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ANCIENT LAKE SHORES

by

James D. Comiensi, Lakewood Public Schools, Ohio

and

Victor J. Mayer, The Ohio State University



TEACHER GUIDE

OEAGLS-Oceanic
Education
Activities
for
Great
Lakes
Schools

OEAGLS Investigation #3

Completed April 1979

Revised June 1980, September 1982 and August 1988

This instructional activity was prepared with the support of the National Oceanic and Atmospheric Administration, Sea Grant College Program Office, U.S. Department of Commerce, under Ohio Sea Grant Project #710678. Funding support was also provided by The Ohio State University's School of Natural Resources and College of Education. Any opinions, findings, conclusions or recommendations expressed herein are those of the authors, and do not necessarily reflect the views of NOAA or the University.

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TEACHER GUIDE ANCIENT LAKE SHORES



by
James D. Comiensi and Victor J. Mayer
Ohio Sea Grant Education Program

OVERVIEW

In this investigation students work with topographic maps and profiles to identify beach ridges in northern Ohio. They learn how to determine the ages of the ridges, how they were formed and how people in the area have utilized them.

PREREQUISITE STUDENT BACKGROUND

Students should be able to read a topographic map and construct a profile. They should also be somewhat familiar with the glacial history of the Great Lakes Region.

OBJECTIVES

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

1. Describe the evidence of past water levels of Lake Erie.
2. Use topographic maps and topographic profiles to locate evidence of past water levels.
3. Describe how people have made use of the beach ridges associated with Lake Erie.
4. Describe some evidence of past changes in the water level of the oceans.

MATERIALS

The following are needed for each group: Copy of the Madison quadrangle, metric ruler, pencil.

One copy of each of the following should be posted in the classroom: An Ohio road map, copy of the map from the publication: The Beach Ridges of Northern Ohio (included in this teacher guide).

Also, several copies of each of the following quadrangles: Geneva, Perry, Mentor and Eastlake. These are available from the Ohio Division of Geological Survey, Fountain Square, Building B, Columbus, Ohio 43224, phone (614) 265-6605. In 1988 they cost \$2.50 a piece plus tax.

SUGGESTED APPROACH

This investigation can be done individually by students, or in groups of two.

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

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INTRODUCTION

Have you ever seen Lake Erie? Have you seen pictures of it? Maps? Does it change? You may have seen or heard of waves on the lake destroying houses along the shore. These are certainly changes that can be seen. But does the lake change in size? Was it once bigger than it is today? Or has it moved? Although the lake may seem to be a permanent feature, it is not. All lakes are temporary. They exist for a few thousand years and then disappear. Will this happen to Lake Erie?

Ohio was once covered by glaciers. These glaciers helped to carve the basin of Lake Erie. About 15,000 years ago the last ice melted back to expose the lake basin. There have been minor advances and retreats of glaciers since then causing the level of the water in the lake to rise and fall. How do scientists determine these past lake levels?

ACTIVITY A: WHAT EVIDENCE IS THERE THAT THE LEVEL OF LAKE ERIE HAS CHANGED?

The questions are designed to lead the students to closely examine an area near Lake Erie to identify evidence of former Lake levels.

MATERIALS: Topographic map of the Madison, Ohio, area; road map of Ohio; graph paper and metric ruler.

PROCEDURE

Most lakes are contained in basins and flat, gently sloping floors. Wind causes waves, which in turn produce currents that act along the shores of lakes. These currents carry and deposit sand and form beaches. Perhaps you have swam from a beach. If so, you know what the sand looks like and how it feels.

Figure 1 is a cross section (a side view) of a beach. Notice the flat floor of the lake, the gently sloping beach area itself, and a ridge at the top of the beach. This **beach ridge** is formed of sand thrown up by the action of waves.

1. What is the contour interval of the map of the Madison area?

T1. 10 feet contour interval.

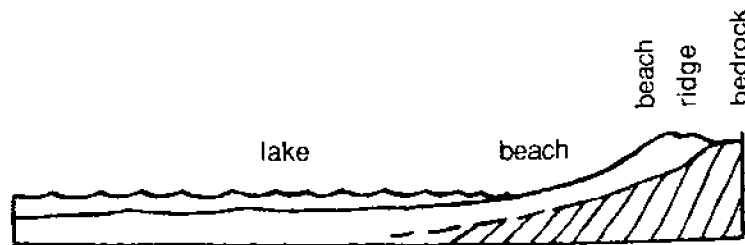


Figure 1. Cross section of a beach.

- Examine the lower left portion of the topographic map. Compare the area immediately north of (above) the Penn Central Railroad with the area south (below) to the map's lower edge. How does the spacing of the contour lines in these areas differ?

T2. North of (above) the Penn Central Railroad, the contour lines are farther apart than south of (below) the Penn Central Railroad.

- What does the difference in the spacing of contour lines mean about the difference in topography in the two areas?

T3. Where contour lines are closer together the area has more relief, or is "hillier." Where contour lines are farther apart, the slopes are gentle or nearly flat. Therefore, there is a change in topography in this area.

- What evidence is there on the map that the lake once extended through the area north of the Penn Central Railroad?

T4. The area north of the Penn Central Railroad is flat, similar to the lake bottom in Figure 1. In addition, there are areas of swamps. There is evidence that the lake may once have extended over this area.

- Using the graph paper on your work sheet construct a topographic profile across North Ridge, Middle Ridge and South Ridge. Start the northern end of your profile where Red Bird Road T-intersects with Chapel Road. The southern end should then be where South Bates Road intersects Interstate 90.

- What difference between the three ridges does the profile reveal?

T5-6. Be certain students use graph paper for the profile, and that they accurately record each contour line. You will need to provide more copies of the graph paper on the worksheet because the profile will be about 34 cm. long. If the profile is not done very carefully, the ridges may not be apparent on the profile.

A completed profile is included in Appendix A. It has a vertical exaggeration of 40:1. This scale makes identification of the ridges easier, but greatly exaggerates the vertical, making the gently sloping "old lake" floor appear hilly. Here would be an excellent opportunity to discuss vertical exaggeration in more detail. Have your students redraw the profile using a much lower vertical exaggeration of perhaps 10:1.

Vertical exaggeration is determined for the scales to which the profile is drawn. That in Appendix A is drawn to a vertical scale of 1 inch = 50 feet and a horizontal scale of 1 inch = 2000 feet. The horizontal line would have to be extended 40 times or the vertical line compressed 40 times to make the scales the same. Therefore, we say the vertical exaggeration is 40:1 or 40x. To redraw the profile using a scale of 10:1, your vertical scale would have to be 1 inch = 200 feet. A profile with this scale will be harder for the students to graph but will give a more realistic look at the slope of the land.

