw or divert water from its natural source)

Land Uses (US only)

FOREST:	89.6%
OTHER:	6.4%
AGRICULTURE:	0.6%
URBAN:	0.2%

Shoreline Uses (US only)

No exact figures are available, however 61% of the basin's private development is located at the shore.

Economic Importance of Region

MINING:
* supplies the U.S. with 80% of its iron ore
* produces 5% of the world's copper and contains major reserves of nickel

LUMBERING:
(Pulp & Paper)
* important pulp, firewood, paper and board producing region of the U.S.

SHIPPING:
* Lake Superior ports supply the U.S. industrial crescent with iron ore, grain, coal, and limestone

FISHERY:
* commercial fishery valued at over $4 million in 1977
* Third largest sports fishery in the Great Lakes. Major species: chub, brown trout, chinook salmon, coho salmon.

TOURISM:
* a major source of revenue for regional economy

Resource Problems

Lake Superior is the most pristine Great Lake, however, there are certain nearshore water quality problems and other resouce problems.

Problem	Source	Effects
Asbestos fibers	Mining operations	Fish contamination, possible human carcinogen if enters water supply
Phosphorus loadings	Inadequate wastewater treatment, agricultural runoff	Eutrophication (overfertilization causing excessive plant growth)
Toxic Substances (PCBs, mercury)	Industrial discharges, airborne pollutants	Fish contamination, economic impacts, human health risks,
Red Clay Erosion	Natural causes such as wave action and human development activities along shore	Aesthetic impacts, destroys fish spawning beds, property damage, makes water unsuitable for fishing and swimming
Limited public access to shore	Private development along shore, conflicting land uses	Limits public recreational use and tourist revenues

Lake Michigan is the third largest Great Lake and the sixth largest freshwater lake in the world. It is the only Great Lake entirely within the United States.

Lake Michigan Watershed

Extends from just north of Chicago through Wisconsin and Michigan's Upper Peninsula, then east to the Straits of Mackinac, south through Michigan to northeast Indiana, and back again to a point east of Chicago. The northern watershed is covered with forests, sparsely populated, and economically dependent on natural resources, while the southern portion is heavily populated with intensive industrial development and rich agricultural areas along the shore.

Lake Michigan Facts

LENGTH: . . . . .307 mi (493 km)
BREADTH: . . . . 118 mi (189 km)
DEPTH: . . . . . .279 ft (85 m) average, 923 ft (280 m) maximum
VOLUME: . . . . .1,180 cubic miles (4,915 cubic km)
WATER SURFACE: . . . . 22,300 sq. mi. (57,757 sq. km)
TOTAL AREA: (land & water): . . .67,900 sq. mi (175,861 sq km)
SHORELINE LENGTH: . . .1,660 mi (includes islands) (2,670 km)
OUTLET: . . . . Straits of Mackinac to Lake Huron
DETENTION TIME: . . . . 99.1 yrs.

Geography

COUNTRIES: . . . . United States
SURROUNDING STATES: . . Michigan, Illinois, Indiana, Wisconsin
MAJOR CITIES: . . . . Chicago, IL; Green Bay, Milwaukee, WI; Gary, South Bend, IN; Muskegon, Grand Rapids, Lansing, MI
MAJOR PORTS: . . . . Chicago, IL; Escanaba, Ludington, and Muskegon, MI; Gary, IN; Green Bay, Milwaukee, WI
POPULATION: 13,970,900
RECREATION: . . . . NATIONAL LAKESHORES: Indiana Dunes, IN; Sleeping Bear Dunes, MI. Forests, islands, fine beaches, wild and scenic rivers, Lake Michigan, and many state parks provide a variety of outdoor recreation activities. These include: fishing, hiking, swimming, boating, and winter sports.

How Water is Used

AGRICULTURE: . . . . 69 million gallons per day (mgd)
POWER PRODUCTION: . . . . .10,193 mgd
MANUFACTURING: . . . . . 5,655 mgd (auto production, food processing, paper production)
DOMESTIC: . 1,219 mgd (provides drinking water for over 50 communities)
COMMERCIAL: . . . . 437 mgd
MINERALS: . . . . 76 mgd
WATERBORNE COMMERCE, FISHERY, RECREATION: . . instream uses of water (does not withdraw or divert water from its natural source)

Land Uses (US only)

FOREST:	49.8%
AGRICULTURE:	23.4%
OTHER:	23.3%
URBAN/INDUSTRIAL:	3.5%

Shoreline Uses (US only)

URBAN/INDUSTRIAL:	39.0%
FOREST LANDS:	24.0%
AGRICULTURE:	20.0%
RECREATION:	12.0%
OTHER:	5.0%

Economic Importance of Region

AGRICULUTURE :
* region is a leading U.S. grower of fruits, vegetables, dairy products, dry beans and other agricultural goods

INDUSTRY:
* 50% of nation's steel produced here
* 25% of U.S. paper production
* important printing and publishing center

SHIPPING:
* iron ore, coal, steel, grain, and farm products shipped through Lake Michigan ports

FISHERY:
* commercial fishery valued at almost $5 million in 1977
* revenues from sports fishery valued at $250 million
  Major species: chinook and coho salmon, brown and lake trout, northern pike, walleye, bass, perch

MINING:
* sand and gravel, limestone, dolomite

TOURISM:
* multi-million dollar outdoor recreation industry

Resource Problems

Problem	Source	Effects
Phosphorus loadings	Agricultural runoff, combined sewer overflows, inadequate wastewater treatment, combined sewer overflow, airborne pollutants	Eutrophication (overfertilizes water which causes excessive plant growth)
Organic pollution, coliform bacteria	Inadequate wastewater treatment, combined sewer overflow	Human health risks, taste and odor problems
Toxic Substances (PCBs, mercury)	Industrial discharges, leaching from hazardous waste disposal sites, airborne pollutants	Fish contamination, human health risks, economic impacts
Suspended solids	Industrial discharges, agricultural runoff	Turbidity (decreases recreational and aesthetic enjoyment) disrupts aquatic systems
Urban flooding	Unplanned development of floodplain	Property damage, safety risks, economic losses
Loss of wetlands	Drainage for agriculture, filled for development	Loss of wildlife habitat, recreation areas, erosion protection, ground water replenishment, toxic purification

Other titles of Oceanic Education Activities for Great Lakes Schools

for middle schools:

