HOW DO ECOSYSTEMS CHANGE OVER TIME?

Overview

In this lesson, students will play a game to learn about competition and survival within ecosystems.

Objectives

On successful completion of this lesson, students will be able to:

- give at least two examples of competition that takes place in real-world ecosystems;
- explain how and why competition takes place in ecosystems; and
- explain how ecosystem changes in one part of an ecosystem can affect other parts of the system.

Alaska Standards

Alaska Science Standards / Grade Level Expectations

[4] SC.3.2 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer of matter and energy by identifying a simple food chain of familiar plants and animals, diagramming how energy flows through it; describing the effects of removing one link.

[5] SC.3.2 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer of matter and energy by organizing a simple food chain of familiar plants and animals that traces the source of energy back to sunlight.

Alaska Cultural Standards

[A] Culturally knowledgeable students are well grounded in the culture heritage and traditions of their community. Students who meet this cultural standard are able to:

[A.3] (extension activity) acquire and pass on the traditions of their community through oral and written history.

[D] Culturally knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning. Students who meet this cultural standard are able to:

[D.3] (extension activity) interact with Elders in a loving and respectful way that demonstrates an appreciation of their role as culture-bearers and educators in the community.

[E] Culturally knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to:

[E.2] understand the ecology and geography of the bioregion they inhabit.

HOW DO ECOSYSTEMS CHANGE OVER TIME?

Bering Strait School District Scope & Sequence

4th grade sequence #3: Ecosystems

5th grade sequence #4: Ecosystems

Materials

- Box of store-brand Fruit Loops
- Masking tape
- Baggies (1 per student)
- "Dead meat" signs (1 per student)
- Animal image cards (1 per student)

Activity Preparations

1. Mark off an area of the classroom using masking tape. Within this marked off area, empty the box of Fruit Loops and spread them out. This area is your "ecosystem." Remove some green and yellow cereal pieces, and set them aside as resources for herbivores. Do not allow students to know that you have these set aside until the appropriate time.
2. Based on the number of students you have, pre-select the animal cards. For every carnivore, you should have 3 herbivores, 1 omnivore, and 1 scavenger. NOTE: if you only have 5 students, make the omnivore be a scavenger.

Whole Picture

Ecosystems, the interactive system of living and nonliving organisms in a specific location, change slowly over time. When new plants and animals arrive in an area, they either thrive or struggle. Thriving species sometimes displace native species. When this happens, the system as a whole begins to change.

Ecosystems can also change when disruptive or catastrophic disturbances occur. Catastrophic events (like large volcanic eruptions) destroy all life in an area. In catastrophic events, life generally comes back to an area, but it can take decades to hundreds of years, and frequently the returning life is different than what was there before. Disruptive events destroy some life, but leave others intact. Take for example a forest fire — generally, a disruptive event. In Alaska's Boreal Forest, black spruce trees burn easily, whereas birch and aspen are slower to burn. Depending on the intensity of the fire, deciduous trees (like birch and aspen) are often the only trees left alive after a fire. However, as time passes, new plants like grasses and fireweed soon begin to grow, and the forest begins to regenerate.

This type of ecosystem change is normal and has been happening on earth for thousands of years. The slow process of change allowed people, plants, and animals to adapt to their surroundings, without worrying for their own survival. However, as the climate warms, rapid ecosystem changes are beginning to happen. These events include flooding, coastal erosion,

permafrost depletion, lakes drying, and more intense wildfires. When ecosystems experience this type of rapid change, the people, plants, and animals that exist within them have to find new ways of surviving.

Scientists and culture-bearers alike have been studying ecosystem changes as the result of climate change, for many years. For many a major indicator of unprecedented change can be seen in plant and animal abundance and behavior. For example, in western Alaska, people have noticed the growth of trees where previously conditions had not been hospitable to such growth. In animals, "elders observe not only fewer seabirds but fewer songbirds. Beluga whales, which regularly migrated along the coast, are also seen less frequently, the number and health of whitefish in inland rivers are said to have declined. Some species, most notably the indomitable beaver, have increased. And new species like the salmon shark are now observed" (Fienup-Riordan and Rearden, 2012, p. 42).

In Savoonga, people have noted changes both in animal behavior and in landscape changes. Kenneth Kingeekuk, former Vice President of the Savoonga Tribal Council explained, "We've lost a lot of coastline. We've lost a lot of lakes and ponds where migratory birds lay their eggs in the summertime … currents have also changed. Here in Savoonga in the fall time, we never really did our whaling here (but on the southwest cape), but since the change in current has diverted the migratory route of the bowhead whale. Now they're starting to come right through our village here, which never used to happen" (Kingeekuk, 2010).

For many, these changes mean a necessary change in how things have traditionally been done. The wisdom of elders, made possible through generations of careful observation and experience seems to be less reliable. People are observing new phenomena and patterns.

