

Ecology of Isle Royale—Final Project (Classroom Outcome)

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Through the elimination of outside influences, a unique natural beauty, and peaceful locale Isle Royale allows for personal reflection and deep concentration leading to new inspirations on not only teaching but on life in general. Sharing this experience with others in the profession of teaching enhances motivation and reinforces a multidisciplinary approach to academics; it inspires me to think of additional ways to bring the Isle Royale experience to my students.

There are so many interesting and varied aspects of Isle Royale to choose from for teachers and one way I felt that this would be a benefit for enhancing a mathematics unit was in the areas of data analysis and statistics. Almost every presentation, brochure, study, or text on Isle Royale had some type of graph or interpretive data included. Being a math teacher I thought this would be an excellent way to bring a variety of topics about Isle Royale into the classroom and would also allow for expansion on the topics from year to year as more data become available. Now admittedly, I was not thinking about bar graphs while I was on Isle Royale, but I do think it would be a cool way to allow students to see a range of topics concerning Isle Royale. It also brought back a memory from my aunt, now deceased, who taught in a one-room schoolhouse for 10 years in the 1930's and 1940's in New York State. This aunt had a wildflower identification chart each spring with a gold star given if a student located the first of each wildflower. She also had the students plant something outside on Arbor Day each year. She was so inspiring to her students that years after the school was closed and consolidated a former student bought the school, made it his home, and published a booklet telling the story of this particular one room schoolhouse. If we, as teachers, can connect our students to nature, whether it be through a trip to Isle Royale or an inspiration from the IR experience, we have a better chance of their appreciating, preserving, and protecting our natural world.

Lesson 1: Temperature Data Analysis and Isle Royale

Overview: In this lesson students, as a group class project, will collect temperature data for their local area for 2 weeks (ten school days) and create a table to display their information. Students will compare their data with that of Isle Royale. Discussion of differences between mainland and IR temperatures will be probed as well as differences between lakeshore and inland values. Teachers may extend discussion to include plant and animal habitats, Lake Superior agriculture, and the uniqueness of Isle Royale situated in Lake Superior.

Goals: Students should be able to collect, organize and present data in a way in which it can be clearly understood by others. They should be able to read and interpret data from a variety of sources and be able to make inferences and possible predictions from such data.

Objectives: Produce a legible table summarizing data collected including daily temperatures and an average temperature for the two week period of collection.

Materials and Requirements: This lesson is applicable in any 9th grade math classroom and the included lesson and internet access are the most pertinent needs, but you will need to find an accessible lakeshore property owner that you may contact every day during class time for the duration of the lesson to report the lakeshore temperature. This person may be a local retiree, a classroom parent or possibly a storeowner or motel owner/worker. If your school is located on Lake Superior then your contact would be an inland homeowner/parent willing to help with a classroom project. Take this opportunity to bring an “outside the school” source to contact with the education process!

Method: Students will collect data for a two-week period; this may be accomplished during class time and recorded on the board with one student keeping a paper copy. Upon completion students will brainstorm an idea for displaying their information (powerpoint, poster, handout, or overhead for examples) and a type or types of charts (bar graphs, line graphs, or a table) for best representation of data and give some rationale for their choices. Upon completion students may compare their information with that of Isle Royale for a similar time of year and discuss the differences and similarities of the values. See www.nps.gov/isro/climtabl.htm for comparison data. As an extension to the science classroom see [Lake Effects: The Lake Superior Curriculum Guide for K-8](#) p. 29-33 for a lesson plan on “Weathering Lake Superior” which includes mean monthly temperature data for the Great Lakes regions.

Procedure: Introduce the topic by asking students if they know that morning’s temperature at their own houses. Does everyone report the same value? Note that temperature value is related to the time of day it is taken, the location (valleys, mountains, lakeshore, or inland), and the actual location of the thermometer being used. Tell them that they, as a class, are going to take a local temperature (inland, most likely) and a lakeshore (homeowner, by phone) temperature every day for 2 weeks. Choose different students to record the temps. Each day students are to record the temps. on the board as well as on paper for safe-keeping. Use the chart below for recording.