The Effect of Lake Erie on Ohio's Temperature
The Effect of Lake Erie on Climate
Ancient Shores of Lake Erie
How to Protect a River
Lake Erie and Changing Lake Levels
Erosion Along the Great Lakes
Coastal Processes and Erosion
Pollution in Lake Erie: An Introduction
Yellow Perch in Lake Erie
Evidence of Ancient Seas in Ohio
To Harvest a Walleye
Oil Spill!
Shipping on the Great Lakes
Geography of the Great Lakes
Ohio Canals
The Estuary: A Special Place
The Great Lakes Triangle
Knowing the Ropes
Getting to Know Your Local Fish
Shipping: The World Connection
We Have Met the Enemy
It's Everyone's Sea: Or Is It?
PCBs in Fish: A Problem?
A Great Lake Vacation
Storm Surge
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for primary grades:

Lake Erie -- Take a Bow!
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GEOGRAPHY OF THE GREAT LAKES

by
Joyce L. Timmons
and
Rosanne W. Fortner, The Ohio State University
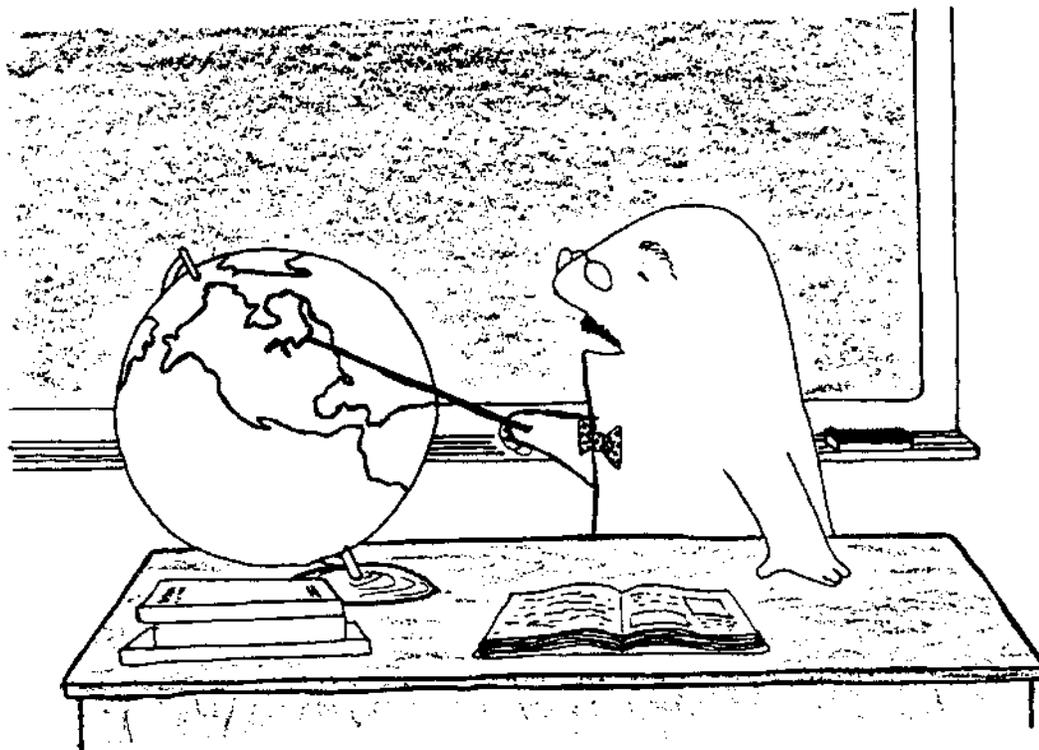
OEAGLS Investigation #14
Completed May 1980
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GEOGRAPHY OF THE GREAT LAKES

by

Joyce L. Timmons and Rosanne W. Fortner
Ohio Sea Grant Education Program

INTRODUCTION

Do you know where the Great Lakes are? Have you ever been there? What are the major cities on the Great Lakes? Can you name the lakes? When grade school students were asked questions like these they often said they did not know the answers. The Great Lakes have played a large part in the development of Ohio and the American Midwest, and they continue to be important economically as shipping and recreation centers.

When you have completed this investigation you will be able to:

1. Name the Great Lakes and locate them on a map.

2. Locate the major cities on the shores of the Great Lakes.

3. Tell what waterways ships use to go from the Great Lakes to the ocean.

4. Use basic math skills to determine distance, area, volume and perimeter.

5. Use water displacement as a measure of volume.

ACTIVITY A: WHAT IS THE GEOGRAPHY OF THE GREAT LAKES AREA?

MATERIALS: Classroom map of the United States, metric ruler.

PROCEDURE

The Great Lakes were formed by glaciers during the Ice Age. The glaciers took away earth and rock from the area as they moved over, creating deep basins. When the glaciers melted, the basins filled with water and the Great Lakes were formed.

1. Figure 1 is a map of the Great Lakes area. List the names of the Great Lakes in the lettered spaces that match the letters on the map. Your teacher will provide a map of the United States that you can use to find the names. Put all answers on your work sheet.

More than a century ago, the Chippewa Chief Kichwiski paddled a canoe from Duluth to Buffalo and then walked on to Washington, D.C., to attend a conference on Indian affairs. When the conference was over he walked back to Buffalo and paddled the 1640 km back to Duluth, using the lakes as a natural highway. The settlers of the midwest also used the Great Lakes as highways for shipments and travel. Large cities have developed along the shores of the lakes. Ohio has two of these major cities along Lake Erie. Toledo is at the western end of Lake Erie, and Cleveland is approximately 155 km east of Toledo.

2. Locate Toledo and Cleveland on Figure 1 and list them below the figure in the spaces having the same numbers.

Pennsylvania has one large port on the shore of Lake Erie. This port is called Erie.

3. Find Erie on Figure 1 and list it in the proper space under Great Lakes cities.

4. One hundred fifty-five kilometers northeast of Erie, Pennsylvania, is Buffalo. In what state is Buffalo? Add Buffalo to your list below Figure 1.

There is one large Canadian city on Lake Ontario. It is called Toronto and is in the province of Ontario. Canadian Provinces are similar to states in the United States.

5. Find Toronto on Figure 1 and list it.

Ships pass between Lake Erie and Lake Ontario by way of the Welland Canal. Water moves from one lake to another through the canal and also through the Niagara River. Niagara Falls is located on this river.

Three hundred ninety kilometers due west of Toledo is the second largest city in the United States, Chicago.

6. In what state is Chicago? On which lake is the port of Chicago? List Chicago below Figure 1.

North of Chicago on the same lake is Milwaukee, Wisconsin. Milwaukee is well known for the beer that it produces.

7. Find Milwaukee on Figure 1 and list it under Great Lakes cities.

Eighty kilometers north of Toledo is Detroit, Michigan. Detroit is the center of the U.S. auto industry.

Detroit is not situated on one of the Great Lakes. It is on the Detroit River, which along with the St. Clair River and Lake St. Clair, forms a connecting waterway between Lake Huron and Lake Erie.