A profile with vertical exaggeration of 10x is included as Appendix B.

- What do you think caused each of the three ridges?

T7. Each one of these ridges is a beach ridge. They mark the previous beaches or boundaries of Lake Erie. They are built up by wave action as described below Figure 1 of the Student Guide.

- One of the ridges is not as prominent as the other two. What could be the reason for this difference?

T8. Middle Ridge is not as prominent as the North or South Ridge. The lake's edge may not have been there long enough to build up a higher beach ridge. Middle Ridge may have been smoothed out by flooding during an increase in lake level.

- Determine an "average" elevation for each of the three ridges.

T9. North Ridge	675 feet
Middle Ridge	695 feet
South Ridge	725 feet

- Compare the elevations of the three ridges to the data in Table 1. What stage does each of the ridges represent?

T10. North Ridge	= Lake Warren
Middle Ridge	= Arkona
South Ridge	= Lake Wittlesay

- Label them on the profile.

A stage of the lake was a time when the lake level remained the same long enough to build a beach and a beach ridge.

Years Before Present	Lake Stage	Elevation of Beach Ridge in feet
0	Erie	573
	Lundy (3 ridges)	620-640
12,700	Warren	690
	Wayne	660
12,800	Whittlesey	735
13,000	Arkona	690-710
	Maumee III	780
13,500	Maumee II	760

Table 1. Data on Beach Ridges.

12. How many stages has Lake Erie had? Refer to Table 1.

T12. There are 8 stages.

13. How old is the oldest stage?

T13. 13,500 years before present.

14. What evidence do geologists use to tell what stage a ridge belongs to?

T14. Its elevation.

15. What do you think could have caused these different stages of Lake Erie?

T15. Here the answers may vary because we are asking the students to "think." The actual cause was the retreat and readvance of glacial ice opening up new lake drainage outlets and closing older ones (as described in "Background Information" on page 7).

Glacial ice caused the variation in the levels of Lake Erie. As the glaciers retreated they uncovered different outlets for the lake. These outlets were at successively lower elevations. When a new one was uncovered the lake dropped fairly suddenly to a new level. Occasionally a glacier may have readvanced over an outlet, blocking it. In this case, lake level rose once again, and the beach ridge was eroded by the higher lake. This may be the reason that Middle Ridge is so much lower than North and South Ridge.

ACTIVITY B: HOW HAVE PEOPLE USED BEACH RIDGES?

This activity leads the students to discover how people have made use of beach ridges. Evidences of changes in sea level are also discussed.

MATERIALS: Topographic map of the Madison, Ohio, area; road map of Ohio; and map from The Beach Ridges of Northern Ohio.

PROCEDURE

The beach ridges have been very useful to the inhabitants of northern Ohio. What are some of these uses?


1. Examine the three beach ridges on the Madison map. What human-constructed feature do they have in common?

T1. North and South Ridges have a highway along their entire length. Middle Ridge also has a highway along most of its length.

2. Why do you think the beach ridges have been used for this purpose?

T2. The beach ridges were used as highways for a variety of reasons. The bedrock surface on each side of the ridges is covered by glacial till. These areas are generally swampy due to low relief and poor drainage. Therefore, the buffalo in Ohio's early history chose the drier, better drained beach ridges for their trails. The Indians, hunting the buffalo, naturally followed the same trails. When the settlers moved into and across the State, they also followed these "established routes," as did the modern highway builders.

3. What type of human-constructed feature is located just southeast of North Perry and north of US Highway 20?

T3. A gravel pit, as indicated by  .

4. How many similar features do you find on Middle Ridge? On South Ridge?

T4. Two sandpits and a quarry along Middle Ridge. One gravel pit on South Ridge.

5. What use of the ridges is implied by these features?

T5. People are quarrying sand and gravel from the beach ridges for use in concrete for construction.

6. What type of human-constructed feature is located at 41°47'30"N 81°02'30"W (just west of the pond)?

T6. Middle Ridge cemetery is located here.

7. How many other features of this type can you find on the three ridges?

T7. There is one cemetery on each of the North and South ridges and two cemeteries on Middle Ridge.

8. How many do you find that are NOT located on one of the three ridges?

T8. There are only two cemeteries on this quadrangle which are not located on the ridges; one of these is on the glacial till forming the lake floor. The other one is in the hills to the south.

9. Why do people prefer to locate these features on beach ridges?

T9. People tend to locate cemeteries in high areas where drainage is good and flooding is minimal.

10. Ask your teacher for a different map. How many beach ridges can you identify on this new map?

T10-12. Answers here will vary, depending upon which quadrangle the students use. Quadrangles to use are: Geneva, Perry, Mentor, and Eastlake.

11. What stages do they represent?

12. Which of the human-constructed features you identified in Steps 1 to 8 are found on the ridges on this map.

These beach ridges extend throughout northern Ohio. They indicate the location of the shoreline of the lake and the amount of area occupied by the lake at each of its stages. Your teacher will have a map of northern Ohio posted on the bulletin board. This map locates each of the beach ridges.

13. In an earlier part of this activity you learned that the people living in this area built many of their roads along the beach ridges. Using your road map and the map on the bulletin board, identify the major highways that have been built on beach ridges. Mark each of them on your road map. Label them with the name of the stage of the beach ridge.

T13. A copy of the northern-most sections of Ohio's road map is included in Appendix C. The beach ridges are marked. Appendix D is entitled "The Beach Ridges of the Glacial Lakes," mapped by Frank J. Carney and generalized by Jane L. Forsyth. The map is reproduced from Ohio Geological Survey's circular no. 25. The Beach Ridges of Northern Ohio by Jane L. Forsyth.

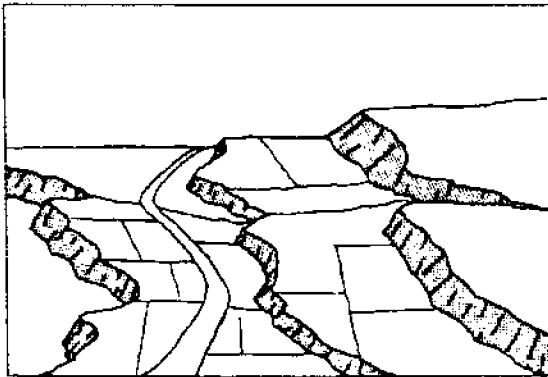
14. List on your work sheet all of the uses people have made of beach ridges in the areas you have studied.

