An Ask A Biologist Activity for at Home or in the Classroom

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Contents

Frozen Connections

askabiologist.asu.edu/experiments/frozen-connections

Experiment Overview

The Arctic marine ecosystem is one of the most rapidly changing regions on Earth. This region is warming first and fastest, with extensive global and local implications. To help manage this changing region, it's important to understand its ecology.

The relationships between the organisms that live there, and between the organisms and the environment are complex, but you will delve into the basics in the game EcoChains: Arctic Futures. As part of this activity, you will also compare academic scientific and local Indigenous knowledge. Doing this will help to deepen your systems thinking and your understanding of how people, processes, and species relate to one another in the Arctic ecosystem.

You have four main tasks:

- Play the EcoChains: Arctic Futures game, where you will navigate the complexities of changing Arctic marine ecosystems.
- Create a list of relationships you make as you play this game.
- Compare how the observations you observe align and differ from those of an Inuit Elder.
- Write up and submit an analysis and reflection.

What you need

- Computer access
- Printed copy of the Frozen Connections Worksheet
- Pen and paper

Instructions

Here are the steps to complete this assignment:

Step 1: Play EcoChains: Arctic Futures online

You will play the EcoChains: Arctic Futures game to see how various changes affect the Arctic ecosystem. Before you begin, read the Introduction and How To Play pages.

Play the game!

Play the Beginner game first. Then, play the Advanced game for an extra challenge! Make sure you are reading card info as you play. While playing, you can click on the cards to learn even more. You can expect the game to take between 10 and 30 minutes for each level. You may want to read ahead through Step 2 and then take notes for your worksheet as you play the Advanced game.

Save your highest score
When you're finished playing, save a screenshot of your final score. Or, use the print results button that appears below your final score to print a PDF of your score. Submit your highest score from either game.

Tip: You can play it more than once to try to get a higher score. Playing more doesn't always mean you'll score higher, so make sure you save screenshots or PDFs as you go.

Step 2: Assessment and description of arctic marine system relationships
Complete part 1 of the Frozen Connections Worksheet by listing and describing 9 relationships between topics, species, or processes (like between sea ice and carbon dioxide emissions as shown in the example in the template) that you observed as you played EcoChains: Arctic Futures. Consider how, why, or what connects the topics, species, or issues.

Try to include at least 3 different kinds of relationships in your list (i.e., they should not all be predator/prey relationships). If you revisit the game, remember to click on each card to get more information to help with this step.

Example topics, species, or processes: Sea ice, ice copepod, eider duck, bowhead whale, human being, carbon pollution, acidification, invasive orca, overharvesting, protecting species, green transit.

Step 3: Compare and Contrast
One of the best ways to learn is to work through ideas on your own before you hear what someone else thought or before you look up an answer. Make sure you have completed Step 2 before you complete Step 3.

Compare your list of observations to those of an Inuit Elder's, as represented in their Arctic coastal systems concept map.

Analysis
Analyze the similarities and differences between your list of relationships and the Inuit Elder's perspectives.

Record your observations from this comparison in part 2 of the Frozen Connections Worksheet:

- What 2 relationships are in both your list and the Inuit Elder's mind map?
- What 2 relationships are included in your list that are not found in the Inuit Elder's?
- What 2 relationships are present in the Inuit Elder's map that are missing from your list?

Step 4: Analysis and Reflection
Write a 500-word analysis and reflection on your experience with this assignment (playing EcoChains: Arctic Futures, listing your observations of relationships, and then assessing how your observations align with and differ from those of an Inuit Elder).

Use an analytical approach by providing explicit examples of observations as you address the following questions:

Comparisons

You should also reflect on the comparisons you made earlier between your list of relationships and the Elder's concept map. This time, think about why they are different instead of just what is different.

- Why might some topics/issues be in both your list and the Inuit Elder's concept map?
- Why might some topics/issues be included in your list but not in the Inuit Elder's concept map?
- Why might some topics/issues be present in the Inuit Elder's map and missing from your list?

Insights

- What insights did you gain from creating your list of 9 relationships you observed from playing EcoChains: Arctic Futures?
- What other insights did you gain from playing EcoChains: Arctic Futures?

Reflection

- Reflect on how these similarities and differences between your perspectives and those of someone with lived experiences highlight priorities or insights into Arctic systems.
- Reflect on why understanding different perspectives is important in advancing towards thriving climate futures.

Submission Instructions

Submit the following 3 items to your instructor.

- A screenshot or PDF of your score from the EcoChains: Arctic Futures game.
- Your completed Frozen Connections Worksheet.
- Your 500-word analysis/reflection, with organized paragraphs addressing the analysis and reflection questions listed in Step 4.