Classroom Temp. Data

Day	Date	Inland Temperature	Lakeshore Temperature
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Data Organization, Description, and Interpretation: Explain to the students that you would like to, as a class, organize, display and offer some interpretation of the data collected. They must first discuss and analyze the data perhaps determining a mean temp. for the inland temps. as well and the lakeshore temps. They may, at this time, compare their data to that of Isle Royale using the site, www.nps.gov/isro/climtabl.htm, or the “Weathering Lake Superior” information. Be sure to note that the lakeshore area temps are similar to Isle Royale while the inland (airport, ie.) are different. Explain how Isle Royale is surrounded by all that cold (40°F) water and that, in turn, keeps the island cooler in above 40° weather and warmer in below 40° weather (except when the lake freezes over!). Have the class determine how they would like to display their data and any comparison data. They should consider their audience...will it be for their classroom only or perhaps a hallway display or a showcase display or a school newspaper article. Once they have determined an audience they can decide on a format (a powerpoint for other teachers to use in their classrooms or an overhead overlay, an 8 ½ x 11 “handout for class members, a classroom poster, or a display and interpretation for parent and student perusal in the hallway. Then they are ready to choose their type of graph, bar graph line graph, table, or pictorial. Let the students discuss and decide the details with you, the instructor, as an informed guide. Even though this is a teacher-guided project be sure to assign grades for participation in data collection, discussion, and final project outcome. Depending on you personal grading method you may work out a rubric for individual grades or assign a group grade (especially if the project turns out nicely)!

Assessment: Considerations for assessment should include collection of data, analyzation and organization of data, interpretation and use of outside data, neatness and practicality of final presentation, inferences and or predictions based on information.

Extension: In addition to the website, www.nps.gov/isro/climtabl.htm, listed above, it would be nice to work alongside the earth science instructor doing the experiment also listed above, Lake Effects: The Lake Superior Curriculum Guide for K-8 p. 29-33 , “Weathering Lake Superior”.

Lesson 2: Graph and Chart Interpretation from the 2005-2006 Wolf Study

Overview: In this lesson students will analyze charts, graphs and pictorials from the 2005 – 2006 Ecological Studies of Wolves on Isle Royale found at

http://www.isleroyalewolf.org/ann_rep/ISRO_annrep05_06.pdf , or from the International Wolf Center (1396 Hwy. 169, Ely, MN 55731 or phone 1-218-365-4695) or the Isle Royale Natural History Association (800 East Lakeshore Dr., Houghton, MI 49931 or phone 1-800-678-6925). There are over a dozen opportunities in this publication to analyze, interpret and predict using charts, graphs, tables and pictorials. Students may also consider whether the best representation was used for the given information and identify possible improvements, if necessary.

Goals: Students should be able to describe and interpret information in graphs, charts and tables and relate the information to the natural situation from whence it came. They will be able to make logical predictions based on the available information.

Objectives: Students will be able to answer questions about data presented. A relationship between the data and the physical situation from which it originated in will be made through discussion and written work. Contingent on known data, logical predictions will be drawn and assessed.

Materials and Requirements: This lesson is for students at or near the 9th grade math level. A classroom set of copies of the 2005 – 2006 Ecological Studies of Wolves on Isle Royale found at http://www.isleroyalewolf.org/ann_rep/ISRO_annrep05_06.pdf , or from the International Wolf Center (1396 Hwy. 169, Ely, MN 55731 or phone 1-218-365-4695) or the Isle Royale Natural History Association (800 East Lakeshore Dr., Houghton, MI 49931 or phone 1-800-678-6925) will be necessary. Using this study and the material herein will suffice for this lesson.

Methods: Students and teacher will read, by section, the 2005 –2006 Wolf Report. It is suggested to either read aloud during class or assign small portions of text for up to several weeks before beginning any data analysis. As this information might be new to many students, a longer period of initiation is encouraged. Allow your students to become familiar with the material, to ask

questions about the pictures, text, and data. Do not expect them to make sense of all the facts in a short period of time, but rather allow them to immerse themselves slowly into the realm of Isle Royale. Use the booklet along with the instructional materials to allow for ideas and interpretations to arise and show their worth.

Procedure:

Day 1: Ask students if they have ever visited Isle Royale. Describe the isolated setting and limited wildlife at the park. On page 3 of the text (2005 – 2006 Ecological Studies of Wolves on Isle Royale) read the Summary section and realize that in one paragraph a huge amount of information is being presented. Show the students how to arrive at the ratio of 15- to – 1 (moose – to – wolves) by reducing the 450 moose / 30 wolves. In the third sentence note that 23% of 30 wolves died which is 6.9 wolves ($0.23 \times 30 = 6.9$). Note that the author offers some inference in saying that the wolves are still healthy but that with the moose population on the decline due to these healthy packs that the moose will continue to decline in numbers until the wolf numbers go down (natural causes, severe weather, lack of available moose, particularly weak or young moose). The last sentence mentions another possible cause of wolf numbers declining and that is inter-pack conflict (fighting leading to killing). **Homework:** Have students determine the ratio of Moose to Wolves for each 5 year period beginning with 1965 and ending with 2005 (9 calculations). Which year had the highest ratio, the lowest? What are some of the students' ideas about what will happen to the wolves and moose next year? In 5 years? (Accept any reasonable answers including more moose decline and a wolf decline, always keeping in mind that disease or weather may trigger unpredictable changes at any point in time).

