

Phytoplankton Food for Thought



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Adapted from:

- "Carrying Capacity" and "How Many Bears can Live in This Forest?"
Project WILD K-12 Curriculum & Activity Guide. Huston, TX:
Council for Environmental Education, 2006.
- "The Bears of Yellowstone." Windows Into Wonderland. National Park
Service U.S. Department of the Interior. 15 Feb. 2007
<<http://www.windowsintowonderland.org/bears/teachers/plan5.htm>>.

Time:

- Preparation: 5 minutes
- Activity: 45 minutes to 1 hour

Level: Grades 5-8

Overview

This activity introduces participants to roles of different organisms, tidepool food webs, and the affects of varied population size on all organisms, using a game activity. This activity is great for students who are not fully engaged in the tidepools down on the beach or if it is raining too hard it can also be done in the sheltered area by the parking lot. This activity may also be done in the classroom.

Oregon State Benchmarks Addressed

Life Sciences (5th Grade):

- SC.05.PS.06.03 Identify examples of energy transfer in the environment. *In this activity students learn about energy transfer through a food chain.*
- SC.05.LS.05.02 Identify the producers, consumers, and decomposers in a given habitat. *Students use role play to act as producers and consumers in the tidepools.*
- SC.05.LS.05.03 Recognize how all animals depend upon plants whether or not they eat the plants directly. *Students recognize organisms in the tidepools rely on phytoplankton. Showing the need for photosynthesis and how all the other organisms rely on the process.*
- SC.05.LS.06.01 Describe changes to the environment that have caused the population of some species to change. *In the variation habitat loss can occur and gives an idea of how a change to the environment change the population.*

Life Sciences (8th Grade):

- SC.08.LS.04.01 Identify that sunlight is the major source of energy in most ecosystems and that energy then passes from organism to organism in food webs. *Phytoplankton in this activity use sunlight and students see through chips that they need sunlight.*
- SC.08.LS.04.02 Identify populations of organisms within an ecosystem by the function that they serve. *Students use role play to see the different functions of organisms in the tidepool ecosystem.*

Learning Objectives

By the end of this activity, participants will be able to:

1. Define terms and give examples of a producer, consumer, decomposer, herbivore, omnivore, and carnivore
2. Describe a tidepool food web.
3. Identify how different sized populations can impact life in the tidepools
4. Identify different organisms in the tidepools

Materials Needed

- ❑ 3 colors of poker or other similar chips (preferably yellow, green, and blue with a large number of yellow half green and a handful of blue)
- ❑ Pictures, preferably laminated, of phytoplankton, mussels, and a sea star
Other pictures of tide pool organisms can be used as well.
- ❑ Paper plates (only for variation)

Background Material

Producer: The beginning of the food chain. A producer is an organism, usually a plant, which is able to generate food, most often through photosynthesis, from inorganic substances, typically the sun and a gas.

Consumer: Constitutes of the main body of the food web. A consumer is an organism that obtains energy by feeding on other organisms, plants and/or animals. Primary consumers are organisms that feed on producers. A secondary consumer is an organism that feeds on primary consumers.

Decomposer: Very important and usually unseen part of the system. Decomposers are organisms, most often bacterium and fungi, that breakdown dead material as their source of food.

Herbivore: As a consumer in the food web herbivores feed only on plant matter.

Omnivore: As a consumer in the food web omnivores feed on plant matter and other animals.

Carnivore: As a consumer in the food web carnivores feed only on other animals.

Carrying Capacity: the maximum amount of organisms that can be supported within a given habitat or environment without depleting resources. Certain limiting factors play a significant role within environments.

Limiting factors: variables that can determine the presents and distribution of organisms within an environment. Examples of limiting factors are food, water, shelter, space, and predator/prey populations.

Activity Description:

Preparation:

If possible count how many students will be participating in this activity. For the first round arrange chips to have an uneven distribution with the total number of chips matching the total number of students. **Yellow** should be the most abundant for a group of **20** students there should be **12** yellow chips (representing nutrients and sun for plants and phytoplankton to use), **green** should be in the middle for a group of **20** students there should be **6** green chips (representing plants and phytoplankton for primary consumers to consume), and **blue** should be the least for a group of **20** students there should be **2** blue chips (representing primary consumers for secondary consumers to consume)

Step 1. Getting Started: Introductions (5-7 minutes):

- ❑ Gather group into a circle so they are focused and listening.

- ❑ Ask questions involving the key terms. Make sure to continue to ask questions so the students develop the answers themselves. The answers are given as examples. Engage and get the students excited about the material and answering questions:

Q: How do plants get their energy?