T14. Answers will vary but should include roads, cemeteries, and pits to obtain construction material.

You have learned in this Investigation that the movement of glaciers caused changes in the level of Lake Erie and that the beach ridges provide evidence of such changes in lake level. The oceans have also had different levels of water. Figure 2 illustrates some of the evidence of higher sea level (**marine terraces**) and lower sea level (**wave-cut cliff**).

Glaciation is also one of the causes of recent variations in sea level. As the glaciers melted, the water returned to the sea, raising its level. There are other causes of sea level changes that your teacher may wish to discuss.

Marine Terraces



Wave-cut Cliff

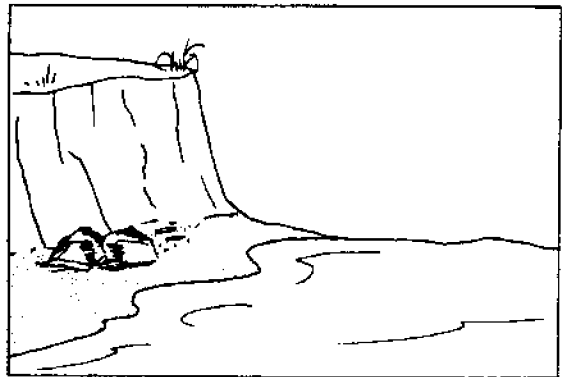


Figure 2. Evidence of sea level changes.

Glaciation has also been one of the agents responsible for recent changes in sea level. Water locked up in the glacial ice has come from precipitation collected over the oceans. The removal of this water lowered the sea level greatly. If the present-day glaciers should melt, sea level would probably rise from 40 to 50 meters.

When sea level is lowered, the size of the continental shelf decreases, thereby decreasing the habitat of shelf-living organisms. Shorelines become broad, relatively flat areas. Land plants and animals can extend their ranges outwards. The climate of focal areas may be affected by the change in its proximity to a large body of water.

Current evidence seems to show that Antarctica has been getting warmer over the last 100 years or so. This could eventually trigger a great deal of melting of glacial ice and the consequent increase in sea level worldwide.

Marine terraces are evidences of a higher sea level because they are formed by wave action. An example would be Palos Verdes Hills, California (photograph pg. 209; Investigating the Earth, 4th Edition, 1987).

Perhaps you could discuss other evidences of sea level changes such as fossil ripple marks, seamounts, and fossilized sea life found in sedimentary rocks on land.

REVIEW QUESTIONS

1. What evidence is there that indicates that Lake Erie has been larger than it is today? How do these features form?

R1. A large, relatively flat area with several swamps and poor drainage. Ridges of sand and gravel (beach material) roughly paralleling the present shoreline.

2. Discuss three ways that people have used beach ridges.

R2. People use beach ridges for highways, for cemeteries and as sources of sand and gravel.

3. What caused the level of water in Lake Erie to change?

R3. The level of water in Lake Erie fluctuated as the lake's outlet was changed by the retreats and readvances of glacial ice.

4. Many type of fruit require well-drained soil. Why would beach ridges be good places for orchards?

R4. The beach ridges and the immediate areas are composed largely of gravel covered with soil. The area is better drained and therefore provides an excellent location for orchards.

Background Information

Beach ridges are formed by storm waves, similar to the berms along the ocean beaches. An excellent source of background reading concerning their formation is Waves and Beaches by Willard Bascom, Chapter IX, Beaches. Each ridge represents an ancient beach formed along the shore of Lake Erie at a time in the past when the elevation of the lake was much higher than it is today. These higher lake levels were caused by the glacier damming the lake's outlet. As the ice front retreated, a series of newer and lower outlets were exposed, so the lake level lowered, changing the outlines of the lake and thus the beach patterns. Several times the ice readvances, causing the lake level to rise and submerge the beach ridges made during a previous stage. The higher water would then scatter the materials making up the beach ridges and smooth them.

References

Forsyth, Jane, 1959. The Beach Ridges of Northern Ohio. Ohio Geological Survey Information Circular No. 25, Columbus, Ohio, illus. 10 pp.

Bascom, Willard, 1964. Waves and Beaches. Doubleday and Company.

Earth Science Curriculum Project, American Geological Institute, 1987, Investigating the Earth, Houghton-Mifflin, illus. 560 pp. (pp. 190 & pp. 362).

Hesser, Dale T. and Susan S. Leach, 1987. Focus on Earth Science. Charles E. Merrill Publishing Co., Col., Ohio, illus. 560 pp.

EVALUATION ITEMS

1. What causes the formation of beach ridges?
 - a. localized flooding
 - *b. waves
 - c. glaciers
 - d. low water level

2. What is one type of evidence used by scientists to locate a former shoreline of a lake?
 - a. hilly terrain
 - *b. beach ridges
 - c. gravel pits
 - d. highways

3. Two separate beach ridges occur close to each other near Lake Erie. What is the best evidence that they were made during the same lake stage (are of the same age)?
 - a. They each have a road on top of them.
 - b. They both have cemeteries on them.
 - c. They have the same amount of sand and gravel in them.
 - *d. Their tops are at the same elevation.