8. List Detroit in the proper space below Figure 1.

Passage through Lake Huron can take a ship either into Lake Michigan or Lake Superior. Ships going to Lake Michigan pass through the Straits of Mackinac. Ships move from Lake Huron to Lake Superior by going through the Soo Locks on the St. Mary's River.

At the extreme western tip of Lake Superior is Duluth, Minnesota.

9. Using the map scale in Figure 1, how far is Duluth from Buffalo by air? By water? Label Duluth below Figure 1.

Duluth is near the Mesabi Range where much of our iron ore comes from. It is a major port for shipping iron ore to the steel mills in Indiana and Ohio.
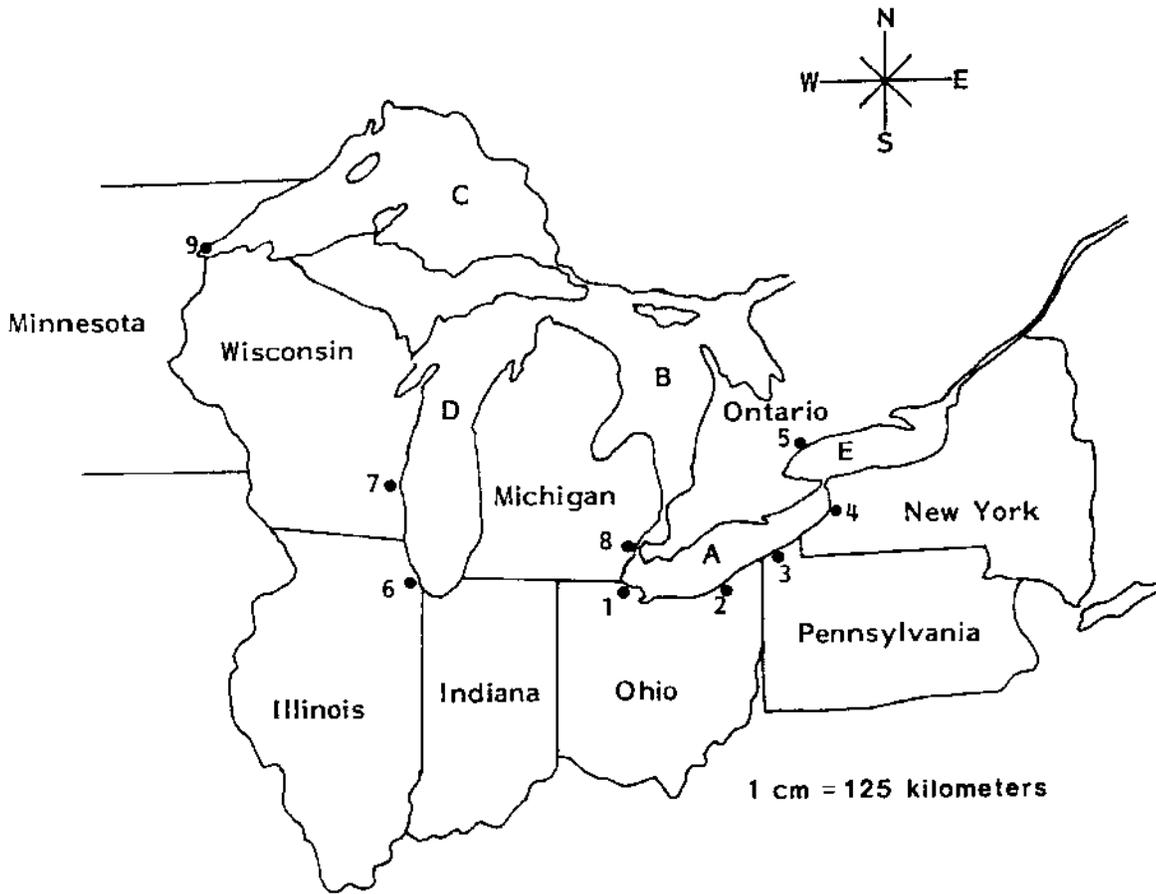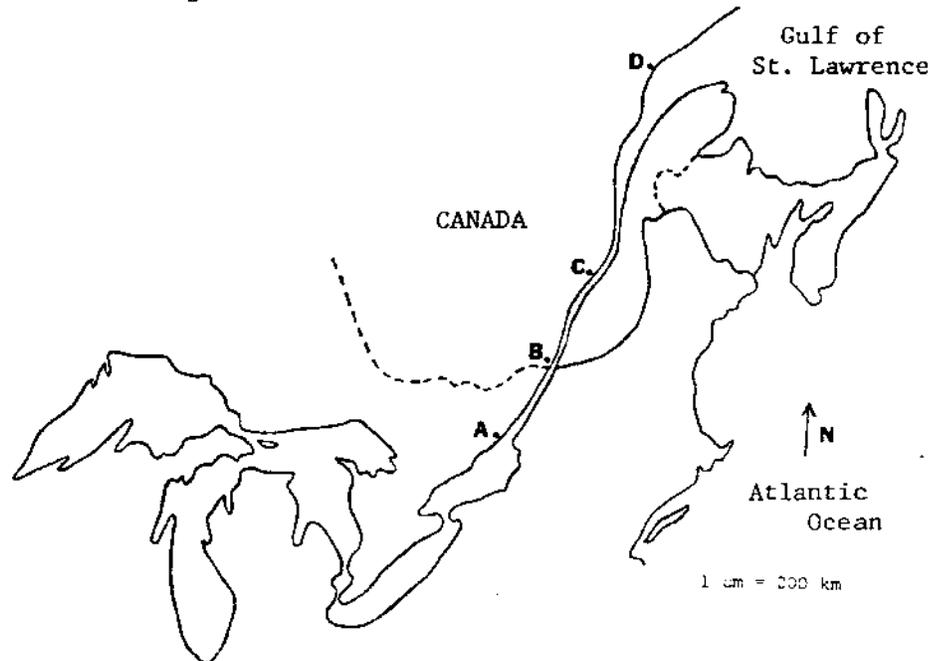