- *“I’m a plant sitting here living a plant life how do I get my energy?”*

A: The sun and nutrients from the soil/air

- *“Yes, plants do get their energy from the sun and other nutrients. They use a special process called photosynthesis to convert the sun’s energy into plant energy.”*

Q: How do animals get their energy?

- *“I’m now an animal hanging out living my animal life how do I get my energy?”*

A: From eating plants or other animals.

- *“Yes, animals get their energy from eating plants or other animals and have other needs such as water, space, shelter, etc...”*

Q: What type of animal eats grass?

- *“I’m now back to being a plant but now I’m a blade of grass living my grass life, getting energy from the sun and soil, then an animal comes by and eats my friend next to me. What type of animal would eat grass?”*

A: Cows, horses, deer, elk, etc....

- *“Yes, cows, horses, deer, elk, or any other animals that were listed all eat grass”*

Q: Do deer only eat grass?

- *“If I were a deer do I only eat grass?”*

A: They eat other plants but only plants

- *“Deer also eat other green plants, nuts, and buds or twigs of woody plants.”*

Q: What is an animal called that only eats plants?

- *“Since deer only eat plants there is a special name for them and other animals that eat plants. What is an animal called that only eats plants?”*

A: Herbivore

- **“ Yes, herbivore is a classification for animals that only eat plants”**

Q: What type of animal eats deer?

- *“The deer ate the grass earlier and gained energy from it. If I were a deer would I have to worry about another animal eating me?”*

A1: Yes

- *“Yes, what type of animal might eat a deer?”*

A2: Coyote, bear, human etc.

- *“Yes, coyotes, wolves, humans, or other animals listed eat deer.”*

Q: Do bears only eat deer?

- *“I’m a bear. Yesterday I had a deer for dinner what else might I eat for dinner tonight?”*

A: Elk, big horn sheep, berries, insects, etc...

- *“Yes, bears have a diverse diet including many things such as the items you listed and elk, big horn sheep, berries, insects etc...”*

Q: What is an animal called that eats plants and animals?

- *“Since bears have a diverse diet including plants and animals, what is the special name for bears and other animals that eat both plants and animals?”*

A: Omnivore

- *“Yes, omnivore is a classification for animals that eat both plants and animals.”*

Q: What is an animal called that only eats other animals?

- *“Now I’m another animal that eats only the flesh of other animals. What is the special name for animals that only eat other animals?”*

A: Carnivore

- *“Yes, carnivore is a classification for animals that only eat other animals.”*

Q: What are some examples of a carnivore?

- *“What types of animals would be considered a carnivore?”*

A: Lion, wolf, etc...

- *“Yes, lions, wolves, and all other animals listed are carnivores.”*

Ask what the students think how they might relate to the tide pools.

Q: How do deer and bears model the food chain?

- *“Why would we be talking about deer and bears when we are out here looking at tide pools and in a marine environment?”*

A: They give examples of consumers, herbivores, and carnivores.

- *“Because there are organisms within the tidepools that play the same role as the other animals discussed.”*

- ❑ Tell students: *“We will now play a game involving the concepts we learned involving organisms within the tidepools.”*

Step 2. Food Game Activity

1. Safety (1-5 min)

- Lay out all safety concerns.
 - ❑ Let the students know there will be no pushing, shoving, biting, kicking, etc.
 - This could be done by asking: *“What safety rules does one need to follow while playing a game?”*
 - From their answers the facilitator can then verify that there should be no pushing etc...
 - If someone is playing in an unsafe manner the facilitator can then reference back to what the students listed as rules of the game.

2. Circling up (1 min)

- If no group circle is formed or the group circle is disorganized
 - ❑ Have group reform a circle and take two large steps back. Instruct the participants to wait there until further notice.

3. Distributing chips (1-2 min)

- ❑ Distribute / scatter chips evenly on the ground within the middle of the circle.
- While distributing poker chips: lay out the guidelines of the activity.
 - ❑ Tell students to at a walking pace collect one and only one chip.
 - They need not worry about the color of the chip but remind them to collect only one chip.
 - ❑ When they collect one chip they then return to the outside of the circle where they are standing now and wait until everyone has collected a chip.
 - Make sure you have counted the number of students and chips correctly so all students are ensured to get a chip and there will be the allotted number of individuals with yellow, green, and blue chips. (Reference the **“Preparation”** heading under **“Activity Description”** for allotted ratios and numbers of chips if needed)