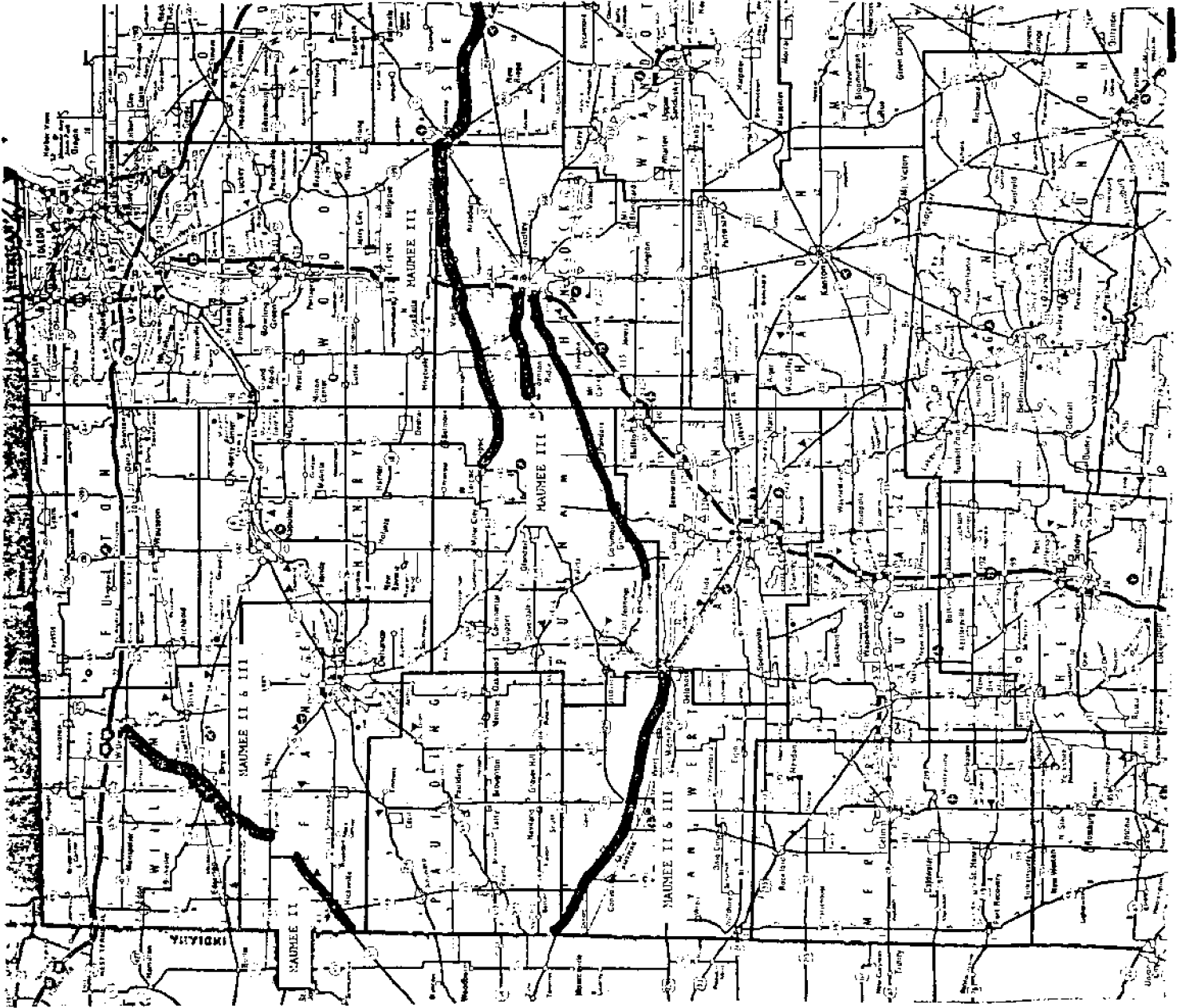
4. Which of the following land forms that occur along a seashore is the result of a rise in sea level (sea level was lower in the past)?
 - a. marine terraces
 - *b. wave-cut beaches
 - c. beach ridges
 - d. sand bars
 - e. spits

5. What is a major use of beach ridges in Northern Ohio?
 - *a. highway routes
 - b. garbage disposal
 - c. ground water sources
 - d. boat launching ramps

6. There is evidence that there have been large changes in the level of Lake Erie in the past. The probable cause of large changes in lake level is
 - a. a sudden change in the course of a river.
 - b. annual changes in the amount of precipitation falling into the lake.
 - c. the erosion of the Niagara River Gorge at Niagara Falls.
 - *d. movement of large continental glaciers.

7. Which of the following construction materials can be obtained from beach ridges?
 - a. limestone
 - b. sandstone
 - *c. sand
 - d. lumber
 - e. clay

Attach page 9 here
(Line up Wyandot County)