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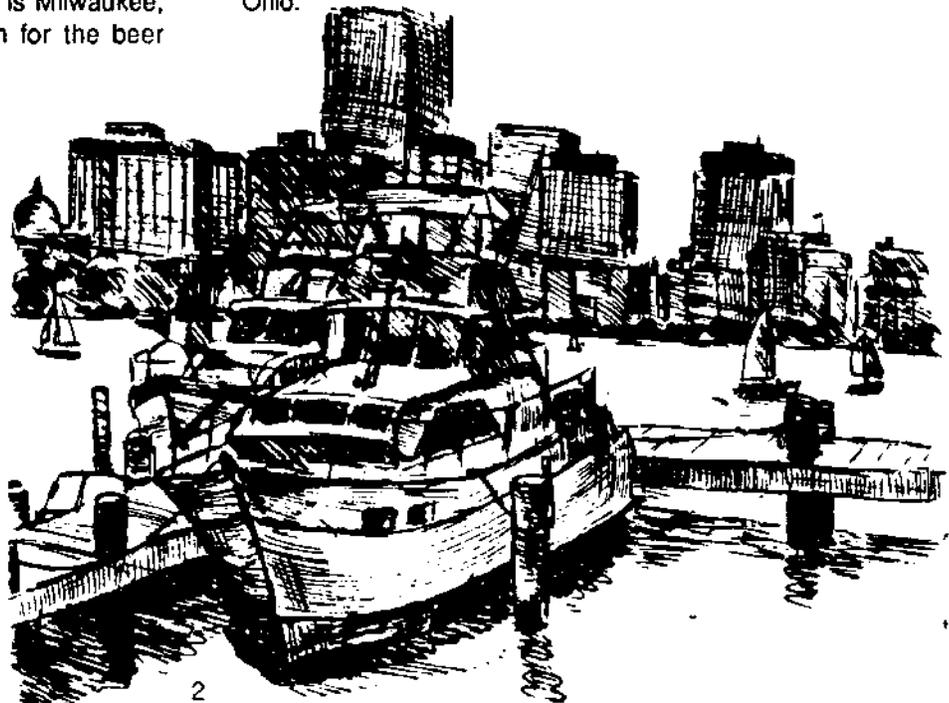
Figure 1: The Great Lakes Area

Figure 2: The St. Lawrence Seaway

3

ACTIVITY B: WHAT IS THE ST. LAWRENCE SEAWAY?

The St. Lawrence River begins at the foot of Lake Ontario and flows generally in a northeasterly direction. The river is at least 3 kilometers wide along its entire length. When it widens to 125 kilometers it becomes the Gulf of St. Lawrence.

MATERIALS: Map of North America, pencil or pen, metric ruler.

PROCEDURE

1. Using the large map your teacher provides, find the Canadian provinces through which the St. Lawrence River flows. Label the provinces on the map on your worksheet. Which province is divided by the river?

2. The St. Lawrence River begins at the foot of Lake Ontario opposite the Canadian city of Kingston. Find Kingston on your map and label it next to the proper letter above the map.

3. Two-hundred fifty kilometers further north along the river is Montreal. In what province is Montreal?

Montreal is Canada's oldest town and is called the "White City" because of the large amount of light grey limestone used as building material. The St. Lawrence River is navigable for seagoing vessels to Montreal. In order for ships to move on up the river to the Great Lakes, a series of canals and locks have been built. These locks make up the St. Lawrence Seaway.

4. The city of Quebec is 280 kilometers north of Montreal. Find Quebec on your map and label it in the space given.

Quebec is the capital of the province of Quebec. The name "Quebec" comes from one of Cartier's followers, the French traders who first explored the St. Lawrence. When the follower saw the huge cliff face rising from the water where the city is, he exclaimed, "Que bec!" ("What a beak!" in French) and the name stuck.

5. The river flows north for another 800 kilometers until it widens into the Gulf of St. Lawrence at Sept-Iles. Find Sept-Iles on your map and label it in the proper space.

6. What is the length of the St. Lawrence Seaway from Kingston to Sept-Iles?

7. How far would a ship have to travel to go from Sept-Iles, Quebec, to Duluth, Minnesota?

8. Assume that a ship is going from Sept-Iles to Duluth. Fill in the names of the rivers, lakes and "connectors" you have learned about in Activities A and B. The list is in the order which a ship would follow from east to west.
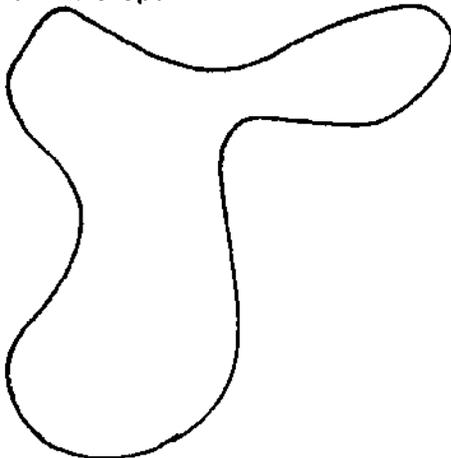
4

Lake Erie lies along Ohio's northern border. The lake, fourth in size of the Great Lakes, is the eleventh biggest body of fresh water in the world. The word "Erie" is from the Iroquois Indian word "Erige," meaning cat or panther. This was the name of a tribe of Iroquois living on the southern shore of the lake.

**MATERIALS:** String, metric ruler.

PROCEDURE

PERIMETER

1. Perimeter is the distance around an object. To find the perimeter of a square you would measure all four sides and add the measurements together. To find the perimeter of an irregular shape is more difficult. How would you find the perimeter of this shape?

One way you can approximate the perimeter is to space dots around the irregular object, connect the dots with lines, and then measure each of the segments and find their total length.
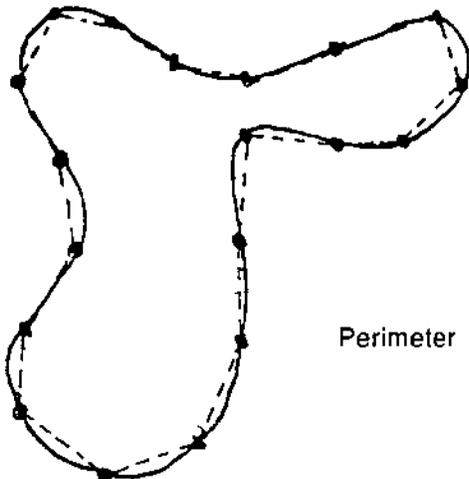
Perimeter = 24 cm

2. The more dots you use, the more accurate your measurement will be. Determine the perimeter of Lake Erie in kilometers using this method and the map in Figure 3.

3. A closer approximation of perimeter may be found using a piece of string. The string is laid along the outside of the shape you are measuring, then the amount of string is measured. Use this method to determine the perimeter of Lake Erie in kilometers.

When geographers measure the perimeter of Lake Erie, they include the perimeter of the islands. The perimeter of Lake Erie including the islands is about 1350 km.

AREA

The area of any regular shape can be found by multiplying the length times the width (L X W = AREA). The figure below has an area of 10 square centimeters.

