



Science Unit: *Plants and Animals Through the Stages of Ecological Life*
Lesson 6: *Ecosystems - Plants and Animals Together!*

School year: 2007/2008
Developed for: Mount Pleasant Elementary School, Vancouver School District
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Grade level: Presented to grades 6 - 7; appropriate for grades 4 – 7 with age appropriate modifications.
Duration of lesson: 1 hour and 20 minutes (revise as needed)
Notes: Fill enough buckets with tap water and leave it to de-chlorinate at least 24 hrs prior de lesson.

The web site 'Snail Care' was developed by Luana to answer students' questions that arose after students took their mini-ecosystems home and continued their observations and experimentation.
<http://members.shaw.ca/bozar/snailcare/snail.html>

Objectives

1. Learn the biotic and abiotic factors of an ecosystem
2. Learn the trophic levels of an ecosystem (decomposers, producers and consumers)
3. Learn that all organisms are connected in an ecosystem

Background Information

An ecosystem is a combination of populations of organisms and abiotic, non-living, factors. The abiotic factors are the constant factors in the ecosystem. All organisms that are part of the ecosystem need and use these non-living elements, such as water, air, light and soil/ nutrients. The biotic factors are divided into three layers: decomposers, producers and consumers. The decomposers are the fungi and bacteria, which will decompose dead plants and animals, thus freeing the nitrogen and carbon for re-absorption by the plants. The producers are the plant organisms. They are called producers because they can produce their food and food for other animals through photosynthesis, which will use light, water, air and nutrients. The consumers are the animals that will eat plants and other animals. An herbivore is a primary consumer, an animal that only eats plants. A secondary consumer is an animal that will eat only herbivores and/ or plants. Secondary consumers can be omnivores or carnivores. A food chain can also have tertiary and quaternary consumers, where the tertiary consumer eats the secondary and it is eaten by the quaternary. Quaternary consumers are those animals that don't have a natural enemy, they are at the top of the food chain.

Vocabulary

<u>Word:</u>	<u>Brief definition.</u>
Ecosystem	An ecological community together with its environment, functioning as a unit.
Abiotic	Non-living elements of an ecosystem
Biotic	Living elements of an ecosystem
Trophic level	The position an organism holds in the food chain



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Decomposers	Microorganisms that decompose organic matter and free nutrients and minerals for plant use.
Producers	Photosynthetic organisms, ones that can create food, complex molecules.
Consumers	Organisms that feed by eating plants or other animals.
Food web	The relationship between all the living organisms in an ecosystem.

Materials

- Pieces of yarn or string
- 1 paper card per student (5 different colours)
- Gravel (per student: 1.75 cups of dry and 0.25 cups of live (bacteria containing gravel))
- Snails (2 per student)
- Water chlorine remover (optional)
- Transparent 2L pop bottles (1 per student)
- Aquatic plants (2 stems per student)
- Fish (2 per student) (optional)
- Pushpins
- Scissors

In the Classroom

Introductory Discussion

So far we have been studying animals and plants separately. Today we are going to study them together.

What is it called when we look at many populations together? (an ecosystem)

What is an ecosystem?

Why do you think ecosystem even exist? Could populations live in isolation?

Imagine a population of hippopotamuses lived in a void: no water, no light, no soil, no plants. What do you think would happen?

Organisms need their environment and one another for food. That is why they are connected in an ecosystem.

What do you think we will find in an ecosystem? (place biotic and abiotic in different columns)

Ecosystems are composed of elements of 2 types. What is common to all elements in each of the columns?

Abiotic elements are part of the environment. These are the constant factors for all the organisms in the ecosystem

If we were to further organize the biotic elements how would you do it?

plants → animals → bacteria → plants

These are the all the players of an ecosystem. Each of these have a specific role and name to describe their role in the ecosystem.

Write the words: Producer, Decomposer and Consumer on the board. Which of the words do think describes the role of an animal? A plant? Bacteria?

Today we are going to become an ecosystem and make an ecosystem.



Science Activity: Modeling a Food Web

Each student will become part of an ecosystem. Cards of different colours will indicate whether they are a decomposer, a producer, a primary consumer, a secondary consumer or an abiotic factor.

You may use any food web. I choose to model the Rocky Mountain ecosystem using the list of organisms provided in the CPAWs website. (the list of organisms can be found at the end of this document)

Each kid will receive a card that will say what organism or environmental element they are. Using the information sheet, each kid should learn what it eats and what eats it. (information sheet can be found at the end of this document)

Then, all kids will walk around and when they find someone they will introduce themselves: "I am an Oak tree. I am a producer because I make my own food using nutrients/soil, water, air and light." The other person will also introduce herself/ himself and if they need each other in any way they will become attached by a string.