APPENDIX D

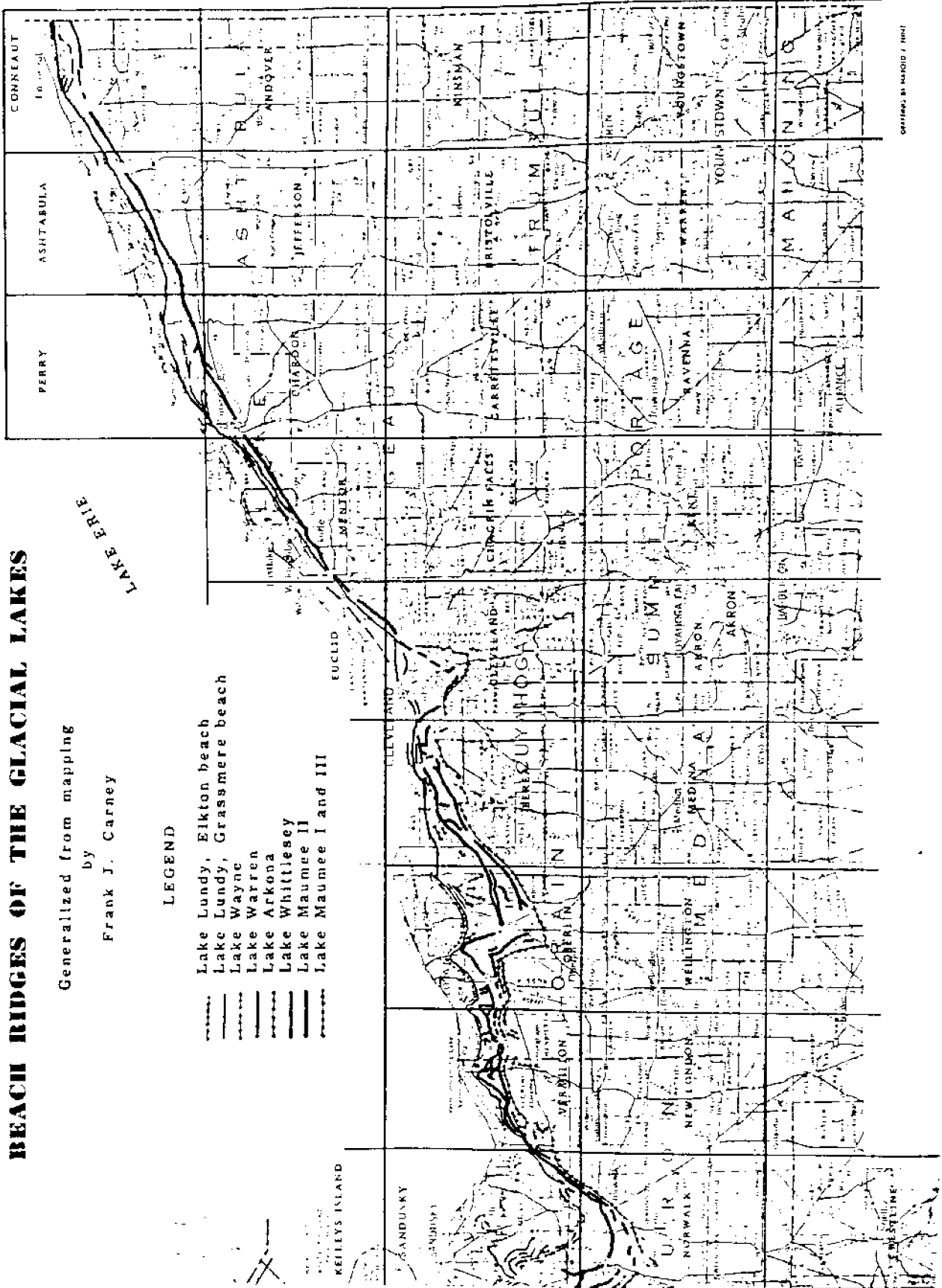
BEACH RIDGES OF THE GLACIAL LAKES

Generalized from mapping

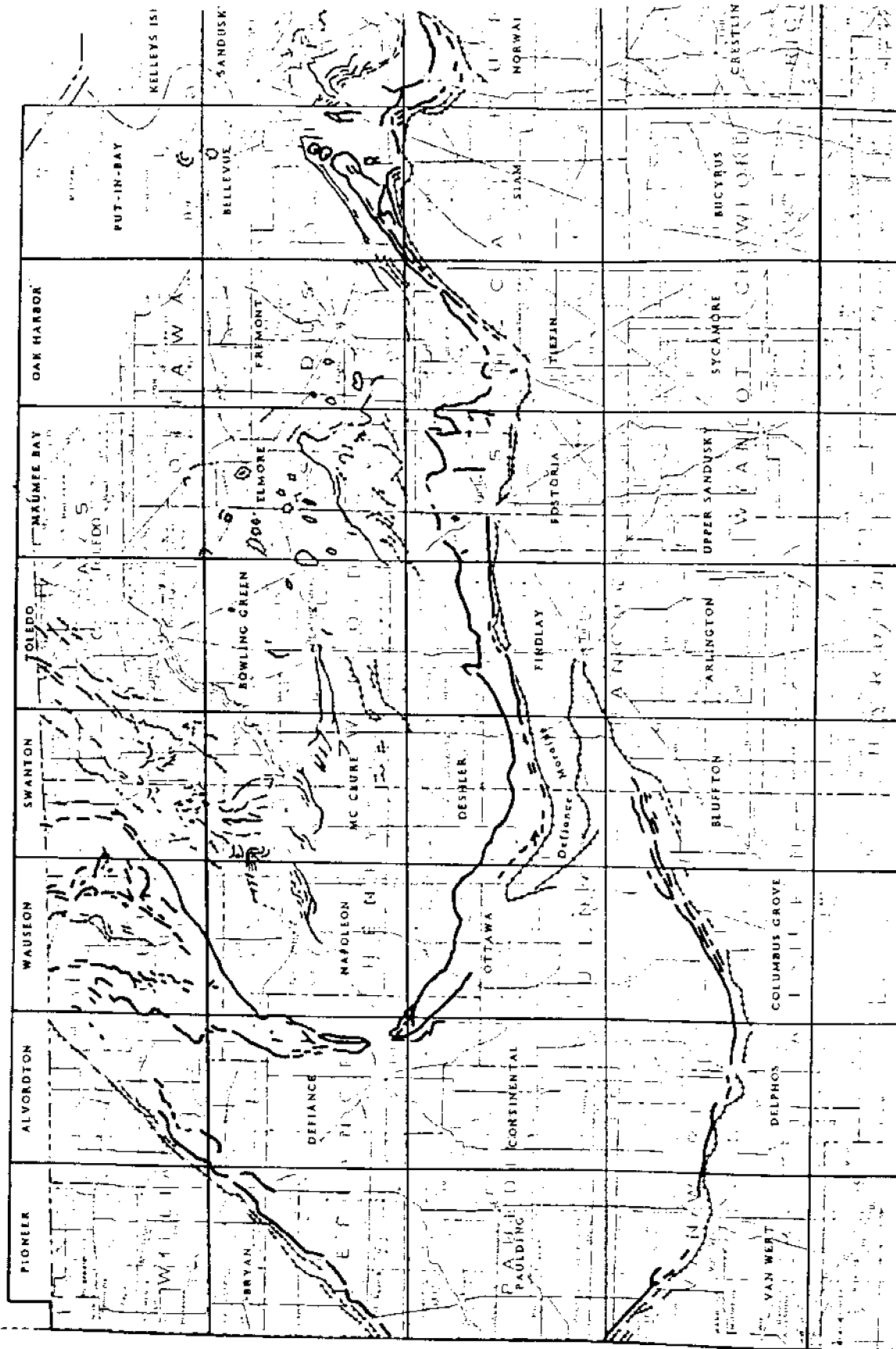
by
Frank J. Carney

LEGEND

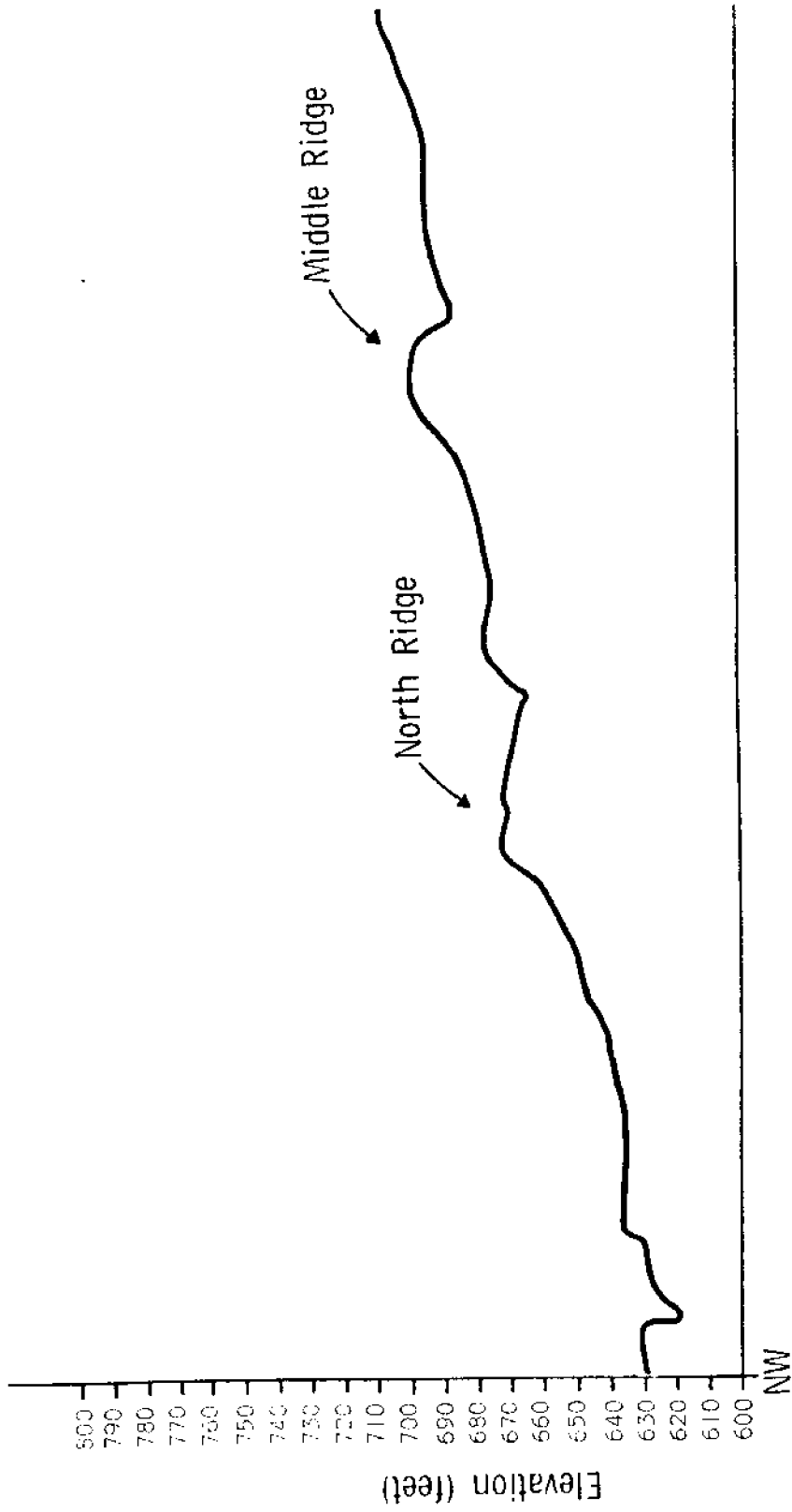
- Lake Lundy, Elkton beach
- ===== Lake Lundy, Grassmere beach
- ===== Lake Wayne
- ===== Lake Warren
- ===== Lake Arkona
- ===== Lake Whittlesey
- ===== Lake Maumee II
