Food Chain Frenzy

Key Topics: Human Impact, Bioaccumulation, Food Web, Food Chain, Pollution, Trophic Level, Photodegradation, Biodegradation, Producer, Consumer, Decomposer, Marine Debris
Grade Levels: K, 5-8
Inside or Outside

EARTH GENIUS RELATIONAL FRAMEWORK

- ❑ **PRIMARY:** Zero Waste
- ❑ **SECONDARY:** Water Wise

Lesson Overview:

In this lesson students will explore the interconnectivity between land-based pollution, water, and life forms via tactile games and physical activity. The lesson discusses the difference between a food web (think about mosquitoes drinking blood of even the highest predators, so not fitting into a chain model) and food chain (a simplified version of the food web). The source of all energy for a food web is the sun. Students will categorize populations of organisms based on what functions they serve in an ecosystem (producers, consumers, decomposers).

Activities:

Option 1 - Intro Activity: Drawing Food Chain Diagrams (15 minutes)
Option 2 - Food Web Game (20 minutes)
Option 3 - Bioaccumulation Tag (20 minutes)
Option 4- Wrap Up (10 minutes)

Suggested Activities and Learning Objectives by Grade:

- ➢ K: Food Web Game, Bioaccumulation Tag
  - K-LS1-1 What do animals and plants 'eat'?
  - K-ESS3-3 How can we keep animals and plants from 'eating' pollution?
- ➢ 2: Drawing Food Chain Diagrams, Food Web Game
  - 2-LS4-1 Compare food webs found in different habitats (e.g. land vs. aquatic).
- ➢ 5: Drawing Food Chain Diagrams, Food Web Game, Bioaccumulation Tag
  - 5-PS3-1 How does the sun support all life?
  - 5-LS2-1 Develop a model showing how matter moves among producers, consumers and decomposers.
- ➢ MS: Drawing Food Chain Diagrams, Food Web Game, Bioaccumulation Tag
  - MS-LS2-3 Develop a model showing how matter moves among the trophic levels of the food web.
  - MS-ESS3-3 How can we reduce the buildup of pollution in the food web?

Essential Question(s) that Connect CCCs and SEPs:

- What does this cause and effect relationship (food web) help to explain? (Cause & Effect Construct Explanations & Design Solutions)
- How will we model the flow of energy and the cycling of matter (among diverse species in the ecosystem)? (Energy & Matter Developing & Using Models)

Materials:

- Slideshow
- For Food Chain Game
  - String
  - Nature Cards
- For Bioaccumulation Tag
  - Set of multi-colored chips
  - 4-5 colored bands of cloth
  - 4 cones (for boundary)

EG Team Support Needed:

- None

Prep:

- Reserve open space area (approximately quarter the area of a soccer field) so there isn't a conflict with PE or other educators
- Set up cones to form a rectangle (approximately 100' x 50')
- Set out white and blue poker chips along one of the 50' widths

Activity Procedure:

Engage: Making Food Chain Diagrams

Action: [Elementary] Intro Activity

1. **Introduce the concept of food chains.** Living things are connected to what they eat, and what eats them. Give an example of a simple food chain that people are a part of. For example, "What do people eat for breakfast?" Write the following phrases on the board. Use colored chalk to emphasize the words in bold.

> Phrase 1: "The sun provides energy to the corn, which gets nutrients from the soil. The chicken gets nutrients and energy from eating the corn and produces an egg. People get nutrients and energy from eating the egg."
>
> Phrase 2: "The sun provides energy to the oat plant, which gets nutrients from the soil. People get nutrients and energy from eating the oats (cereal)."

Comprehension Check

"What do these examples help to explain? The cause and effect of food chains!"

2. Look at the sentences on the board and ask students to see if they can replace the words **nutrients** and **energy**, along with the connecting words, with arrows from one subject to another.

Give an example showing the flow of **energy**:

Sun → corn (producer) → chicken or egg (consumer) → people (consumer)

Sun → oats (producer) → people

You could also make a chain showing the flow of **nutrients**:

Soil → corn (producer) → chicken or egg (consumer) → people (consumer)

Soil → oats (producer) → people(consumer)

In these two examples, the source (sun or soil) is the only thing that changes. When studying the flow of energy in a food chain, we start with the sun. When looking at the flow of nutrients, we start with soil. For the rest of the lesson, we will focus on the flow of energy as it moves through the food chain, starting with the sun.