When a group meets another group, the person at the highest trophic level will introduce the group. If they need each other they should also become attached.

In the end the entire class should be attached by a tangled web of strings. This is our food web!

Point out to the students that they have become attached as the result of the need animals; plants and microorganisms have on each other.

Bring the students back to carpet and start by asking who had the colour the represented plants (ie. Let's start with the green cards. Who has a green card? What were you? Answer: Yellow glacier lily. What do you eat? Who eats you?)

Go through all colours in order: plants→primary consumers (herbivores)→secondary consumers (carnivores or omnivores)→ decomposers and then the abiotic elements.

At each step have the students tell the class what they were and what they eat or what eats them. Have a few students of each colour describe themselves. And ask the class to guess what organisms that colour represented and its name in an ecosystem.

Science Activity: Making a mini-ecosystem

Students will make their own self-contained ecosystem that could be used to run other experiments or to take home.

1. Each student should have a 2L transparent pop bottle.
2. Make a line just below where top of the bottle curves - this is just above the plastic label.
3. Using a pushpin make several holes on the drawn line.
4. Cut the bottle along the line leaving the top hinged
5. Add 2 inches of gravel to the bottle
 - a. 1 $\frac{3}{4}$ in of dry gravel (about 2 cups)
 - b. $\frac{1}{4}$ in of live gravel (about 1 cup)
6. With your finger make small hole to place the plant stems
7. Place the plants and secure them to the gravel
8. Add chlorine and copper-free water leaving about 1 in. at the top (~500 ml)
 - a. copper-free (let the tap run for about 3 minutes before collecting)
 - b. chlorine-free (leave tap water in a bucket for 48 hrs or use chlorine remover)
9. Add snails and fish (optional)
 - a. Make sure to add snails/ fish of the same species so they can mate
10. Place the top part back on the bottle and attach it with duct tape.



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- a. If your bottle does not have a cap place tape in the opening and make holes with the pushpin

Closure Discussion

With the students' help draw the ecosystem they just built in their bottles. Ask them to name the trophic levels. What does the food web in the bottle look like? What are the abiotic factors?

Ask them to predict what will happen

References

CPAWS – Canadian Parks And Wilderness Society Calgary/Banff Centre. Resources of Educators. 'Keys and Webs' lesson. < http://www.cpawscalgary.org/education/edu_resources.php> Accessed Mar 08, 2008.

Kutchel, Louise; Covernton, Libby and Stewart, Angela. Ecosystem Models, Lesson 2, *Food Webs and Making Miniature Ecosystems*, Scientist in Residence Program; see <http://www.scientistinresidence.ca> to view and download this lesson plan.

Graham. Owner of Noah's Ark Pet Store, Vancouver, BC.

Extension of Lesson Plan

1. Use the ecosystems to model ecosystem changes. Remove one trophic level (remove plants) or change one variable (pH, light, salinity) and observe the effect.
2. To bridge this unit with climate change/ ecological living have the students make their own household cleaning products and do an experiment comparing the damage of store-bought cleaning products and a home made product.

Rocky Mountain Food Web

Information obtained from the Keys and Webs Lesson plan posted on the CPAWs website (see references)

1. Soil (abiotic)
2. Sun (light) (abiotic)
3. Water (abiotic)
4. Air (CO₂) (abiotic)
5. Air (O₂) (abiotic)
6. Grizzly bear (secondary consumer)
7. Cougar (secondary consumer)
8. Worms (decomposer)
9. Microorganisms (bacteria) (decomposer)
10. Mushrooms (fungi) (decomposer)
11. Moose (primary consumer)
12. Wolverine (secondary consumer)
13. Yellow glacier lily (producer)
14. Willow shrubs (producer)
15. Hoary marmots (primary consumer)
16. Mountain bluebird (secondary consumer)
17. Long-tailed salamander (secondary consumer)
18. Red-tailed hawk (secondary consumer)
19. Mallard duck (secondary consumer)



20. Lynx (secondary consumer)
21. Snowshoe hare (primary consumer)
22. Gray wolf (secondary consumer)
23. Bighorn sheep (primary consumer)
24. Northern sweet-vetch (producer)
25. Canada Buffalo-berry (producer)
26. Wood ant (decomposer)
27. Water vole (primary consumer)
28. Humans (secondary consumer)

Food Web Information Sheet

Instructions: find your assigned role on the list below and learn about 'yourself'.

Human – eat all animals and plants. May be eaten by bear, cougar and lynx.

Microorganisms – decompose all decaying animals and plants.