- ===== Lake Maumee I and III



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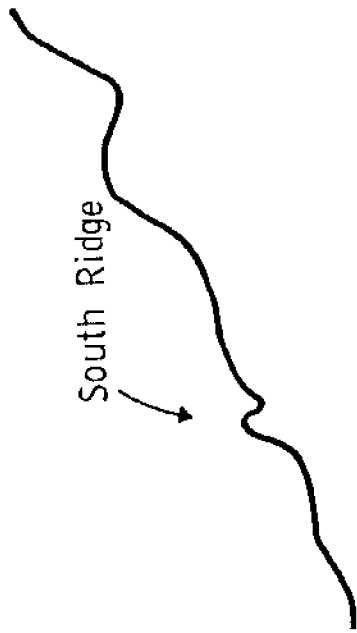
Appendix A.



Horizontal Scale = 1 inch equals 2000 feet

Vertical Scale = 1 inch equals 50 feet

V.E. = 40X

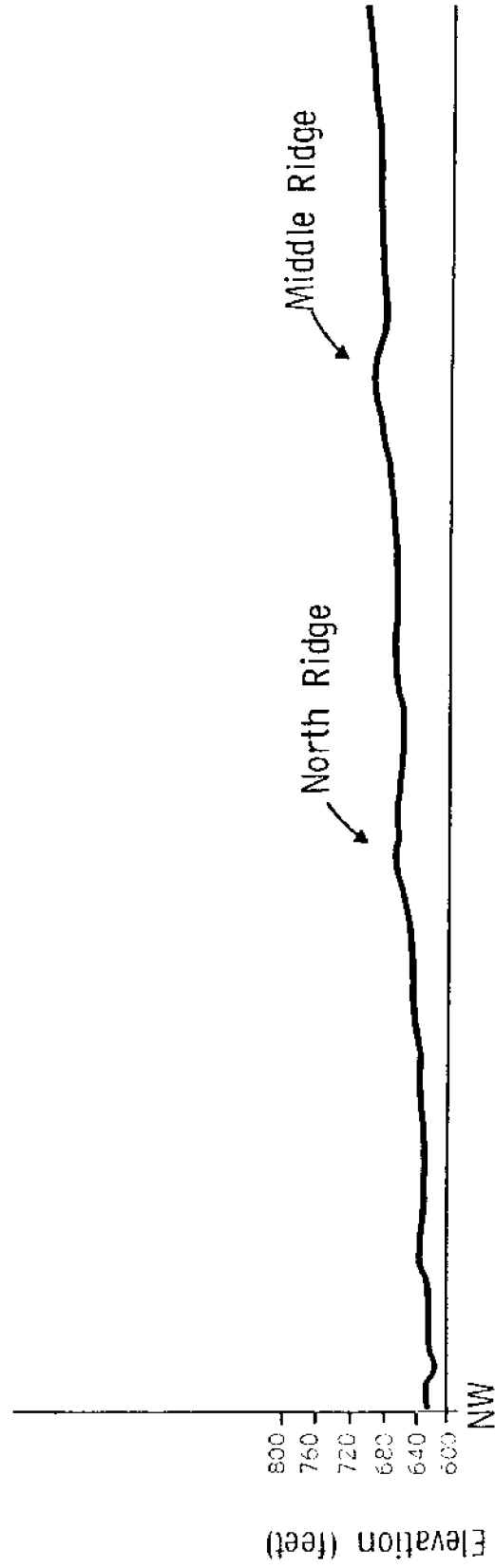


South Ridge



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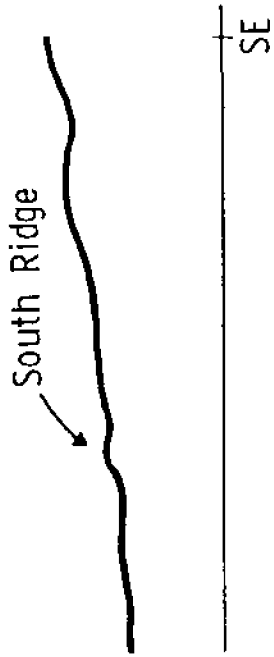
Appendix B.