Tip: Ask your teacher if there are more details on how this assignment will be graded and if they plan to use the provided rubric.

References

Elder's map: Heyes, S. 2011. Cracks in the knowledge: sea ice terms in Kangiqsualujjuaq, Nunavik The Canadian Geographer / Le G'eographe canadien 2011, 55(1): 69–90 DOI: 10.1111/j.1541-0064.2010.00346.x

Frozen Connections - For Teachers

In this activity, students will be learning about the ecology of and threats to the Arctic marine ecosystem. They will explore relationships between organisms and the environment, better understand the impacts of a warming climate, and learn about Indigenous ways of life in this region. Students should complete this activity with an understanding of the vulnerabilities and responses of Arctic systems. They should also develop new viewpoints that consider Indigenous ways of life.

The majority of learning about Arctic ecology takes place while students play the EcoChains: Arctic Futures game, but the concept map comparison and the reflection and analysis portions of the activity serve to solidify that knowledge and provide students with additional cultural and ecological context.

This activity is recommended for advanced high school students and college students. For younger students, modifications can be made to simplify the concept map and reflection portions of the activity.

A grading rubric is provided below; feel free to align with your point system as you see fit. For some students, the rubric may need to be simplified, but this hopefully helps you get started on building your rubric.

Tips for Classroom Implementation

Time Required

- 1 to 1.5 hours, in one class (with possible homework to complete) or split across two classes

Breakdown

- 20 - 30 minutes to play both game levels and read most cards
- 15 - 20 minutes to fill out the worksheet
- 20+ minutes for reflection

What may be most helpful is for students to play the Beginner game for about 10 minutes, then read over the Step 2 assignment. With those tasks in mind, they can then play the Advanced game, and take notes on what processes add or remove ice in their games, and any other relationships they notice.

Classroom Set up

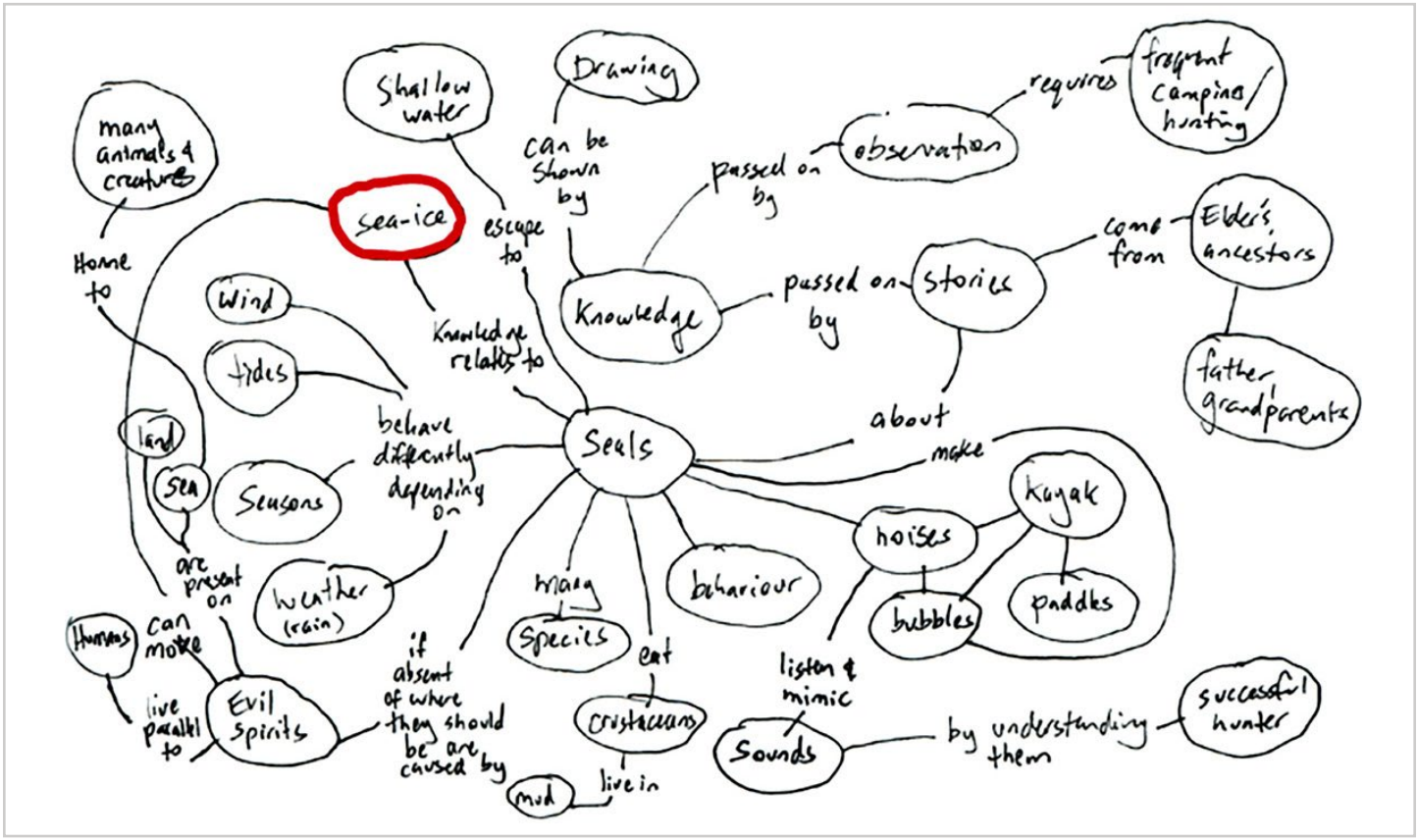
While this is a great individual exercise, students can also work in pairs or slightly larger groups if preferred. If working in groups, it's still good for the students to play their own game, if enough computers are available. For younger students, you may want to shorten the reflection or discuss the map comparison as a class; in this case, you can add a personal reflection question on the worksheet for students to complete.

