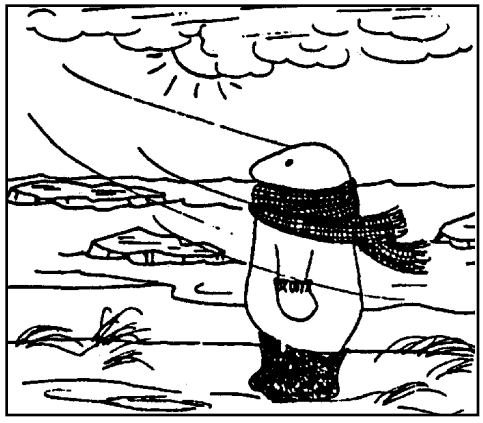
What factors impact ice coverage on the Great Lakes?

What impacts do you think ice on the Great Lakes might have on the surrounding area? Ice actually has a considerable impact. Shipping is shut down for a part of the year. Fish spawning can be impacted. Shoreline structures can be damaged. Even the climate itself is impacted by the ice coverage.

OBJECTIVES

In this activity you will demonstrate the ability to

- Develop a hypothesis identifying the major factors involved in ice coverage of the Great Lakes.
- Design an investigation of relationships in the Earth System.
- Evaluate your hypothesis and suggest other investigations related to it.



PROCEDURE

Part I

You already have some knowledge about the Great Lakes and the freezing of lakes / water. Use your knowledge to predict how the Great Lakes freeze. Complete *Table 1 - Predictions* on the next page with your predictions.

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Earth Systems Understandings

This activity focuses on ESU's 3 and 4 (scientific processes and interacting subsystems).

Materials

Handouts, pencil or pen, graph paper, other materials depending on investigations developed.

Teacher Notes

After students have recorded their own perceptions of ice coverage of the great lake and then compared them to actual data, they will be asked to develop an investigation that will test factors that they believe influence ice coverage on the Great Lakes.

The format that this activity takes is very open ended and you can modify it to fit your style. Some possible variations include:

a. The class selects one investigation after a discussion and every one does this investigation in groups or individually.
b. Students conduct their approved investigations outside of class in groups or individually.

After investigations are conducted, reports can be written, oral or in a conference style where each group would report results and conclusions. Then the class would try to determine what factors are most important in ice coverage of the Great Lakes from the data collected.

Predictions Lake:	#1-5 First to last to start to freeze	Month it reaches max. ice coverage	#1-5 First to last to start melting	% of lake frozen in normal winter	% of lake frozen in severe winter
Lake Erie					
Lake Huron					
Lake Michigan					
Lake Ontario					
Lake Superior					

Table 1 - Predictions

Part II

6. What different conditions do you think influence the formation of ice on the Great Lakes? What factors did you consider in making your predictions?

Answers

9. Brainstorm ideas. Some possible factors that might work well for investigation development in the next part of this activity are depth of the water, the volume of the lakes, wind patterns and location of the lake (southern lakes are closer to warmer conditions).

7. Take a look at Table 2 (provided by your teacher) and then revise your predictions, if needed. Why do you suppose your answers differed from the information in Table 1? [Alternatively, use the Great Lakes Ice Model developed for computers by the Great Lakes Environmental Research Laboratory.]

Computer Program Source

A DOS or MAC version of "Great Lakes Ice Simulation" is available from: Publications, NOAA, Great Lakes Environmental Research Laboratory, 2205 Commonwealth Blvd, Ann Arbor, MI 48105-1593

8. Compare your list of factors in question 6 to lists made by other students in the class. Taking into consideration what you found in Table 2, hypothesize factors that you think might affect ice conditions on the Great Lakes and list them.

9. Discuss these factors with your teacher and class.

Part III --- Investigation Planning

10. Select one factor that you believe affects ice conditions on the Great Lakes and design an investigation that you can conduct to test your hypothesis that the factor you chose affects ice conditions. **Complete the form below and get it approved by your teacher before conducting your experiment.**

A. If _____ is a factor affecting ice formation then I expect the following to happen in my investigation _____

_____

B. Materials needed: _____

_____

_____

_____

_____

C. Procedure: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

D. Data - What data are you going to collect? (What will you record?) _____

Signatures: _____ _____ _____ _____

Student or Team Date Teacher Date

Part IV - Investigation Results

10. Produce a chart or graph of the data you collected in your investigation.

11. Did the results come out as you expected? If not, why not?

12. What other investigation would you like to do based on the results of this one?

Part V

Record your thoughts about each of the following and then discuss them with your class.

13. When there is ice on the Great Lakes, how would it affect:

a. shallow harbors -

b. deep harbors -

c. temperature of air above the lake -

d. humidity of the air above the lake -

e. "lake effect" winter storms -

14. Some scientists predict that global warming could increase the average world temperature by 1.5 to 4.5° Celsius. How do you think global warming might affect the Great Lakes in regards to:

a. length of shipping season (currently about 10 months) -

b. evaporation rate of lake water -

c. lake levels -

d. precipitation rates -

Answers

There are a variety of answers possible to questions 13 and 14. The following are provided as a starting point for discussion.

13.

a. Ice will form first in shallow harbors because of a faster heat loss for the volume of water. Thus the shipping season will be shorter or icebreakers will be needed.
b. Ice formation will be later.
c. Ice formation insulates the water below and slows heat loss to the atmosphere. This means that the lake can not warm the air (serve as ha heat source) the way it does before the ice forms. Temperature moderation will cease and temperatures along the shores will be colder than normal.
d. With ice covering the lake, evaporation will be slowed and the lake will not contribute extra humidity to the atmosphere.
e. With no extra humidity being added to a storm system moving over the lake, there will be no added lake effect snow storms.

14.

a. Shipping season may be lengthened.
b. Evaporation levels may increase.
c. Lake levels may be lowered with increased evaporation.
d. Precipitation rates may increase with increased evaporation. We are not sure what will happen.

Evaluation - Have students draw a concept map of the interactions that they see as a result of question 13 or 14.

Other Resources

For more information you may want to get a set of Global Change in the Great Lakes Scenarios and or GLIMCES - Great Lakes Instructional Materials for the Changing Earth System. Both are Ohio Sea Grant Publications. 1541 Research Center, 1314 Kinnear Rd, Columbus, OH 43214. 614/ 292-8949

Ice Coverage and the Great Lakes

Normal winter ice events	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Early Ice Cover	Jan 20-30	Jan 25-Feb 5	Jan 25 - Feb 5	Jan 15 - 25	Jan 25-Feb 5
Mid - Season Ice Cover	Feb 25- Mar 5	Feb 20 - 28	Feb 25 - Mar 5	Feb 1 -10	Feb 15 - 25
Maximum Ice Cover	Mar 25 - Apr 5	Mar 15 - 25	March 20 - 30	Feb 20 - 28	Mar 10 - 20
Early Decay (melting) Period	April 1 - 10	Mar 20 - 30	Mar 25 - Apr 5	Feb 25 - Mar 5	Mar 15 - 25
Percentage of Lake Covered by ice at maximum:					
Mild Winter	40	10	40	50	8
Normal Winter	60	40	60	95	15
Severe Winter	95	80	80	100	25

Table 2 - From Phillips, D.W. and J.A.W. McCulloch. 1972. The Climate of the Great Lakes Basin. Climatological Studies Number 20. Environment Canada. Toronto.