

Inquiry Activity Sequence

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Overarching question: Over the last 100 years, the organisms found in the Great Lakes have changed considerably. What has caused this change?

Comment: At the beginning of the unit students will answer this question on a sheet of paper and hang it around the room. As we proceed through each lesson in the unit they will add information, modify their hypothesis, support their original idea, and ask new questions using sticky notes that are placed on the sheet. This allows them to track the progression of their ideas as we learn new information.

Focus Objective

Objective	Type
I can use data and evidence to argue that complex interactions in an ecosystem maintain stable conditions within that system.	Data analysis: students look for and explain patterns in “experientially real” data sets that are given to them.

Comment: I ask the student this question because it is relevant to them, as they live near and have visited the Great Lakes. Often there are articles or news stories that reference the changes in the Great Lakes. Since students have some background knowledge, they are more motivated to share their ideas.

Big Ideas and examples

Big Idea: Because there are many organisms in an ecosystem, they interact in many complex ways. One type of interaction is competition. Species will compete other species for food, space, or any other limited resource. When there are two species in the same niche at the same time, they will compete. This is known as the competitive exclusion principle. Rather than compete species typically divide resources. This competition and division of resources helps to determine the number and types of species in a community and the role of a species in the community.

Comment: The big idea of this activity sequence is that interactions between species can have an affect on other species and the ecosystem as a whole. Relating back to the overarching question, students will be able to argue that some of the changes in the Great Lakes comes from changes in these relationships.

Goal: I want students to apply the idea of competition and division of resources among species and relate this to the change in the organisms in the Great Lakes. If competition or division of resources changes the way species interact, it can have drastic effects on the ecosystem as a whole. In the case of the Great Lakes, factors such as invasive species, decreasing water level, and overfishing have led to drastic changes in the organisms found in the lakes.

Students will arrive at these explanations by finding patterns and analyzing data from:

- Simulating a predator-prey relationship with an additional ecosystem species in the simulation
- Graphing a data set of a predator-prey relationship

Comment: Through this activity sequence, most formative assessments come in the form of adding sticky notes to their original hypothesis sheet. This gives students practice in modifying their ideas and supporting those changes with evidence. These sticky notes also are a great tool for having students write questions down and trying to answer them as they learn new information. In the end students are able to look back and see how and why their ideas have changed over time.

Sequence of Activities

Purpose of Activity	Brief Description of Activity	Formative Assessment	Scientific Practices
Establish a problem / Engage	I would pose the initial question of: What do you think would happen if there were no consequences for	Whole class discussion model. At the end students will make a prediction on a sticky note to go on	Hypothesizing Predicting Using person experiences

Comment: I will begin by posing the question to the entire class and calling on volunteers to answer. Since the question relates to the students’ lives, they will have some base knowledge to answer the question. The question is an introduction to the idea that one change can affect many other things that are in the same system.

	<p>missing school?</p> <p>If students did not come to school as regularly, what do you think the school administration would do?</p> <p>These questions would focus student ideas on interactions and the effect interactions have on a system. Then we would talk about some of the interactions happening in the Great Lakes, returning them to the overarching question. This would lead into a discussion on what they think the “complex interactions” are and the role that the interactions would play in a changing ecosystem.</p>	<p>their hypothesis sheet.</p>	
Questions	<p>Class discussion on the types of questions we can ask using a given set of data about the wolf and moose population on Isle Royal. Students will then write questions on sticky notes that they think they could answer using the data. They will have to justify why they think they will be able to answer the questions.</p>	<p>Students will turn in the sticky notes at the end of the discussion. These questions will then be posed back to students when they work on their explanations.</p>	<p>Questioning Justifying ideas</p>
Evidence: Data and patterns	<p>Data set: Students will receive a data table showing wolf and moose population on Isle Royal. They will graph this data and make conclusions about the relationship between these organisms based on their graph.</p> <p>Simulation: The class will be divided up into trees, giraffes, and lions. Students will form a hypothesis about a species population if we change the population of</p>	<p>Using the sticky notes students will support or modify their hypothesis using evidence from the activities. They will also add new questions that the activities bring up.</p>	<p>Hypothesizing Analyzing data Revising models based on evidence Questioning Justifying ideas with evidence</p>

Comment: I introduce the topic of the sequence by asking a question that relates back to the previous sequence. This provides the foundation for students to build their ideas off of. Logistically I would have students volunteer to share their answers. Having volunteers answer first helps the class feel more comfortable and allows the more advanced students to assist the students who may be struggling.