4. Assigning roles (1-2 min)

- ❑ Allow students to carefully collect chips at a walking pace and return to their spot on the outside of the circle

5. Filling the students in (5-10 min)

- Once all the students have returned to the outside of the circle

- Tell them each color chip represents basic needs for organisms
 - *Yellow chips* represent sun (that phytoplankton need)
 - ⇨ Ask all students with yellow chips to raise their hands
 - ⇨ Tell them that the yellow chip they hold in their hand represents sun and nutrients in the water.
 - ⇨ Ask Q: ***“What type of organisms in the tide pools need sun for energy?”***
 - ➔ ***A: Plants and other photosynthetic organisms*** *Students will give different answers (kelp, sea grass, plants etc...) remind them of the previous exercise.*
 - ⇨ Tell them there is a special tiny type of organism that cannot be seen by the naked eye called *phytoplankton*. Phytoplankton like plants use the sun’s energy and nutrients within the water in photosynthesis to get their energy.
 - ⇨ If possible hold up a picture of the phytoplankton and tell them the picture is an enlarged version.
 - ⇨ Tell students with yellow chips within the game they will be phytoplankton
 - *Green chips* represent phytoplankton (that mussels and other organisms feed on)
 - ⇨ Ask all students with green chips to raise their hands
 - ⇨ Tell them the green chip they hold represents phytoplankton
 - ⇨ Ask Q: ***“What type of organisms in the tide pools need phytoplankton for energy?”***
 - ➔ ***A: snail, urchin, mussels etc...*** *This is a bit of a tricky one for students but keep asking questions such as “What might eat phytoplankton?” or simply “What lives in the tidepools?” and “Do you think (blank) would eat phytoplankton?” Many of the organisms in the tide pools eat phytoplankton.*
 - ⇨ Show a picture of mussels. Say this is a larger organism that feeds on plankton.
 - ⇨ Tell students how mussels eat. *“Mussels are filter feeders and ‘suck’ water through them to filter out phytoplankton to eat.”*
 - ⇨ Tell students with green chips within the game they will be mussels
 - *Blue chips* represent mussels (that sea stars feed on)
 - ⇨ Ask all students with blue chips to raise their hands
 - ⇨ Tell them the blue chip they hold represents a mussel or urchin
 - ⇨ Ask Q: ***“What type of organisms would eat a mussel or urchin?”***
 - ⇨ ***A: Sea otter, sea star etc...*** *This is also a bit tricky for students. Keep asking questions and if they don’t get it suggest “Would a sea star/sea otter eat a mussel or urchin?”*

- ⇒ Show a picture of a sea star and explain *they eat their prey by wrapping their arms around them and consuming them through their mouth in the center.*
- ⇒ Tell students with blue chips within the game they will be starfish

- ☐ State we are going to now get into our roles and eat or consume what we need to stay alive.

6. Rules of the Game-Round 1 (3-5 min)

- ☐ Describe how the game works:
 - While doing this start to distribute more yellow chips on the ground in the middle of the circle allowing students to keep the chips they are holding. It is not necessary to count the chips simply scatter approximately two to two and a half times the number of students that are playing the role of phytoplankton.
- Phytoplankton
 - ☐ Ask all the phytoplankton to raise their hands
 - Remind them they are the ones holding a yellow chip
 - ☐ Tell the phytoplankton: *"You are able to 'float' around and collect these yellow chips in the middle of the circle. You need to get two chips (total of three yellow chips) in order to advance to the next round. You can only get one chip at a time and must return to the spot you are standing in right now before you can collect your second chip. However watch out for the urchins who can tag you and take your chips (eating you). When you are waiting on the outside of the circle you are safe and cannot be consumed. You must move at a slow walking pace."*
- Mussels
 - ☐ Ask all the mussels to raise their hands
 - Remind them they are the ones holding a green chip
 - ☐ Ask, *"Do mussels move?"*
 - Respond, *"No, mussels don't move much if at all when they are anchored on to a rock. However for this game to work everyone who is a mussel will move."*
 - ☐ Tell all the mussels: *"You are able to move around slowly to collect and eat plankton. If you tag a phytoplankton you must take that plankton back to the outside of the circle where you are standing right now and collect their chips. You must get three phytoplankton to move on to the next round. When you are waiting on the outside of the circle you are safe and cannot be consumed. You must also move at a slow walking pace."*
- Sea Stars
 - ☐ Ask all the sea stars to raise their hands
 - Remind them they are the ones holding a blue chip
 - ☐ Tell the sea stars: *"You are able to move around slowly to collect and eat mussels. If you tag a mussel you must take that mussel back to the outside of the circle where you are standing right now and collect their*

chips. You must get three mussels to move on to the next round. You must move at a slow walking pace."