Day 2: Review homework from Day 1. Assign reading of the section titled “The Wolf Population” from page 3 through page 7. Discuss pictures, pictorial (figure 2, p. 4) , and charts a little before sending them home with the reading. Notice that the different packs cover different square areas and that the packs are different sizes. Ask whether students know why the three bar graphs on p. 6, figure 8 are grouped together. The wolf population has remained the same size, approximately, for the past few years, but is it the same wolves? No, by looking at the percent mortality some wolves have died and looking at the % of pups born there have been many new pups each of these years. Look at the line graph on page 7, figure 10. Notice that the middle pack

has the highest ratio of moose to wolves. Look back at figure 2 and see that the MP also has the largest area to roam. The caption for the picture on Figure 11 notes this. **Homework:** Read the section titled “The Wolf Population” on pages 3 – 7. Discuss after reading that radio collars have been used but with varied success. Discussion of how two of the wolves died, one from complications of a hernia and one from fighting between wolf packs, is mentioned as well as courtship behaviors and expected pups for the coming season. At the end of the last paragraph on page 4 it is mentioned that the East pack is dominating the Chippewa Harbor Pack to some degree by taking over territory and killing one of the CHP. It is mentioned that the CHP has a high kill rate for moose, but that its existence is uncertain if the EP takes over its territory. On page 6 the author makes some predictions about the future. It is also mentioned that there has been some wolf/human interaction although no one has been harmed. How do the students feel about wolves and humans? Are they scared? Do they think that “wolves will be wolves” and humans have to be careful or do they think that people pay to go to a national park and that the wolves should be controlled? Allow them to express their opinions and determine how they have come to feel the way they do. Some may be hunters and think that wolves would make good prey. Some may think that animals should be allowed to remain in their natural habitats. Others may want to see wild animals in zoos and “safe:” places. Explain that visitors are asked to “leave no trace” at Isle Royale National Park so that wild animals do not become accustomed to human food and garbage. In this way they will stay away from humans and live a more natural lifestyle. Humans will have less impact on the island.

Day 3: Students will read and familiarize themselves with the section on “ The Moose Population”. Guide the learners back to figure 1 on page 3 for the moose population line graph. On page 8 notice that figure 13 represents the percentage of the total number of moose which are young calves (6 months old or less) for each year. Figure 12 at the top of page 8 shows where most of the moose are located. Charts on page 9 indicate issues affecting the moose population. **Homework:** Read pages 8 and 9 on “The Moose Population” and using figure 15 on page 9 determine an average moose mortality rate for 1974 – 2006. Round the yearly rate for deaths per day to the nearest tenth , add them together and divide by 33 years. Students should come up with an average of near 0.5 deaths per day. Ask students what causes most moose deaths? The caption for figure 15 states that all recorded moose deaths are from wolf predation. Why don't moose die from old

age? Because the wolves kill them when they become weak from either disease or age. Wolves kill moose calves because they are small and old or weak moose because they aren't as strong. Moose in their prime are difficult targets for wolves to kill even with all the hunters in the wolf pack. The author seems to think that moose locations change due to predation. Researchers keep track of moose conditions on kills as these are related to weather, food availability, and tick levels. Allow the students to relate that Isle Royale, which is very isolated, has a complex relationship between its plants and animals. Imagine how much more complex each of our local ecosystems!

Day 4: Students will read the final required section of the Wolf report covering "Forest Vegetation" on page 10, "Other Wildlife" on pages 12 and 13, and "Weather, Snow, and Ice Conditions" on page 15. Readings exclude the gray sidebars. Moose are shown eating snow and lichens. River otter are pictured scampering over the snow. These sections offer some more overview of the Isle Royale "circus" as Candy Peterson called it. We are the spectators of what's going on in the circus but aren't really part of the act. **Homework:** Read pages 10 – 15, omitting sidebars, but including data charts. What is a Julian Day, see page 15, figure 23. Answers may vary but it is my impression that the days are being counted from January 1st. Some of the dates are in January and February on the sidebars, although the starting day could be anytime in winter. Should the start date have been included on the graph? Notice that the snow depth is in cm. and the temperature is in Celcius. Most students in the US will be used to snow in inches and temperature in Farenheit.