George Noongwook, a respected hunter from Savoonga, would like to know more about the kinds of changes to come. In this way, he hopes to be able to make adaptations. "It is probably safe to say that changes are going to become a daily part of our lives. In light of more unstable weather conditions, I think that it would help if we can anticipate these changes based on observations and data collected by the scientific community and also observations by local hunters. Then we can make a collective prudent decision of where and when to concentrate our efforts in order to feed our souls, physical, and biological needs" (Krupnik and Jolly, 2002, p. 189). One of the challenges, however, is that the rate at which changes are now happening is unprecedented, making observations and predictions difficult.

For example, each fall the village of Shishmaref "faces massive flooding and increased erosion when storms off the Chukchi Sea hit the barrier reef island" (Marino, 2009, p. 43). The erosion and damage to the ecosystem and village infrastructure is so extensive that the village is in the planning process of moving to a more sustainable location. The move away from their home land, where people have lived for thousands of years, will be costly — not only in terms of moving homes, people, and infrastructure, but in terms of adapting to a new lifestyle in a new landscape.

HOW DO ECOSYSTEMS CHANGE OVER TIME?

Ecosystems have always changed — but in the past they changed slowly over hundreds and thousands of years. Today, people can no longer count on these slow changes, but instead must deal with rapid and unpredicted changes.

Vocabulary

competition a kind of contest among populations that need to get a certain amount of food, water, and shelter to survive.

ecosystem a community and its physical environment together.

population a group of organisms of one kind that live in one location.

predator an animal that kills and eats other animals.

prey an animal that is eaten by a predator.

Vocabulary for Review

food chain a food chain is a way of organizing living things by what they eat.

food web a food web is similar to a food chain, but shows the interconnections between all animals in the system.

carnivore an animal that eats other animals.

herbivore an animal that eats plants.

omnivore an animal that eats both plants and animals.

scavenger an animal that eats on already dead animals for food.

producer organisms that use energy from the sun, water, and nutrients to create their own food.

consumer organisms that need to eat other organisms to gain energy and survive.

decomposer organisms that eat decaying matter; these organisms break down the decaying matter, releasing nutrients and minerals back into the soil to be used again by producers.

Activity Procedure

1. Review previous vocabulary with students. If students are not yet familiar with these terms, introduce and explain them.
2. Invite students to choose an animal card from the pile you have previously selected.
3. Explain that the designated area represents an ecosystem, and the Fruit Loops represent organisms within that ecosystem.
4. Give each student a plastic baggie and instruct students to collect Fruit Loops, but not eat them. They may collect as many or as few as they wish. (Some students will collect many, others only a few; some will collect only a certain color — allow this to happen.)

5. When students have finished collecting, instruct them to return to their seats, where they will organize their Fruit Loops by color on the desk or table in front of them.
6. Reveal what each color represents:
   a. Green: plants
   b. Blue: water
   c. Red: predator meat
   d. Orange: scavenger meat
   e. Yellow: shelter
   f. Purple: pollution
7. Explain that if they are an herbivore they need to put any red or orange Fruit Loops back into their baggies. They do not need these, because as herbivores, meat is not a useful resource for them.
8. Explain that if they are a scavenger, they need to put all green and red Fruit Loops into their baggies. As scavengers, they do not eat plants, and only scavenge meat leftover by predators.
9. Explain that if they are a predator, they should put all green Fruit Loops into their baggies. As predators, plants are not a primary resource.
10. Now, the scenarios will begin. Proceed through each scenario, allowing students to ask questions, make inferences, and pose "what-if" scenarios. If you have a particularly small class, allow students who "die" in each scenario to begin again. Otherwise, allow these students to remain as "dead meat."
11. **Scenario 1**: "Normal" (balanced) climate: plants grow as expected; there aren't any major landscape changes; animals reproduce normally and have plenty of resources.
    a. Instruct all herbivores to collect 5 extra green or yellow loops
    b. Announce that you are now an herbivore baby (representing population increase)
    c. Choose one carnivore to "kill" one herbivore.
       i. The carnivore should take any red loops the herbivore previously put in their baggie, and distribute these amongst any other carnivores.
       ii. The herbivore will turn his or her card over so that it says "Dead Meat."
       iii. The scavenger should go to the "Dead Meat" herbivore, and take all but one yellow loop and distribute these amongst any other scavengers.

Note: If you have chosen to add detritivores and plant producers to your activity, they should now go to the "Dead Meat" and take all remaining resources, passing them out equally among the plant producers.

    d. Instruct students to examine their pile of resources; ask if they think their population is healthy (Answer: yes. Plenty of plant resources mean that the herbivore and

omnivore populations are healthy. Because there are plenty of herbivores, the carnivores and scavengers also have plenty of resources.)