5 cm (length)

2 cm (width)

5 cm x 2 cm = 10 cm²

4. This method can be used to form a very rough approximation of the area of Lake Erie. If the approximate length of Lake Erie is 375 kilometers, the width is approximately 89 kilometers, what is the area?

5. Another way to find area is by using a grid. See Figure 3 on page 6. Each square on the grid of Lake Erie measures one-half centimeter per side. Count the number of one-half centimeter squares that lie completely within the lake. Put that number in the chart under I on your worksheet.

6. Now count the number of partial squares around the perimeter of the lake. Put this number in the chart under II. Divide this number by 2. This converts partial squares to whole square equivalents.
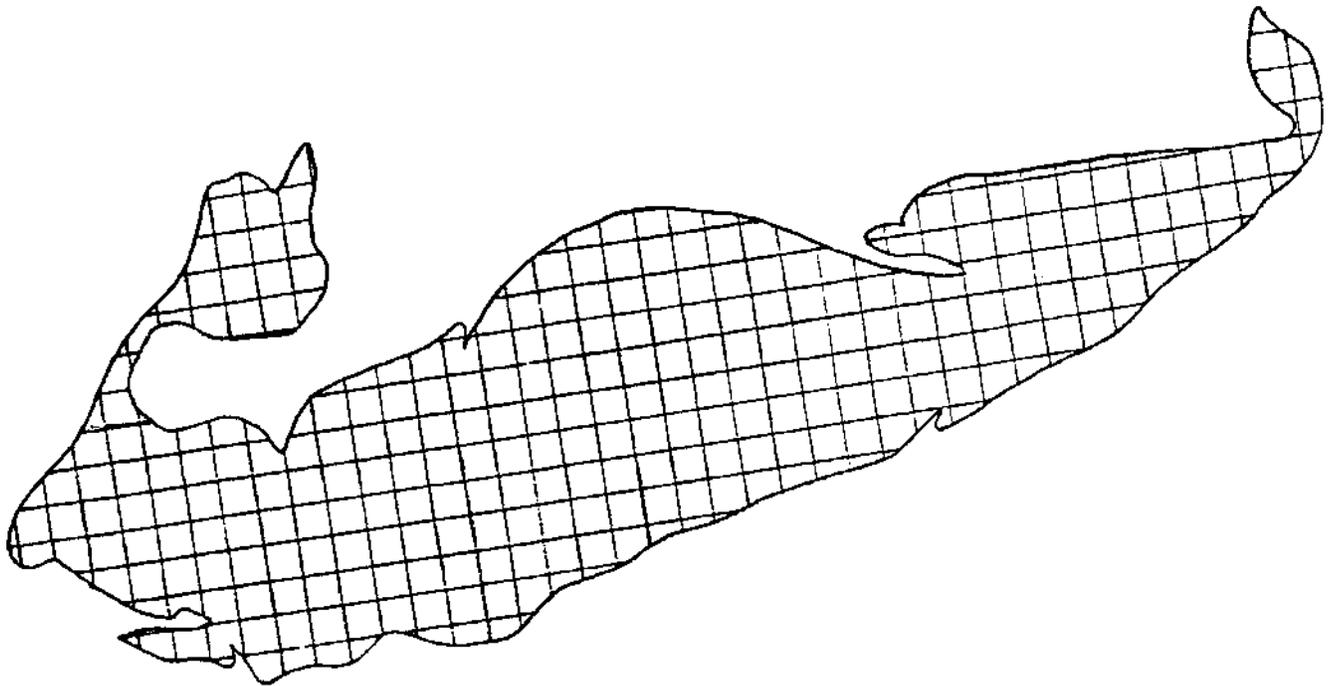
5

Figure 3. Area map of Lake Erie

7. Add I and II together and put the total in III. This gives you an estimate of the area of the small map in square one-half centimeters.

8. To convert the area from square one-half centimeters to square kilometers, divide the number in III by 4. This will give you the area in square centimeters. Put the area in cm² in the table under IV.

Four squares 1/2 cm on a side have an area of one square centimeter (1 cm²).
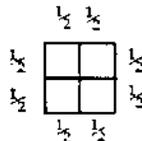
A square is a shape that has four equal sides. If you know the length of one side of a square, you can find the area by multiplying the side by itself. This is called "squaring." For example, if one side of a square has a length of 3 centimeters, its area would be 9 cm².

9. On our map one centimeter in length is equal to about 20 kilometers. What area does one square centimeter represent?

10. Multiply this number by the number of square centimeters in column IV. This is the approximate area of Lake Erie in square kilometers. Put this value in column V in the table.

The actual surface area of Lake Erie is about 25,370 km².

APPLYING WHAT YOU KNOW:

DISTANCE, RATE AND TIME PROBLEMS

The Great Lakes are used to ship heavy bulk products such as iron ore. They are well suited for this purpose because they are deep enough for very large ships to be used. Is travel by waterway the fastest way for people to travel?
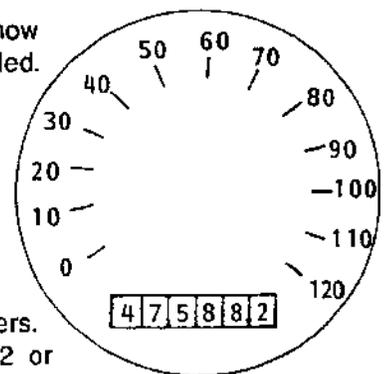
Problems that deal with distance, time needed to go from place to place, and speed are called "distance, rate, and time" problems. There is a formula that can be used to compute these values.

$$RATE = \frac{DISTANCE}{TIME} \quad R = \frac{D}{T} \qquad TIME = \frac{DISTANCE}{RATE} \quad T = \frac{D}{R}$$

$$DISTANCE = RATE \times TIME \ (D = RT)$$

An odometer indicates how far a vehicle has traveled. This odometer reads, "forty seven thousand, five hundred eighty-eight point two kilometers," or forty seven thousand, five hundred eighty-eight and two tenths kilometers. It is written: 47,588.2 or 47,588 2/10.

6

You can determine how far you have gone by subtracting your odometer reading at the beginning of your journey from the reading at the end of the journey. If when you start out your odometer reads 12,583.1 and when you reach your destination it reads 12,621.8, you have traveled 38.7 kilometers.

$$12,621.8$$
$$-\ \underline{12,583.1}$$
$$38.7 \text{ kilometers}$$

11. A ship sets sail for Buffalo from Toledo going 40 km/hr. The ship reaches Buffalo 10 hours later. How far is it from Toledo to Buffalo by water? (Show all your work on you work sheet.)