- Clarify
 - ❑ To make sure you know what it is you are eating everyone must keep their color chip visible and if asked by another person they must identify themselves.
 - ❑ Ask if there are questions and if everyone understands the rules. Let them know they will have 1 minute for round 1.
 - ❑ Set the timer, remind students of the safety rules addressed at the beginning, and to move at a slow walking pace. Go.

Step 3. Producers and Consumers-Round 2 (5-10 min)

1. Explaining Producers and Consumers (3-5 min)

- Produce/Consume
 - ❑ Ask, "What does it mean to produce something?"
 - Respond, "To produce something means to create or make it on your own."
 - ❑ Ask, "What does it mean to consume something?"
 - Respond, "To consume is similar to eating or using something."
- Producer
 - ❑ Ask, "If I were to define an organism as a producer what of the three organisms we have represented phytoplankton, mussels, and sea stars would be a producer, and why?"
 - Respond, "The phytoplankton would be considered a producer because it uses photosynthesis to 'produce' its energy."
- Consumer
 - ❑ Ask, "If I were to define an organism as a consumer what of the three organisms we have represented phytoplankton, mussels, and sea stars would be a consumer, and why?"
 - Respond, "Both the mussel and the sea star would be considered a consumer because they both consume other organisms to obtain energy."
- Primary and Secondary Consumers
 - ❑ Ask, "If the sea star is eating a mussel that is also considered a consumer should there be another name to distinguish between the two consumers?"
 - Response, "There is a way to distinguish between the two consumers. A consumer that eats a producer is the first level of the food chain and is considered a **primary consumer**. A consumer that feeds on primary consumers is considered a **secondary consumer**. A consumer that feeds on secondary consumers is considered a tertiary consumer and so on."
- Decomposers
 - ❑ Ask all the students who have three chips in their hands to raise their hand.
 - Students with three chips in their hand were able to live.
 - ❑ Ask, "What happens to organisms that die? Why is there not an abundance of dead organisms lying around?"

- Response, *“Other organisms can eat them if they are not too old or rotting. Or bacteria can then eat them. Bacteria and other organisms that break down organic matter such as dead organisms into inorganic matter are called decomposers.”*
- Energy
 - ❑ Ask, *“All the sea stars are the phytoplankton important to you?”* or *“Well do you have any yellow chips in your pile?”*
 - Respond, *“Yes the phytoplankton are important to you because they were food for the mussel you ate. Also the sun is important to you because the phytoplankton need it to survive.”*
- Continuing
 - ❑ For the game to continue all the organisms that didn’t live are regenerated back into phytoplankton and are now gathering yellow chips make sure the students understand that organisms don’t automatically get regenerated into phytoplankton this is only part of the game.

2. Round 2 (2-3 min)

- ❑ Give students another opportunity to gather chips using the same guidelines as **Round 1** giving them more time if needed.
- ❑ Take note of how the populations have fluctuated and who is still living and who is not.
- ❑ Ask what was difficult for each group of organisms.

3. Variations (5-25 min)

- Given the similar guidelines adjust different populations and allow students to play more rounds.
- As an adaptation students can also discuss what is needed in a habitat. Such as food, space, and shelter. Various limiting factors can take part in controlling populations.
 - ❑ Give all the mussels and sea stars a paper plate and tell them it is their home.
 - ❑ Conduct a few rounds
 - In between rounds you can either add or take away habitat (paper plates) . You can make it due to a new development of a hotel or a huge wave came and washed away the rock they were living on.
 - Use your imagination and the creativity of the students.

Step 4. Gauging Understanding (5-10 min)

1. A few questions:

Q: What is an herbivore?

Q: What is an omnivore?

Q: What is a carnivore?

Q: What is a producer?

Q: What is a consumer?

Q: What is the difference between primary and secondary consumers?

Q: What is a decomposer?

Q: What are the basic needs of phytoplankton?

Q: What are the basic needs of mussels?

Q: What are the basic needs of sea stars?

Q: How did the different sizes of populations affect the other populations?

Ask if there are any other questions

Step 6. Wrap Up (1-2 minutes)

- Now that everyone learned about these fun new organisms lets go out into the tidepools and see them and other organisms....except for the phytoplankton because we would need a powerful microscope. Enjoy the tidepools and be safe.