3. **Now write a sentence describing a food chain in a marine community.** The sun provides energy to phytoplankton. Krill (which are like tiny shrimp) get energy from eating phytoplankton. Fish get energy from eating krill. People get energy from eating fish. A food chain diagram would look like this:

Food Chain: Sun → phytoplankton → krill → fish → people

4. **In a food chain, organisms are assigned roles based on the type of food they usually eat.** Write this on the board:

a. Producers: photosynthetic organisms that convert solar energy to starch. (Examples: phytoplankton, algae, plants)

b. Consumers: eat other organisms for food. Examples follow: • Herbivores: these animals eat producers most of the time (Eelgrass) • Omnivores: these animals eat producers and other consumers (Crab) • Carnivores: these animals eat mostly other animals (Sea otter) • Top carnivores: these animals eat exclusively other animals (Orca)

c. Decomposers: eat dead and decomposing organisms of all sorts, including producers, herbivores, omnivores and carnivores. Decomposers are the ultimate omnivores. (Example: bacteria, bat stars, sea cucumbers)

5. **Next, apply roles to each of the steps in the food chain.** Use colored chalk or markers for each role:

Food Chain: Sun → phytoplankton → krill → fish → people

Roles: Source → producer → herbivore → carnivore → top carnivore

Action: [Middle School Only. For Elementary grades, skip to the Food Chain Game] Intro Activity
You will use the powerpoint slides as your guide for visuals in addition to this information:

1. Ask students to talk with their partner about what they remember about food chains/webs. Hopefully a student references the concept of trophic levels; lead the discussion towards defining the term trophic level [the hierarchical position in the food chain]. Illuminate the marine ecosystem food pyramid on the board.
2. Tell them the word 'trophic' is derived from Greek referring to food or feeding. Ask them to discuss in pairs why they think that is and to make some observations about the marine ecosystem food pyramid, then share. Hopefully they observe there are fewer organisms at the top.
3. Define the ten percent rule, the concept that only about 10 percent of the energy available in one trophic level is available to organisms in the next trophic level. Ask them where they think the energy is lost along the way [exertion, living, etc.; heat]
4. [OPTIONAL]: Tell students that energy available at each trophic level is measured in units called kilocalories (kcal). Explain that if 7,000 kcal are available in producers, then only 700 kcal can be transferred to primary consumers. Have students calculate the kcal available for secondary consumers and tertiary consumers. In basic terms that's like having a candy bar with 7000 calories, but when you eat it you only get 700 calories, or 10% of it's total energy. The rest of the energy isn't broken down by our body because we're inefficient at digesting it, and it's excreted as waste (but decomposers do get to break it down).
5. Ask them what they notice about the amount of energy available at higher trophic levels compared to lower trophic levels.

Comprehension Check

Ask them to draw some conclusions from that. Go to Slide 2 if they're unable to put forth any ideas.

"What do these trophic levels help to explain? The cause and effect of energy being transferred within the system!"

6. Ask students if they think the 10 percent rule applies to marine debris that enters the food chain [No, animals can't digest plastic and other persistent toxins]. Follow up by asking, so what happens when 1 shark eats 10 fish that each have each eaten 10 pieces of plastic?
7. Tell them this process is called 'bioaccumulation.' Break down the word for them into its component parts by asking them what 'bio' and 'accumulation' means.
8. Wrap up by telling students we're going to play a game of bioaccumulation tag and see what happens to marine ecosystems.

Explore: Playing the food chain game

"How will we model the flow of energy and the cycling of matter (among diverse species in the ecosystem)?" Well, we are going to play two different games today! Let's get move and get outside.

Comprehension Check

Note: Before you pass out cards and play any games or head outside, ask students what good behavior looks like and how even though we are "playing" we are also learning and still in class.

1. Pull out nature cards for each species in your selected food web(s) including the sun and plant cards.
2. Start the activity with an example. Select 5 volunteers from the class to represent different roles in the food chain and have them line up in front of the rest of the class. Hand one species card to each student. Ask students to read their cards aloud so that everyone knows what they are.
3. Place the student representing the Sun on the left and hand the end of string to the student. The next in line is a student representing a producer, then an herbivore, an omnivore or carnivore, a top carnivore and a decomposer. Pass the ball of string to each student, having each student hold onto the string as it passes by them. Show the class that this is an example of a food chain.
4. Play the game again, using all the students. Hand species cards to every student and direct them to stand in a circle, or just keep everyone sitting at their desks. Assign one student to be the SUN, or assume the role yourself. As the source of energy on Earth, the Sun always starts the game. The Sun starts with the end of string, and the ball passes through the different food chain roles until everyone is hold the string. Tell your students that they have just created a food web.

