You are What You Eat

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Grade level: 6-8th grade

Context:
This lesson emphasizes human impacts on ecosystem function by explaining how nutrients move through a food web. Students should have been introduced to the Arctic as an ecosystem, the adaptations required to live in this environment, and have knowledge about Arctic food web connections.

Overview/Concept:
Organisms within an ecosystem are interconnected through the food web. Ocean ecosystems are not separate from human activities and are impacted by climate change.

Learning Goals:
Students will be able to:
-List three ways that choices in their daily lives are connected to ocean health and resources
-Create a food web diagram
-Use observations to answer research questions and evaluate evidence to draw conclusions based on a problem scenario.

Learning goals address the following Alaska State Science Content Standards:
A Science as Inquiry and Process
1. develop an understanding of the processes of science used to investigate problems, design and conduct repeatable scientific investigations, and defend scientific arguments.
C. Concepts of Life Science
3. develop an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy.

Materials:
Student Worksheets: *You Are What You Eat, Food Webs*
Cardboard chips in two colors
Plastic cups
Index cards with pasted photos of organisms in the food web
Plastic tubs or buckets for chip collection

Procedure:
1. (5 min) Introduce the problem scenario of a future year of no Arctic sea ice coverage (Engagement)

Problem (future sea ice regime): *It is the year of 2050 here in Alaska and many things have changed. The ice that used to cover the Arctic Ocean even in summer is gone. The algae that grew under the ice and provided food for many animals is also gone. How has the ecosystem/ food web changed as a result of this ice loss?*

2. (10 mins) Background lecture explaining what stable isotopes are, how they are used in feeding studies and in association with fatty acids as well as other methods to trace Arctic food webs such as IP_{25}. (This is written from the point of view of Tanja Schollmeier, the scientist who is doing the research described, but can be modified by a teacher to describe the research project.)

Information provided:
Before we can dive into exploring this problem in the future you need some more information. Up here in the Arctic Ocean we have two sources of algae that provide food for other animals. Algae are plants that come in very different shapes and sizes, here I am talking mainly about very small plants. These plants can either grown floating in the open water or can grow attached to the bottom of the ice. This second type is called ice algae. It is a source of food mostly in Spring and early summer when the ice melts and releases the algae.

What I am interested in my research is whether animals such as crabs and clams eat more of one or the other. But how do I find that out? Well, for that I look for one at their fatty acids. Fatty acids are building blocks of fats that we as well as these animals eat. In theses fatty acids we can look at how they differ in the two sources of algae. To see this difference I can look at the isotopes in these fatty acids. Isotopes are different forms of different elements such as Carbon and Oxygen which have slightly different weights. But for my purposes it acts like a fingerprint. Ice algae growing under the ice are heavier in the isotope while the algae in the open ocean are lighter. This is how I can decide which animal eats more fatty acids coming from ice algae and which eats more of the algae in the open ocean.

In the last couple of years something else has been found to answer the same question. It is called IP_{25}, which means Ice Proxy. This is similar to a fatty acids but it is only produced by algae if the algae grows under the ice.

To better explain this we are going to play a game. It is a feeding activity game. Each of you will get a card that will explain what animal you are and how and what you eat. These cardboard chips I have here will be our algae and you will collect the algae in your cups. If you are for example a zooplankton, which is a small animal, you will eat algae. If you are a small fish you will eat zooplankton. We will play this like a game of tag. The small fish will tag the zooplankton and the zooplankton has to hand over their chips into the cup of the small fish.

Rules: no running, no hitting, tagging is only allowed on the shoulder or arm, no pushing

3. (15 mins) Feeding game activity (exploration, engagement)
This activity aims to explore the concepts of isotopes in the ecosystem using colored chips and a game of "tag" for both demonstrations.

For this activity, each student is given a plastic cup and an index card with a photo on one side of their organism's identity and, on the other, information about their feeding habits and restrictions for the upcoming game. Primary production will be in the form of two colors of cardboard chips. Assign organisms in the food web so there are fewer top predators than primary consumers and more producers than consumers.

There will be two rounds of the feeding game that model two scenarios:
Scenario 1: no ice algae (production occurs by algae in the water column; all chips are one color)
Scenario 2: ice algae present (alongside production by algae in the water column; chips are in two colors)

4. (25 mins) Feeding game data collection and discussion (explanation, evaluation)
Students group together by trophic level group and pool their chips. Chip collection is separate for each game scenario. Explain the significance of chip color to sources of primary producation and the meaning behind each scenario.

Divide the class into two or more groups depending on class size (grouped by scenario one and scenario two). Each group counts chips from different trophic levels and responds to two questions in small group. Use the following prompts: "What do you notice about the distribution of chips in the food web? What do you think the other scenario group's data look like? Develop a hypothesis."

Scenario groups present their hypotheses followed by their findings. As a class, we then evaluate our hypotheses in a group discussion (formative assessment).

5. (10 mins) Wrap up
Ask the question: "Why do you think it would be important to find out if animals eat more algae that grows under the ice or other algae?"

If there is sufficient time, finish the lesson with a KWL chart about the effects of climate change on the ocean (Evaluation). Use the prompt: "In what ways does climate change effect the ocean and us?" This could also be done as a free-write that would be handed into the teacher at the end of the lesson.

Extension Idea:

Similar lesson plans (beginning with learning about the ecosystem, adaptations, and food webs) could be repeated for different ecosystems (i.e. coral, deep sea, freshwater systems). The class could then compare and contrast with what they have learned about the Arctic. Another extension idea is to consider other purposes that fatty acid and isotope research can be important, such as in the food industry for example.

Management and Participation Strategies

- Facilitating several large group discussion.
- Providing students with opportunities to talk in small groups
- Prompt for free write (optional)

  Because the activity is especially interactive, the challenge will be to engage students during discussions about the activity and what they learned from it.

You are What You Eat
Student Worksheet

Your space to take notes:

Feeding Game

What group are you:

How many chips do you count for each organism and each color:

What does this mean to you?

How do you think the other groups' chips look like. Develop a hypothesis of what you expect and explain why.

Food Webs
Student Worksheet

Terms/ Definitions

Producer:

Phytoplankton:

Zooplankton:

Herbivore:

Omnivore:

Carnivore:

Food Chain:

Consumer:

Decomposer:

Abiotic Factors:

Biotic factors:

Food Chain example:

Food Pyramid:

Arctic food web example (draw all the connections between the animals)