12. At the same time a man on a motor bike leaves Toledo following routes 2 and 90. The odometer on the man's motor bike reads 28,749.1 km when he leaves Toledo and 29,229.1 km when he reaches Buffalo. How far has he traveled?

13. If the man traveled at 40 km/hr, how long did he ride?

14. If you had a choice of going from Toledo to Buffalo by a car traveling at 88 km/hr or a ship traveling at 40 km/hr, which would you choose if:

a) You wanted to get to Buffalo the shortest way?

b) You wanted to get to Buffalo the fastest way?

15. What speed would you have to drive in order to arrive at Buffalo at the same time the ship arrives?
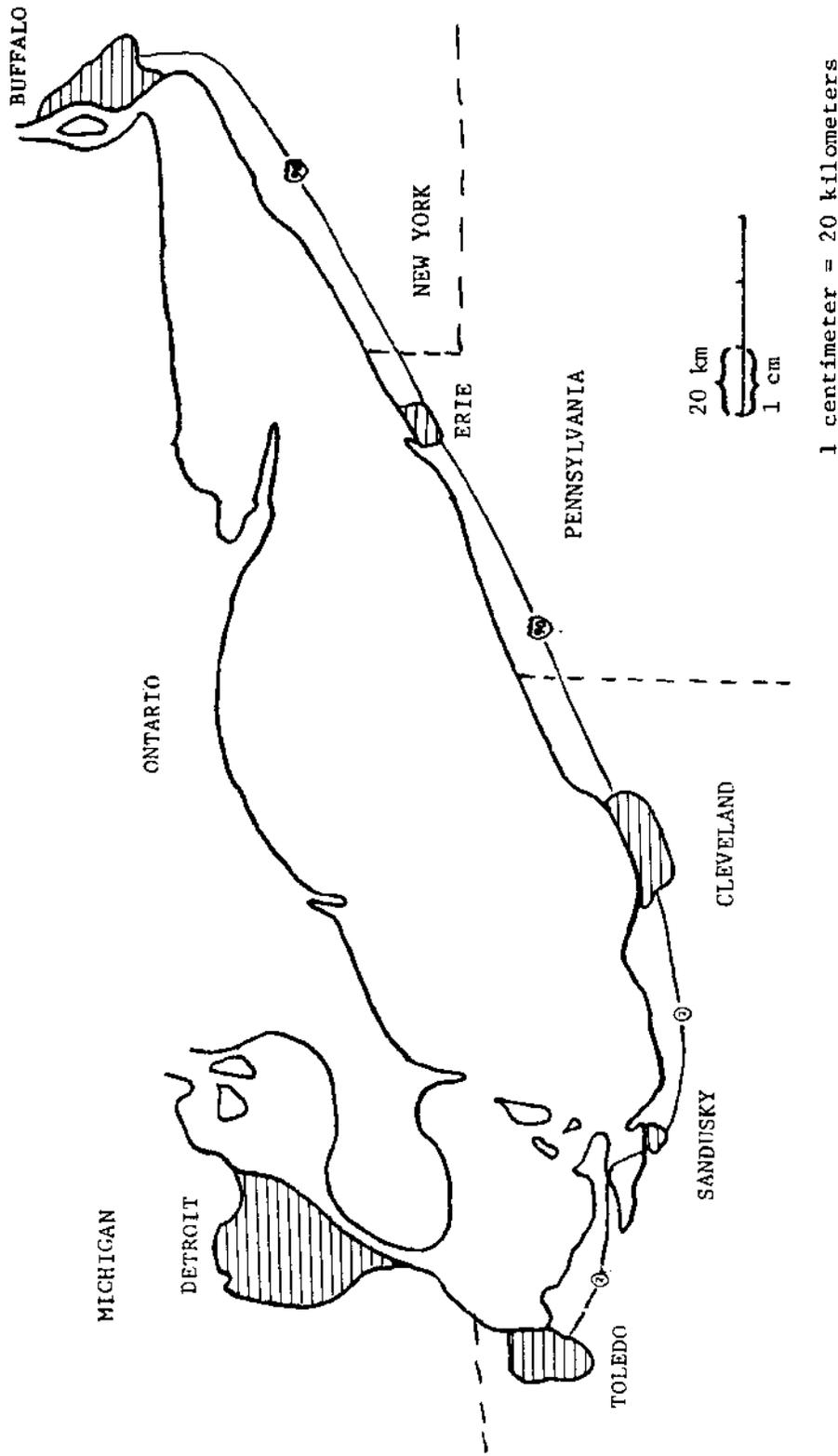
Figure 4. The Lake Erie Region

# ACTIVITY D: HOW CAN WE FIND THE VOLUME OF A LAKE OR OTHER CONTAINER?

MATERIALS: Two plastic containers; an easily measured container such as a small, clean milk carton; a metric ruler; and a graduated cylinder.

PROCEDURE

One half of all the fresh water in the world is in the Great Lakes. Lake Erie is the shallowest of the Great Lakes.

Volume is a measure of the amount of liquid, air, etc., a container will hold. To find the volume of a container you multiply the length times width times height. The units used to measure volume are called cubic measurements, such as cubic centimeters (cm^3).

1. What is the volume of the container pictured below?
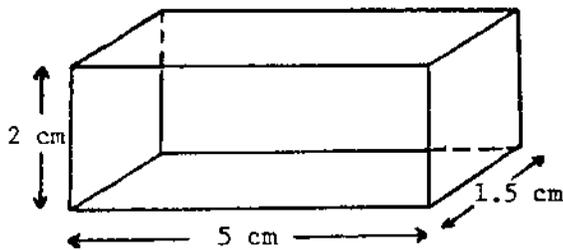
$$V = L \times W \times H$$

Geographers measure the surface area of Lake Erie to be 25,370 km^2. The depth of the lake varies from east to west and north to south, so it is necessary to average several numbers to find a depth to use for calculating volume.

2. The depths of the parts of Lake Erie are shown below. Add up the average depths for the basins and divide by three to get an average depth for the whole lake. (This gives only a rough estimate, since the three basins are not all the same size and shape.)

3. Now that you know the area (L x W) and the depth (H), you can find the volume of the lake. (Don't forget to convert meters to kilometers! There are 1000 meters in one kilometer.)

Another way to measure volume is by **displacement.** Displacement is the word used to describe the amount of water that has to move to another place when anything with some weight is added to the water. You can see the effects of displacement when you sit in a bath tub full of water and the water level rises. Your body takes up the space where the water was. Ships are weighed by the amount of water they displace when they float.