How many inches is 50cm. of snow? ($50 \text{ cm.} \times 1 \text{ in} / 2.5 \text{ cm} = 20 \text{ inches of snow}$). How cold is -10°C in $^{\circ}\text{F}$? ($-10 \times 9/5 + 32 = 14^{\circ}\text{F}$). Reiterate that there are few influences on the wildlife at Isle Royale and we still have trouble interpreting and predicting information. Our own ecosystem is much more complex and we will have more difficulty unraveling its mysteries and relationships!

Day 5: Allow students to ask questions and comment on text information, charts, graphs, pictures, or sidebars. **Homework:** Read sidebars pages 11 & 12, 14 – 16. Allow discussion concerning pack dominance, moose kills, and radio collaring. This will conclude a school-week long introduction to the wolves of Isle Royale. It is important for students to familiarize themselves with information before trying to understand where the data arise from for many of the

graphs and charts. Information with background is more easily understood than simple data representation. One of the pitfalls of condensing data for easy review is loss of information. For example a mean, or average, value may not show outlying scores. When you feel students have a grasp of the booklet you may assign them the worksheet that follows on reading, interpreting, improving a graph style, and predicting using data analysis.

Data Analysis and Isle Royale Worksheet

1. Using your Day 1 calculations on moose to wolf ratios create a line graph similar to figure 10 on page 7 for the nine ratios you computed. You may use this paper, graph paper or a computer generated printout.
2. Based on the graph you prepared in question #1, what do you expect to happen to the moose –wolf ratio in the next 5 years? What factors will influence the ratio?
3. Looking at the pictograph on page 4, figure 2, and assuming that Isle Royale is 40 miles long by 8 miles wide, how big would you estimate the area in square miles for each wolf pack. Remember, this is an estimate, and I am more interested in your method than just a final answer!

Assessment: Students will be assessed on the basis of their participation in classroom discussions, homework assignments, and on the final worksheet (answers below).

Extension: Students are encouraged to make a trip to Isle Royale National Park to see the moose, hear the wolves, and experience the climate, isolation, and inspiration of the island wilderness. ;)

Data Analysis and Isle Royale Worksheet (Answer Sheet)

1. Using your Day 1 calculations on moose to wolf ratios create a line graph similar to figure 10 on page 7 for the nine ratios you computed. You may use this paper, graph paper or a computer generated printout.

1965: $600 \text{ moose} / 26 \text{ wolves} = 23 - 1$

1970: $1200 \text{ moose} / 18 \text{ wolves} = 67 - 1$

1975: $1200 \text{ moose} / 40 \text{ wolves} = 30 - 1$

1980: $750 / 48 = 16 - 1$

1985: $1100 / 22 = 50 - 1$

1990: $1400 / 15 = 93 - 1$

1995: $2400 / 16 = 150 - 1$

2000: $800 / 30 = 27 - 1$

2005: $500 / 30 = 17 - 1$

2006: $450 / 30 = 15 - 1$

Accept any legible style line graph with the above information.

2. Based on the graph you prepared in question #1, what do you expect to happen to the moose – wolf ratio in the next 5 years? What factors will influence the ratio?

Similar to 1980, they might expect the wolf population to dwindle due to low numbers of moose. Then the moose population may recover for lack of predators and as this happens the wolf population may again recover. At any time a natural disaster such as severe weather may cause a decrease in both the wolf and moose populations. Snow depth may cause trouble for moose, in-breeding or disease may create havoc for wolves. Allow for any reasonable inferences.

3. Looking at the pictograph on page 4, figure 2, and assuming that Isle Royale is 40 miles long by 8 miles wide, how big would you estimate the area in square miles for each wolf pack. Remember, this is an estimate, and I am more interested in your method than just a final answer!

Middle Pack: Using a rectangular estimate with length being about 20 miles and perhaps 7 miles for the width(since there is a large bay not containing land) say 140 sq. miles.

Chippewa Harbor Pack: Approximately 15 miles by 6 miles to equal 90 square miles of territory.

East Pack: Similar in size but maybe slightly smaller than the CHP or about 80 sq. mi.

Students may come up with many intricate methods for determining areas. Allow them to express their ideas!

4. Using figure 2 on page 4 approximately how large is the overlapping area, in square miles, of the Chippewa Harbor Pack and the East Pack? In conjunction with the pictograph on page 8, figure 12, what do you notice about the overlapping area of CHP and EP?

Approximately 2 mi. x 4mi. = 8 sq. miles. The overlapping area is where there is a concentration of moose that the wolves may be in contention over.

5. Graph the information on the three bar graphs found in figure 8 on page 6 onto a line graph using a different color for each line. Does this help you interpret the information the bar graphs provide? Why do you suppose that the information is presented as 3 separate bar graphs in the report? You may use graph paper or a computer generated graph.