   TIP #1: Remind the students before you start to be safe and not tangle themselves or try to get rope burn.
   TIP #2: While passing the ball of string around, just call out "Alright, now everyone that is a producer raise your hand!" and have the string passed between them. You can also walk the ball of string around yourself to speed things up. Use this sequence of hand-raisers: producers, primary consumers, small consumers (small fish), larger consumers (bigger fish), things that eat fish, things that eat things larger than fish, decomposers

Explain:

While the class is still holding the string, ask them to gently pull their string to feel their connection to each other. Discuss the fact that the flow of energy connects all living things in a community to one another. Think about what would happen if there were no Sun, or producers, or decomposers? Every role is essential in the food web.

Now that they know how they are all connected in the food web, introduce an impact on the food chain (LIKE MARINE DEBRIS) and make predictions as to how it will impact the other players. To do more than one of these scenarios, the students who are impacted will drop their string at their feet and pick it up again after each scenario is finished.

Discuss examples of how the food chain could be altered:

a. Phytoplankton are plants. If herbicide, which kills plants got into the ocean it could kill phytoplankton. What organisms would be impacted if phytoplankton died? Have the student in the role of phytoplankton tug gently on the string. Organisms that feel the tug would be affected by the loss of phytoplankton. This could happen if people dump herbicides into the ocean or into storm drains that flow into the ocean.

b. Mussels are omnivores that feed on tiny particles drifting the water. Mussels are consumed by sea otters and birds. If there were toxins in the water that killed mussels, what other organisms would be affected? Have the student playing the mussel role tug gently on the string. Organisms that feel the tug would be affected by the loss of mussels. This is why keeping our ocean free from pesticides, herbicides and other toxins is important.

c. Lots of animals are programed to eat small, colorful things. If plastic got into the ocean and animals ate that plastic, how many animals would then accidentally get plastic inside of THEM because they ate animals that ate plastic? Have the students that think their animal would eat plastic tug on the string or even sit down, and then instruct everyone to sit down if someone next to them sat down. By a domino effect, everyone will eventually be sitting.

Elaborate: Bioaccumulation Tag

Remind students again about meaningful play and class is still in session!

1. Have students line up on the 50' width across from the side where the poker chips are laid out.
2. Select 1/10 (To simulate trophic levels) of the students to be top predators in the game. Give them laminated necklaces. Tell the other students they are secondary consumers (small fish).
3. The secondary consumers' goal is to run to the other side, grab one poker chip (representing plankton), and return safely without being tagged (simulating predation). Tagged secondary consumers must escort themselves out of bounds.
4. The top predators goal is to tag as many secondary consumers as possible. Whenever a secondary consumer is tagged, they must give up all the poker chips they have and step out to the side til the next round.
5. After each round, ask the top predators how many of each color poker chip they've acquired, have them return the white chips, and let the secondary consumers that were tagged return to the starting line.
6. Once a top predator tells you they have acquired more than 10 blue/red poker chips, stop the game. Tell students, "Marine animals have a hard time differentiating prey from marine debris.

In the game, blue/red poker chips represent marine debris. If a top predator has more than 10 blue/red poker chips, their stomach is now filled with plastic and they die. Please leave the game. If a secondary consumer has 3+ blue/red poker chips, they also suffocate on plastic and die. Please leave the game."

   a. [OPTIONAL:] Ask how many students have heard of the Great Pacific Trash Gyre. Explain to them what that is and tell them researchers estimate that for every 2 lbs of plankton there is 13 lbs of plastic.

7. Let the game continue for a couple more rounds until the white chips have been depleted. Ask students what happens to the primary consumer population once all the top predators are removed from the ecosystem [the secondary consumers are freed of predation and eat all the primary consumers]. Define bioaccumulation for students.
8. Close by telling students that 80% of land-based, plastic litter ends up in the ocean. As you can see, marine debris devastates marine ecosystems. Encourage them to do their part by picking up litter when they see it around campus/in their community and buy products that have less packaging.

Evaluation:

Elementary:

1. Arrange these species in a food chain with arrows showing who's eating who (provide an out-of-order list of marine species on the board)
2. What land-based litter does the most harm to marine animals? [Plastic]

Middle School:

1. What percent of energy transfers from one trophic level to the next? [10%]
2. What is bioaccumulation? [The buildup of indigestible, harmful substances within an organism]

Also, refer back to the Learning Objectives for your grade level and ensure that they have been met by asking the given learning objective question.

Extension Activities:

- National Oceanic Atmospheric Administration (NOAA) Marine Debris Activities & Curricula

Tips and Caveats:

- Noted in introduction that you can set up middle school differently than elementary school

Cited Curriculum:

- Turning the Tide on Trash
- An Educator's Guide to Marine Debris
- Games adapted from various Animal Game and Food Chain Game Lesson Plans online such as this one