Extensions

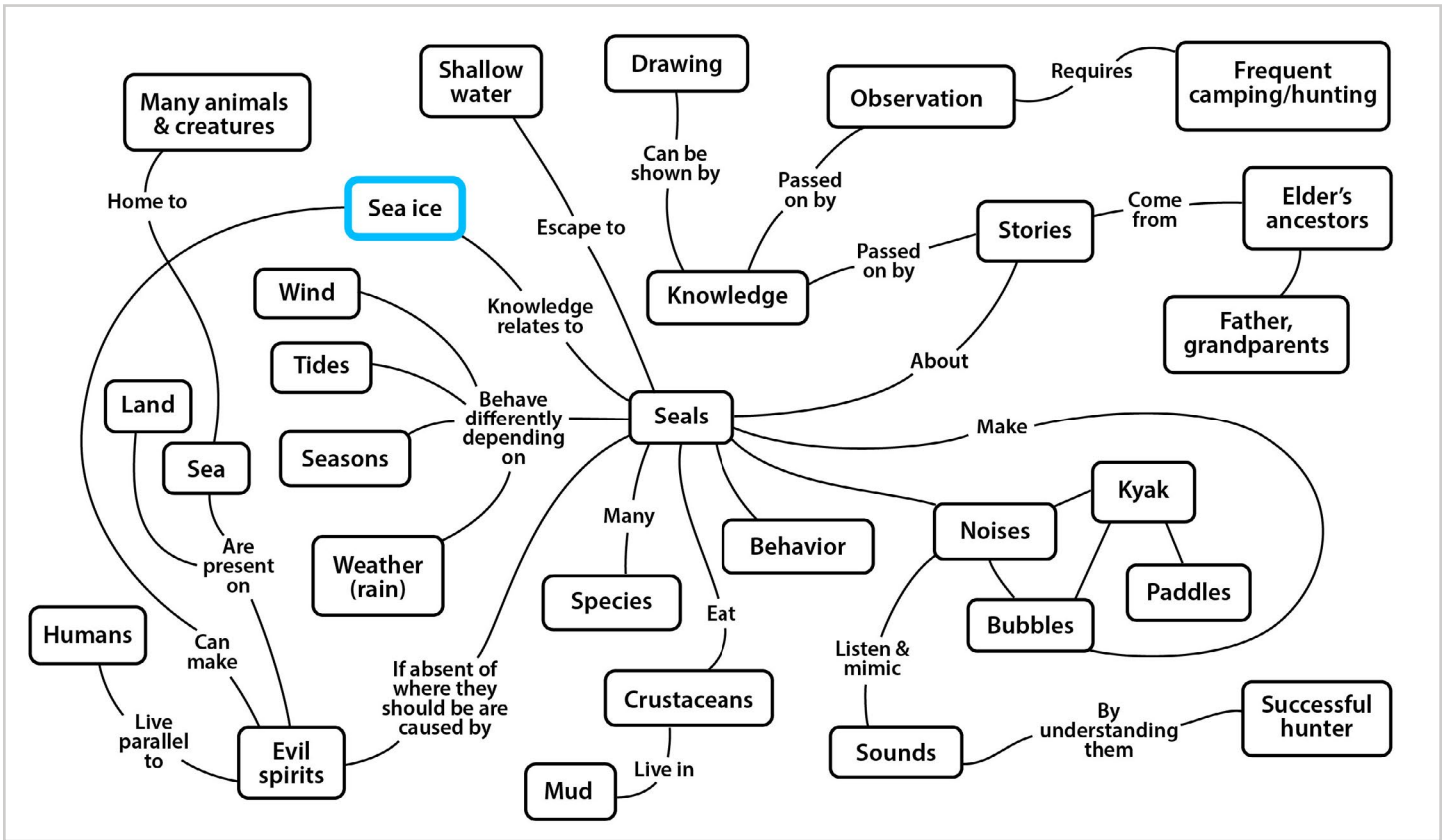
Students can be tasked with trying to improve the game design, or creating their own version of the game. Assessments can include student reports on additional learning objectives or how their new design or focus promotes additional learning.