Accept any neat and statistically correct graphs. Making the graphs may help them analyze the information but students may relate that there is too much information to work with reasonably. You may suggest that they look only at extreme years or at 5 year periods. The colors and regraphing should help them notice when conditions were harsh for wolves (for example in the early 80's the mortality was high and few pups were born but in 1983 the pups rebounded—maybe some strong and healthy wolves survived) The information may be presented in separate tables because the inside of the brochure is in black and white ink only(probably to save on costs) and to fit in available space.

6. For this question, use the snow depth line graph on figure 23, page 15. Beginning with the first value (dot on the line graph) , estimate a snow depth for each dot on the graph and fill in the table below. (the first one is done for you). Find an average snow depth using your estimates, a median value, and the mode of the distribution. Use the second blank table to compute the median, if desired. Round the average to the nearest cm.

48 cm.	47	47	48	49	55	49	48	38	38	42	48	44	51	50	54	52	49	48	48	46
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Snow depth in cm.

Students might mention the early 80's, or the 1995-96 period, or the current 2005 –2006 time slot. These might arise from figure 1 (Moose-Wolf Populations), figure 8 charts on page 6, figure 15 on page 9, Balsam fir tree abundance and mortality on page 10, or any other applicable information.

Lesson 3: Decision Making on Isle Royale

Overview: In this lesson students will be asked to assimilate the information they have learned about Isle Royale through data analysis and Lake Superior temperatures into an answer to an open-ended question. It is a brief lesson used to wrap up exposure to a new topic.

Goals: Students will incorporate writing skills into their data analysis. They will infer and predict about an unknown situation. This is a chance to extend their thinking of math as having right and wrong answers to thinking of data analysis as a means of influencing ideas through support of numbers, history of what has happened before, along with ingenuity of what is possible.

Objectives: Students will describe and interpret data. Students will organize and present ideas supported with data . They will infer and predict an outcome.

Materials: Students will need their work from Lessons 1 and 2 of this Unit and the 2005 – 2006 Ecological Studies of Wolves on Isle Royale used in Lesson 2.

Methods: In this lesson students will be presented with an unknown situation and asked to write their predictions for the outcome of the circumstances

Procedure: Ask students to respond to the following scenario with a solution that they can defend with what they have learned in lessons 1 and 2 of this unit.

Scenario: The wolves of Isle Royale die out due to a severe winter in 2006 -2007 and the National Park Service wants a recommendation as to whether or not to reintroduce wolves on the island. Based on what you have learned about Isle Royale, what do you recommend and why?

Assessment: Students should be graded on their grasp of the issues, their command of language, their interpretation of data, and their persuasiveness using information.

Michigan Mathematics Benchmarks Addressed:

Strand I: Standard 1.1 Patterns, Relationships and Functions, Standard I.2 Variability and Change

Strand II: Geometry and Measurement, Standard II.1 Shape and Shape Relationships

Strand III: Data Analysis and Statistics, Standard III.1 Collection, Organization and Presentation of Data, Standard III.2 Description and Interpretation, Standard III.3 Inference and Prediction

Strand IV: Number Sense and Numeration, Standard IV.3 Number Relationships

Michigan Science Benchmarks are also addressed as follows:

Strand I: Constructing New Scientific Knowledge, Standard I.1 Constructing New Scientific Knowledge

Strand II: Reflecting on Scientific Knowledge, Standard II.1 Reflecting on Scientific Knowledge

Strand III: Using Scientific Knowledge in Life Science, Standard III.5 Ecosystems

Bibliography:

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Dufresne, J. (1991). Isle Royale National Park, Foot Trails and Water Routes. Seattle, WA: The Mountaineers.

Peterson, Rolf O., and Vucetich, John A. (2006). Ecological Studies of Wolves on Isle Royale 2005 - 2006. Houghton, MI: School of Forest Resources and Environmental Studies

Peterson, Rolf O. (1995). The Wolves of Isle Royale: A Broken Balance. Minocqua, WI: Willow Creek Press

Simonson, D. (1996). The Diary of an Isle Royale School Teacher. Houghton, MI: Isle Royale Natural History Association.

www.ltr.org for information on Leave No Trace Outdoor Ethics

<http://www.isleroyalewolf.org/> for past wolf studies and publications

<http://www.northland.edu/Northland/soei/Programs/TimberWolfAlliance/> for Wolves of Michigan publication and other resources.

<http://www.nps.gov/archive/isro/pphtml/nature.html> for park and island information and additional links.

http://www.nps.gov/archive/isro/NR_Profile_Internal/NR_pages/Natural_Resources_index.htm
this is a great site for kids to explore in the classroom!