4. Set up your apparatus as in Figure 5. The milk carton will represent a ship. The inner plastic container represents Lake Erie and the outer container is to catch overflow.
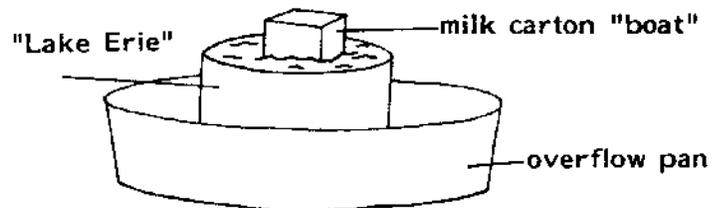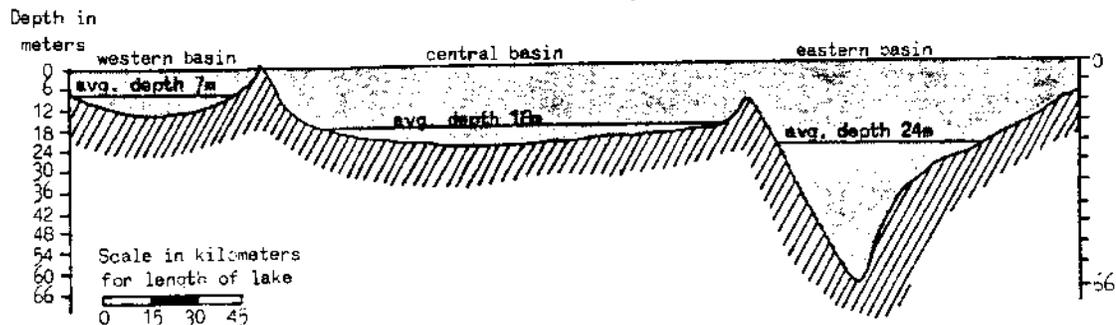

Figure 5. Model of a Ship on Lake Erie.

Cross Section of Lake Erie.

5. Fill the inner plastic container that represents Lake Erie with as much water as it will hold. The water must be all the way up to the top. Float your empty "ship" in the container. Discuss what happens.

6. Fill your ship container with water. Carefully float it in the lake container. You may have to steady it to keep it from tipping over. When water stops spilling from the lake into the overflow basin, remove both the ship and the lake containers from the overflow basin, being careful not to spill any more water. Pour the water from the overflow basin into the graduated cylinder and measure it. How much water was displaced by the ship container?

7. Discard the water in the ship container. Pour the water from the graduated cylinder into the ship container. Is it the same amount of water? Discuss why this happens.

8. Measure the volume of the ship container by using a centimeter scale. Is the volume in cubic cm the same as the volume in milliliters?

In this activity you measured the water that spilled out of your model lake. In nature, the lake is so large that the displacement of water by large ships cannot be detected.

REVIEW QUESTIONS

1. What are the names of the Great Lakes?

2. What is the name of the lake along the northern border of Ohio?

3. What are the names of five of the large cities along the shores of the Great Lakes?

4. What waterway is used by ships going from the ocean to the Great Lakes?

5. How do you find the area of an object?

6. What other way besides measuring with a ruler is used to determine volume?

7. What is the distance around an object called?

Name _____

GEOGRAPHY OF THE GREAT LAKES
Worksheet

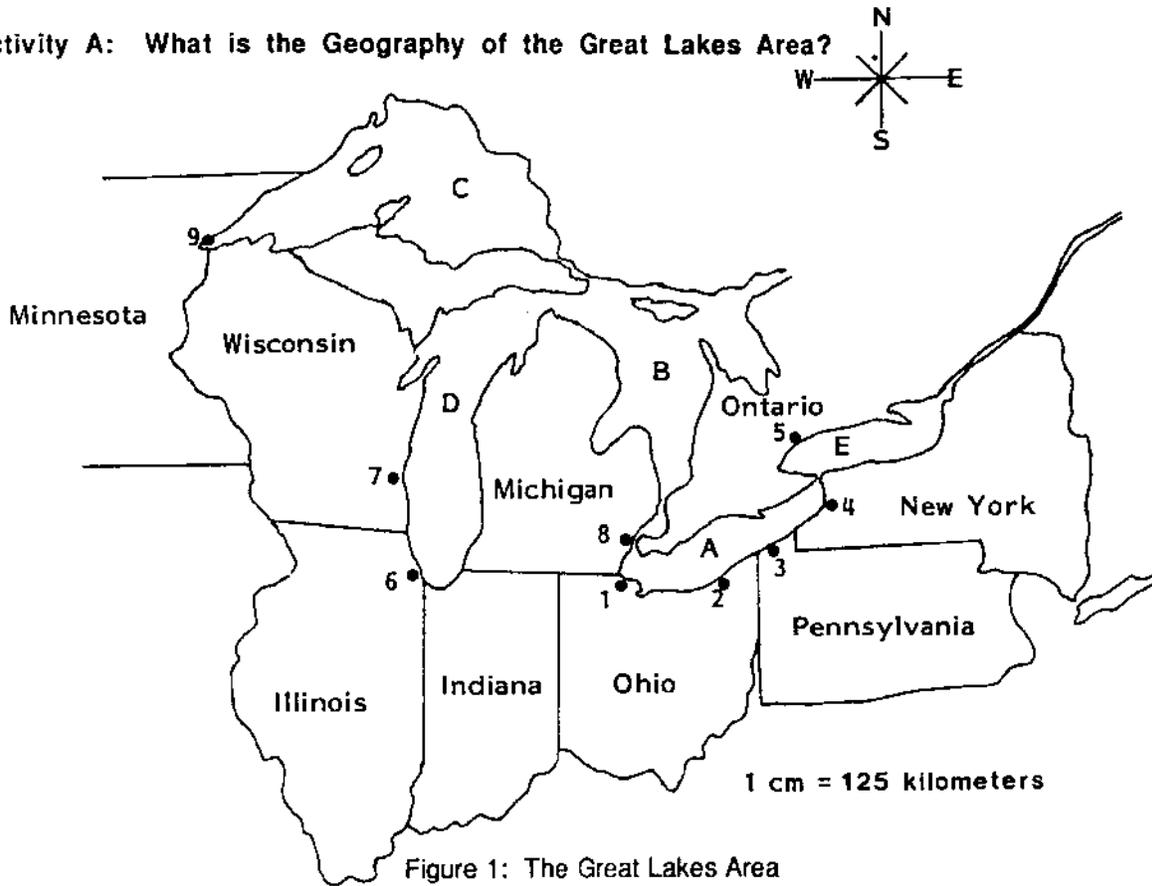**Activity A: What is the Geography of the Great Lakes Area?**