Comment: Here I would switch my method to a “Think-Pair-Share”. I am asking students to generate new ideas which they may not be comfortable sharing with the class right away. By having them think of an idea, share it with a partner, then the partnership sharing the idea, they still have ownership of that idea but do have some anonymity in the partnership. This is especially helpful for shy students and those who fear the rejection of their idea.

Comment: By writing on sticky notes, students can submit work anonymously. This is another tool used to help all students feel comfortable sharing their ideas with the whole class.

Comment: Graphing and analyzing data is an important skill that some students struggle with. By incorporating this into an activity sequence students will be able to get practice.

Comment: Since Isle Royal is a part of Michigan, many students have heard about and discussed this region. Having a familiar topic increases student engagement since they already have some prior knowledge.

Comment: Having students actively model a situation we are discussing gives them a more concrete understanding of the phenomenon. Students already know about the relationship between predator and prey, but the idea that this relationship can change other factors in the ecosystem is more abstract.

	<p>the other species. For each round of the simulation we will change the initial number of each species and determine the remaining numbers after 2 minutes. Students will analyze this data to determine the interactions between the species.</p>		
Students' explanations/models	<p>At the end of the unit we will revisit a selection of the questions students originally said could be answered by the wolf and moose data. Students will answer these questions and support their answer by citing data from their graphs and the conclusions they drew from the simulation activity.</p> <p>Each student will create a flow chart diagramming the relationships between the wolf-moose populations on Isle Royal and work in other species. To begin they will do just the relationship between the wolf and moose. They will have to explain what happens to one population when the other changes. Then I will give them new species to describe the relationship between those species and the wolf and moose.</p> <p>Students will also make any further modifications to their hypothesis, answering any questions they asked during the sequence.</p>	<p>Revised hypothesis from the beginning of the sequence</p> <p>Answers to questions originally posed by the class, giving students practice with explaining ideas and supporting them with evidence</p>	<p>Revising models</p> <p>Communicating ideas</p> <p>Analyzing data</p>
Scientific theories or models	<p>In the previous unit we would have discussed competition but they will now need to apply this concept to whole ecosystems and the idea that this affects more than just the species competing.</p>	<p>Modifying the hypothesis to reflect the theories</p>	<p>Communicating ideas</p> <p>Revising models</p>

Comment: By answering select questions from the beginning of the sequence, we can discuss how to use data to answer questions. We can also discuss the fact that only certain questions can be answered by scientific data.

Comment: This sequence focuses heavily on having students analyze data. Through data analysis students are able to find patterns and relationships that are typically more abstract to think about. Their analysis also allows me to see what they are thinking and make lesson planning decisions. If I notice that students are having difficulty finding the patterns in the data, I can modify my lesson to include more scaffolding. If I notice that everyone is able to find the relationships, I can present a new and more complex set of data for students to analyze, thus furthering their understanding.

Comment: Since the ideas that students are going to be explaining are complex, the flow chart gives them a way to organize their thoughts. I have them begin by diagramming the relationship between the wolf and moose since they have seen data describing the relationship, making the idea concrete. I then slowly have them add in the more complex relationships, such as how plant population is affected by the wolf and moose populations. Since this relationship is indirect, the idea is more abstract for students. At this point in the diagram they would be drawing together ideas from the simulation. In the end students will have a model that they can use to explain other situations involving these complex ecological relationships.

Communication	Students will create a proposal for preserving the balance on Isle Royal. They will need to argue whether hunters should be allowed on the Isle to hunt moose or wolves and the impact that this would have on the populations overall.		Communicating ideas Revising ideas
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Comment: This question relates back to an idea students have already learned about, the wolf and moose populations on Isle Royal, but adds in a new factor, a hunter. They will have to use their knowledge and the new information they learned in the sequence to support an argument for or against the hunting. This application of data and patterns to a new situation will show me the level at which students are understanding the material.