V.E. = 10X

Horizontal Scale = 1 inch equals 2000 feet

Vertical Scale = 1 inch equals 200 feet



Attach page 15 here

Other titles of Oceanic Education Activities for Great Lakes Schools

for middle schools:

The Effect of the Great Lakes on Temperature
The Effect of the Great Lakes on Climate
Ancient Lake Shores
How to Protect a River
Changing Lake Levels on the Great Lakes
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
River Trek

for primary grades:

Lake Erie -- Take a Bowl
Build a Fish to Scale
A Day in the Life of a Fish
Supplemental Curriculum Activity
for Holling Clancy Holling's
Paddle-to-the Sea

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OBJECTIVES

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

1. Describe the evidence of past water levels of Lake Erie.
2. Use topographic maps and topographic profiles to locate evidence of past water levels.
3. Describe how people have made use of the beach ridges associated with Lake Erie.
4. Describe some evidence of past changes in the water level of the oceans.

ACTIVITY A: WHAT EVIDENCE IS THERE THAT THE LEVEL OF LAKE ERIE HAS CHANGED?

MATERIALS: Topographic map of the Madison, Ohio, area; road map of Ohio; graph paper and metric ruler.

PROCEDURE

Most lakes are contained in basins and flat, gently sloping floors. Wind causes waves, which in turn produce currents that act along the shores of lakes. These currents carry and deposit sand and form beaches. Perhaps you have swam from a beach. If so, you know what the sand looks like and how it feels.

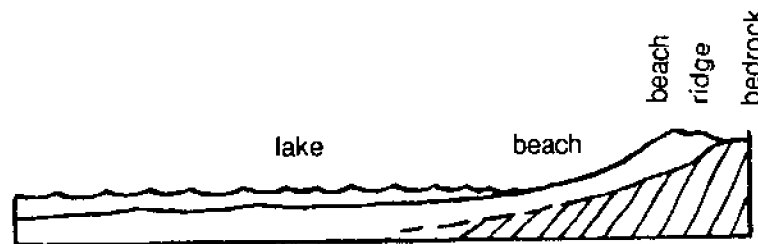


Figure 1. Cross section of a beach.

Figure 1 is a cross section (a side view) of a beach. Notice the flat floor of the lake, the gently sloping beach area itself, and a ridge at the top of the beach. This **beach ridge** is formed of sand thrown up by the action of waves. Answer the following questions on the work sheet provided at the end of this activity.

1. What is the contour interval of the map of the Madison area?
2. Examine the lower left portion of the topographic map. Compare the area immediately north of (above) the Penn Central Railroad with the area south (below) to the map's lower edge. How does the spacing of the contour lines in these areas differ?
3. What does the difference in the spacing of contour lines mean about the difference in topography in the two areas?
4. What evidence is there on the map that the lake once extended through the area north of the Penn Central Railroad?
5. Using the graph paper on your work sheet construct a topographic profile across North Ridge, Middle Ridge and South Ridge. Start the northern end of your profile where Red Bird Road T-intersects with Chapel Road. The southern end should then be where South Bates Road intersects Interstate 90.
6. What difference between the three ridges does the profile reveal?
7. What do you think caused each of the three ridges?
8. One of the ridges is not as prominent as the other two. What could be the reason for this difference?

Years Before Present	Lake Stage	Elevation of Beach Ridge in feet
0	Erie	573
12,700	Lundy (3 ridges)	620-640
	Warren	690
	Wayne	660
12,800	Whittlesey	735
13,000	Arkona	690-710
13,500	Maumee III	780
	Maumee II	760

Table 1. Data on Beach Ridges.

9. Determine an "average" elevation for each of the three ridges.
10. Compare the elevations of the three ridges to the data in Table 1. What stage does each of the ridges represent?
11. Label them on the profile.
12. How many stages has Lake Erie had? Refer to Table 1.
13. How old is the oldest stage?
14. What evidence do geologists use to tell what stage a ridge belongs to?
15. What do you think could have caused these different stages of Lake Erie?

A **stage** of the lake was a time when the lake level remained the same long enough to build a beach and a beach ridge.

Glacial ice caused the variation in the levels of Lake Erie. As the glaciers retreated they uncovered different outlets for the lake. These outlets were at successively lower elevations. When a new one was uncovered the lake dropped fairly suddenly to a new level. Occasionally a glacier may have readvanced over an outlet, blocking it. In this case, lake level rose once again, and the beach ridge was eroded by the higher lake. This may be the reason that Middle Ridge is so much lower than North and South Ridge.

ACTIVITY B: HOW HAVE PEOPLE USED BEACH RIDGES?

MATERIALS: Topographic map of the Madison, Ohio, area; road map of Ohio; and map from The Beach Ridges of Northern Ohio.

PROCEDURE

The beach ridges have been very useful to the inhabitants of northern Ohio. What are some of these uses?

1. Examine the three beach ridges on the Madison map. What human-constructed feature do they have in common?
2. Why do you think the beach ridges have been used for this purpose?
3. What type of human-constructed feature is located just southeast of North Perry and north of US Highway 20?
4. How many similar features do you find on Middle Ridge? On South Ridge?
5. What use of the ridges is implied by these features?
6. What type of human-constructed feature is located at 41°47'30"N 81°02'30"W (just west of the pond)?
7. How many other features of this type can you find on the three ridges?
8. How many do you find that are NOT located on one of the three ridges?

9. Why do people prefer to locate these features on beach ridges?

10. Ask your teacher for a different map. How many beach ridges can you identify on this new map?

11. What stages do they represent?

12. Which of the human-constructed features you identified in Steps 1 to 8 are found on the ridges on this map?

These beach ridges extend throughout northern Ohio. They indicate the location of the shoreline of the lake and the amount of area occupied by the lake at each of its stages. Your teacher will have a map of northern Ohio posted on the bulletin board. This map locates each of the beach ridges.

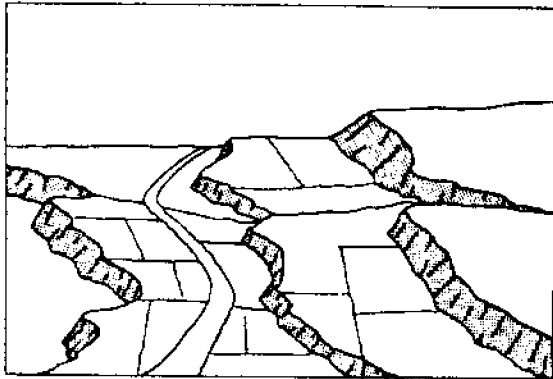
13. In an earlier part of this activity you learned that the people living in this area built many of their roads along the beach ridges. Using your road map and the map on the bulletin board, identify the major highways that have been built on beach ridges. Mark each of them on your road map. Label them with the name of the stage of the beach ridge.