Frozen Connections - Inuit Elder's Arctic Coastal Concept Map

Original



Typed



Frozen Connections - Worksheet

Name: _____ Date: _____

Part 1

List and describe 9 relationships (between topics, species, or processes) that you observed as you played the EcoChains: Arctic Futures game.

	Topic/species/process	**Topic/species/process**	**Relationship**
Example	*Sea ice*	*Carbon dioxide emissions*	*Warming caused by carbon dioxide emissions is melting sea ice.*
1			
2			
3			
4			
5			
6			
7			
8			
9			

Frozen Connections - Worksheet

Part 2

Compare your list of relationships with those shown in the concept map drawn after an interview with an Inuit Elder who was a hunter.

What 2 relationships are in both your list and the Inuit Elder's mind map?

1	
2	

What 2 relationships are included in your list that are not found in the Inuit Elder's?

1	
2	

What 2 relationships are present in the Inuit Elder's map that are missing from your list?

1	
2	

Frozen Connections - Grading Rubric

Criteria: Completeness

Meets all requirements of the assignment – addresses all required content elements in a clear and organized way, meets word count.

- **Excellent:** Fully meets or exceeds all assignment requirements. All required content elements are thoroughly addressed. The assignment is very well-organized, with a logical structure that clearly highlights each required element. Word count is met or exceeded appropriately.
- **Proficient:** The assignment is generally well-organized and covers all required elements. Some sections could be more clearly distinguished or connected. Meets all assignment requirements. Word count is near the required range.
- **Developing:** The assignment includes many of the required elements, but organization may make it difficult at times to identify whether all requirements have been addressed. Some content may appear out of order, buried, or insufficiently signposted, requiring extra effort from the reader to track the elements. Word count falls significantly short or goes far beyond the requirement without justification.
- **Needs improvement:** Required elements are missing, unclear, or difficult to locate. The assignment lacks clear organization. The absence of structure or logical flow prevents the reader from determining whether the assignment requirements have been met. Word count is far below the requirement.

Criteria: Analysis

Uses an analytical approach (based on evidence, research), with specifics as articulated in the assignment (using explicit examples, including references to research, personal experiences, class discussions or presentations, readings, etc.). Integrates in-text citations of references and resources if desired or required.

- **Excellent:** Consistently applies a strong analytical approach grounded in evidence and experiences. Provides specific, explicit examples.
- **Proficient:** Uses an analytical approach that is supported by experience. Provides relevant examples, though some may be general rather than highly specific.
- **Developing**: Demonstrates some attempt at analysis but relies more on description or opinion than evidence-based reasoning. Examples may be limited, vague, or only loosely connected to the point.
- **Needs improvement:** Minimal or no analytical approach is evident. Examples are absent, irrelevant, or highly general. Analysis is superficial or missing altogether.

Frozen Connections - Grading Rubric

Criteria: Insights

Reflects on, synthesizes, and presents the results of the analysis and insights gained in detailed and meaningful ways.

- **Excellent:** Demonstrates deep reflection and synthesis. Presents insights that are original, specific, and highly meaningful, showing strong connections between analysis and conclusions. Goes beyond surface-level observations to reveal significance and implications.
- **Proficient:** Provides clear reflection and synthesis. Insights are specific, detailed, and meaningful, with solid connections to the analysis. Lacks the originality or depth of "Excellent," but demonstrates strong understanding.
- **Developing:** Shows limited reflection or synthesis. Insights are vague, superficial, or incomplete, with weak or unclear connections to the analysis.
- **Needs Improvement:** Provides little or no reflection or synthesis. Insights are absent, irrelevant, or fail to connect to the analysis.

Standards

Next Generation Science Standards

High School - Interdependent Relationships in Ecosystems

HS.LS2.1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS.LS2.6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

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