N
W—E
S

C

9

Minnesota

Wisconsin

B

D

Ontario

5

E

7

Michigan

4   New York

8

6

A

1   2   3

Pennsylvania

Illinois   Indiana   Ohio

1 cm = 125 kilometers

Figure 1: The Great Lakes Area

Great Lakes

a. _____

b. _____

c. _____

d. _____

e. _____

Major Great Lakes Cities

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

4. In what state is Buffalo? _____

6. In what state is Chicago? _____

   On which lake is the port of Chicago?_____

9. How far is Duluth from Buffalo by air? _____ By water?_____

Activity B: What is the St. Lawrence Seaway?
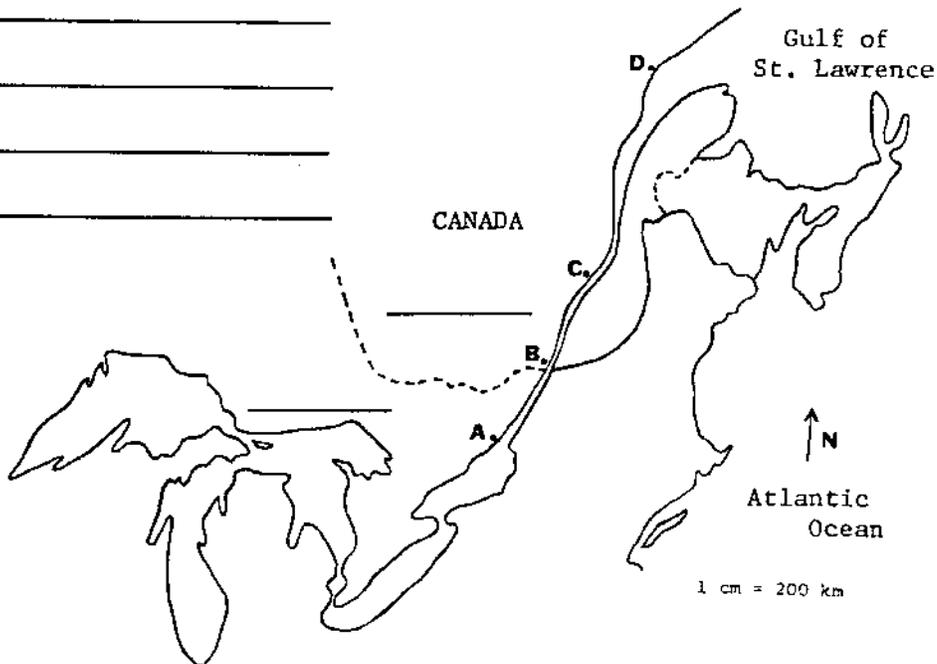
Cities on the Seaway

A. _____

B. _____

C. _____

D. _____

Figure 2. The St. Lawrence Seaway

1. Which province is divided by the river? _____

3. In what province is Montreal? _____

6. What is the length of the St. Lawrence Seaway from Kingston to Sept-Iles? _____

7. How far would a ship have to travel to go from Sept-Iles, Quebec, to Duluth, Minnesota?

_____

8. Fill in the names of the rivers, lakes and "connectors" you have learned about in Activites A and B. The list is in the order which a ship would follow from east to west.

Sept-Iles, Quebec

_____River to Kingston, Ontario

Lake _____

_____ Canal

Lake _____
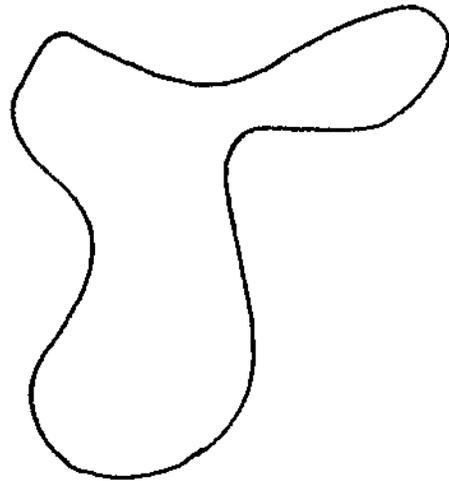
_____ River

Lake _____ at Detroit

_____ River

Lake _____

_____ Locks

Lake _____

Duluth, Minnesota

Activity C: What are the surface dimensions of Lake Erie?

1. How would you find the perimeter of this shape?

_____

_____

2. Determine the perimeter of Lake Erie in kilometers using the dots and the map in Figure 3.

Perimeter = _____ km

3. Use the string method to determine the perimeter of Lake Erie in kilometers.

    Perimeter = _____ km

4. What is the area of Lake Erie?

    _____ square kilometers

I	II	III	IV	V
Number of complete squares:	Number of partial squares ___ divided by 2:	Add results in I and II:	Area in cm^2 (III ÷ 4):	Area of Lake Erie in km^2 (IV x 20^2):

9. What area does one square centimeter represent? _____

11. How far is it from Toledo to Buffalo by water? (Show your work.)

    _____km

12. How far has he traveled? (Show your work).

    _____km

13. If the man traveled at 40 km/hr, how long did he ride?

    _____hours

14. If you had a choice of going from Toledo to Buffalo by a car traveling at 88 km/hr or a ship traveling at 40 km/hr, which would you choose if:

    a) You wanted to get to Buffalo the shortest way? _____

    b) You wanted to get to Buffalo the fastest way? _____

15. What speed would you have to drive in order to arrive at Buffalo at the same time the ship arrives? (Show the formula and calculations)

    _____ km/hr

Activity D: How can we find the volume of a lake or other container?

1. What is the volume of the container pictured on page 9? (Show your work.)

   V = _____

2. Add up the average depths for the basins and divide by three to get an average depth for the whole lake. (This gives only a rough estimate, since the three basins are not all the same size and shape.) Show your work.

   Average depth = _____ meters

3. Now that you know the area (L x W) and the depth (H), you can find the volume of the lake. (Don't forget to convert meters to kilometers! There are 1000 meters in one kilometer.)

   _____

5. Float your empty "ship" in the container. Discuss what happens.

   _____

   _____

6. How much water was displaced by the ship container?

   _____ milliliters (ml)

7. Is it the same amount of water? _____ Discuss why this happens.

   _____

   _____

8. Measure the volume of the ship container by using a centimeter scale. Is the volume in cubic cm the

   same as the volume in milliliters? _____

Review Questions

1. What are the names of the Great Lakes? _____

   _____

2. What is the name of the lake along the northern border of Ohio? _____

3. What are the names of five of the large cities along the shores of the Great Lakes?

   _____

   _____

4. What waterway is used by ships going from the ocean to the Great Lakes?

   _____

5. How do you find the area of an object? _____

6. What other way besides measuring with a ruler is used to determine volume?

   _____

   _____

7. What is the distance around an object called? _____

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