14. List on your work sheet all of the uses people have made of beach ridges in the areas you have studied.

You have learned in this Investigation that the movement of glaciers caused changes in the level of Lake Erie and that the beach ridges provide evidence of such changes in lake level. The oceans have also had different levels of water. Figure 2 illustrates some of the evidence of higher sea level (marine terraces) and lower sea level (wave-cut cliff).

Glaciation is also one of the causes of recent variations in sea level. As the glaciers melted, the water returned to the sea, raising its level. There are other causes of sea level changes that your teacher may wish to discuss.

Marine Terraces



Wave-cut Cliff

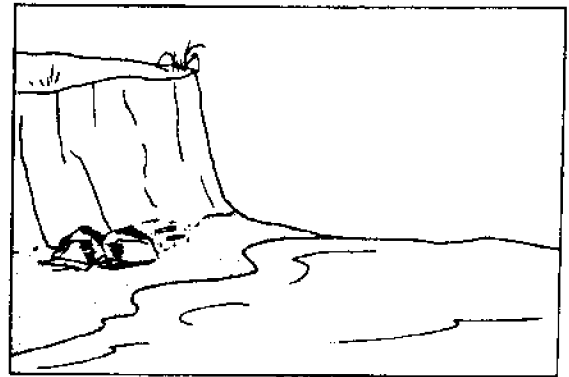


Figure 2. Evidence of sea level changes.

REVIEW QUESTIONS

1. What evidence is there that indicates that Lake Erie has been larger than it is today? How do these features form?
2. Discuss three ways that people have used beach ridges.
3. What caused the level of water in Lake Erie to change?
4. Many types of fruit require well-drained soil. Why would beach ridges be good places for orchards?

Name _____

ANCIENT LAKE SHORES WORK SHEET

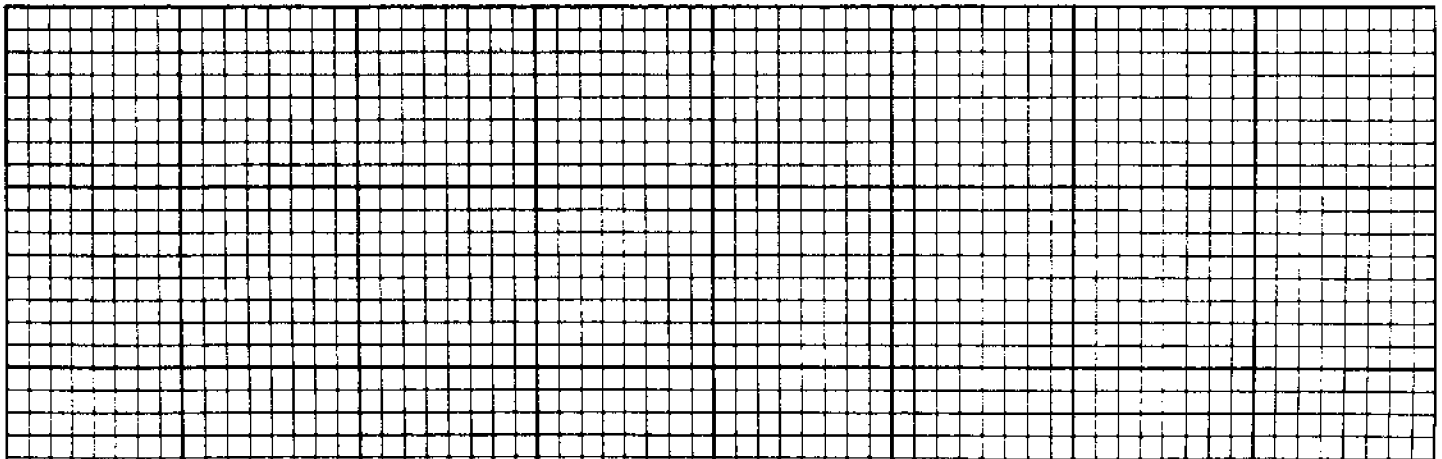
ACTIVITY A: What evidence is there that the level of Lake Erie has changed?

1. What is the contour interval of the map of the Madison area? _____
2. How does the spacing of the contour lines in these areas differ? _____

3. What does the difference in the spacing of contour lines mean about the difference in topography in the two areas? _____

4. What evidence is there on the map that the lake once extended through the area north of the Penn Central Railroad? _____

5. Construct a topographic profile across North Ridge, Middle Ridge and South Ridge. Start the northern end of your profile where Red Bird Road T-intersects with Chapel Road. The southern end should then be where South Bates Road intersects Interstate 90.



6. What difference between the three ridges does the profile reveal? _____

7. What do you think caused each of the three ridges? _____

8. One of the ridges is not as prominent as the other two. What could be the reason for this difference?

9. Determine an "average" elevation for each of the three ridges. North _____

Middle _____ South _____

10. Compare the elevations of the three ridges to the data in Table 1. What stage does each of the ridges represent? North _____ Middle _____

South _____

11. Label these stages on the profile.

12. How many stages has Lake Erie had? _____

13. How old is the oldest stage? _____

14. What evidence do geologists use to tell what stage a ridge belongs to? _____

15. What do you think could have caused these different stages of Lake Erie? _____

Activity B: How have people used beach ridges?

1. What human-constructed feature do the three beach ridges have in common? _____

2. Why do you think the beach ridges have been used for this purpose? _____

3. What type of human-constructed feature is located just southeast of North Perry and north of US Highway 20? _____

4. How many similar features do you find on Middle Ridge? _____

On South Ridge? _____

5. What use of the ridges is implied by these features? _____

6. What type of human-constructed feature is located at 41°47'30"N 81°02'30"W (just west of the pond)? _____

7. How many other features of this type can you find on the three ridges? _____

8. How many do you find that are NOT located on one of the three ridges? _____
9. Why do people prefer to locate these features on beach ridges? _____

10. How many beach ridges can you identify on this new map? _____
11. What stages do they represent? _____
12. Which of the human-constructed features you identified in Steps 1 to 8 are found on the ridges on this map? _____

14. List on your work sheet all of the uses people have made of beach ridges in the areas you have studied.

Review Questions

1. What evidence is there that indicates that Lake Erie has been larger than it is today?

2. How do these features form? _____
3. Discuss three ways that people have used beach ridges. _____

4. What caused the level of water in Lake Erie to change? _____

5. Many types of fruit require well-drained soil. Why would beach ridges be good places for orchards?

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