12. **Scenario 2**: It's an unusually dry year, and was a very cold and dry winter. As a result, many plants did not survive the winter, and this has caused hardship for the herbivores and some omnivores.
    a. Instruct all herbivores and omnivores to put 5 green loops into their baggies.
    b. Instruct any omnivores to collect 1-2 orange or red resources from the baggies of herbivores.
    c. Say, "You need 5 primary resources (red, orange, or green, depending on role) to survive this scenario. If you have less than that, you have "died." Put up your "Dead Meat" sign.
    d. Choose one carnivore to "kill" an herbivore. Take the red loops from their baggies and distribute them amongst other carnivores.
    e. Instruct the scavenger(s) to collect any orange resources from the baggies of the "Dead Meat."
    f. Instruct students to examine their pile of resources; ask if they think their population is healthy (Answer: herbivores are not healthy, because of diminished food sources. Omnivores, carnivores, and scavengers, who can eat the meat of some of the herbivores, survive in this type of situation. However, competition between these groups can escalate, making carnivores and scavengers more successful.)
13. **Scenario 3**: Explain that excessive pollution has contaminated the food and water sources in the area.
    a. Instruct all students to look at their pile of purple loops. Explain that these represent pollution, and contamination to their food and water. For every purple (pollution), they must take away one water (blue) or food source (green, red, orange). These "used resources" should go into their baggies.
    b. Select a predator to "kill" an herbivore or an omnivore. Distribute the red loops evenly amongst other carnivores.
    c. Say, "You need four waters, four food sources, and four shelters to survive this scenario." Any student who does not have enough has "died" and should put up their "Dead Meat" sign.
    d. Instruct the scavengers to take five resources from the "Dead Meat." Explain that as animals die off, scavengers have more resources.
    e. Instruct students to examine their pile of resources; ask if they think their population is healthy (Answer: pollution hurts all populations, but scavengers generally do ok, because as animals die, their food supply increases. However, sometimes, the meat from dead animals can also be contaminated, and this would kill off the scavengers.)
14. Instruct students to do a "Think-Pair-Share" to explain what this activity represents. Pose this scenario to students: Thinking about our own area, and the plants and animals within it, which animals are herbivores, carnivores, omnivores, and scavengers? How

do they depend on and compete against one another? Encourage students to use local names and terminology where possible.

Extension Activities

- Add plants and decomposers to the organisms that students might represent. Create new scenarios using plants and decomposers as part of the ecosystem, to illustrate the important role that they play.
- Instruct students to ask their family members and neighbors to share stories about how different animals within the ecosystem compete against one another. Students may come back to class with interesting stories about how certain animals came to be.
- Invite an elder or culture-bearer into the classroom to talk about how the ecosystem is changing — if they have noticed different plants and animals on the landscape.

Answers

11.d. (Scenario 1): Yes. Plenty of plant resources mean that the herbivore and omnivore populations are healthy. Because there are plenty of herbivores, the carnivores and scavengers also have plenty of resources.

12.f. (Scenario 2): Herbivores are not healthy, because of diminished food sources. Omnivores, carnivores, and scavengers, who can eat the meat of some of the herbivores, survive in this type of situation. However, competition between these groups can escalate, making carnivores and scavengers more successful.

13.e (Scenario 3): Pollution hurts all populations, but scavengers generally do ok, because as animals die, their food supply increases. However, sometimes, the meat from dead animals can also be contaminated, and this would kill off the scavenger(s).

14. Think-Pair-Share: Students should recognize the interconnectedness of all species and should realize that what happens to one part of the system affects the others.

References

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Teacher Information Sheet

Use this list for student roles in the activity. If you have a particularly small class, ensure that for every carnivore, you use at least 3 herbivores, 1 omnivore, and 1 scavenger. In especially small classes, the omnivore can be a scavenger.

If you have many students in your class, and choose to create new scenarios, include plants (producers) and bacteria or fungi (detritivores / decomposers).

Animal / Plant	Type
vole	herbivore (prey)
moose	herbivore (prey)
caribou	herbivore (prey)
arctic fox	omnivore / scavenger (predator)
bear	omnivore / scavenger (predator)
wolf	carnivore (predator)
eagle	carnivore / scavenger (predator)
raven	scavenger (predator)
human	omnivore (predatore)
lichen	plant (producer)
blueberry	plant (producer)
willow	plant (producer)
mushroom	detritivore (decomposer)
fly	detritivore (decomposer)

Caribou - Herbivore (prey)

Moose - Herbivore (prey)

Vole - Herbivore (prey)

Arctic Fox - Omnivore/ Scavenger (predator)

Bear - Omnivore/ Scavenger (predator)

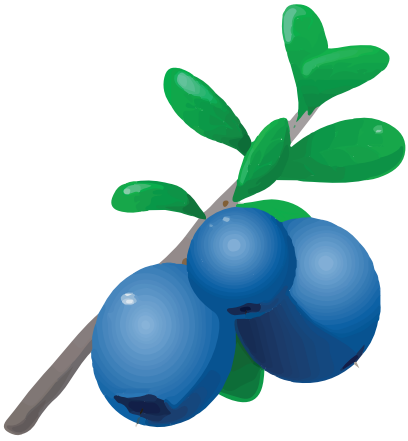
Wolf - Carnivore (predator)

Eagle - Carnivore/Scavenger (predator)

Mushroom - Detritivore (decomposer)

Fly - Detritivore (decomposer)

Willow - Plant (producer)



Blueberry - Plant (producer)

Lichen - Plant (producer)

 Human - Omnivore (predator)	 Raven - Scavenger (predator)
DEAD MEAT	DEAD MEAT
DEAD MEAT	DEAD MEAT

DEAD MEAT	DEAD MEAT
DEAD MEAT	DEAD MEAT
DEAD MEAT	DEAD MEAT