Mushrooms - different species of mushrooms cover the forest floor, where they thrive on dead leaves and animals. Many forest animals, including humans eat mushrooms.

Worms – eat dead/ decaying plants and animals. Worms get eaten by birds, frogs and other small animals.

Mountain bluebird – These relatives of the robin are bright blue and can be found nesting in woodpecker cavities or nest boxes throughout the mountains. They may swoop to eat flying insects, or forage on the ground for beetles, ants and other terrestrial invertebrates, such as worms.

Hoary marmot – This marmot relies on sleeping to survive the harsh alpine environment – it hibernates for up to 9 months. This “whistler” feeds on grasses, sedges and herbs like yellow glacier-lily. These large, furry rodents run into their burrows to escape their predators, which include grizzly bears and golden eagles.

Long-tailed salamander – These secretive amphibians feed on invertebrates under logs and rocks. As tadpoles, they are preyed upon by waterfowl; as adults, they are preyed upon by weasels and red-tailed hawks.

Red-tailed hawk – The distinct “kieeeaaarr” call of this raptor can be heard throughout Alberta and on many movie soundtracks. Identified by their rusty-red tails, they dive to capture mice, voles, birds and amphibians.

Yellow glacier-lily – One of the first flowers to bloom in early spring, the glacier lily’s bright yellow flowers have 6 petals and grow from a bulb in the ground. Bears and rodents eat the nutritious roots, while deer and sheep graze on the seed pods.

Moose – The largest member of the deer family in North America, the moose is well-adapted to its environment: long legs allow it walk over forest debris and through deep snows, and its big bulbous nose and lips hold willow twigs in place so the lower incisors can rip them off. Grizzly bears, cougar and wolverine prey upon moose calves. Only the bulls (males) grow antlers.

Wolverine – Wolverines are extremely sensitive to human disturbance and their populations have declined across North America. These elusive weasels are highly predatory and hunt for birds, rodents and even large mammals like moose. These 5-toed carnivores look like a small bear with a long bushy tail.

Mallard duck – Found across Alberta, these dabbling ducks feed on seeds, aquatic invertebrates and larval amphibians at the surface of the water, tipping only their head in, rather than diving to deeper depths. Mallards are frequently hunted by humans and other predators like coyotes.

Willow shrubs – There are many types of willows that dot the Alberta landscape. Their woody vegetation is an important food source for ungulates (hoofed mammals) and rodents alike. Willows are



also important for humans: willow bark contains a compound that is used in Aspirin. Seeds are hairy capsules (i.e. not fleshy).

Lynx – One of three wild cats found in our mountains, the lynx is identified by the long black tufts of fur protruding from its ears. Its primary prey is the snowshoe hare. Wild cats have four toes with retractable claws.

Snowshoe hare – These animals are found almost anywhere there is dense shrub in the Rockies. They feed primarily on grasses and brush, including the buds, twigs and bark of willows. These hares are often mistakenly called rabbits.

Grizzly bear – an emblem of the wilderness, grizzlies require large home ranges for finding food and surviving. 80% of this bear's diet comes from vegetation, including Canada buffaloberry or northern sweet-vetch. With their long 5-toed claws they will dig up ground squirrel burrows or pull apart decaying logs to eat ants. They will follow the smell of and eat rotting carrion up to 16 km away and occasionally hunt and kill young hoofed animals like moose or bighorn sheep. Their predators include other grizzlies, wolves, cougars and humans.

Gray wolf – resembling a long-legged German shepherd with long large paws, the gray wolf can actually vary in colour (coal black to creamy white). Wolves are designed to eat large herbivores like bighorn sheep. Due to human hunting and habitat changes, wolf populations have declined across North America.

Bighorn sheep – While both the females and males have horns throughout their lives, it is the ram's curl that is most recognized. Bighorns feed on nonwoody plants (glacier lily) and grasses on alpine meadows and rocky slopes.

Newborn lambs become prey for grizzlies, cougar and eagles.

Northern sweet-vetch – Found on moist open slopes, these pink-flowered plants are members of the pea family (5 unequal petals). Sweet-vetch roots were widely used by native people for food. Grizzly bears will dig up the roots of sweet-vetch for food.

Canada buffaloberry – Also called soapberry, the fleshy berries from this woody shrub are an important food source for grizzly bears in the Rockies. Grizzlies will eat up to 200,000 red buffaloberries per day!

Wood Ant – There are at least 21 species of wood ants in Alberta that live in ant hills. Wood ants can bite when provoked leaving a stinging sensation from the formic acid stored in their abdomens. These invertebrates play an important role in pollinating flowers, distributing seeds and assisting in decomposing plant matter.

Water Vole – Hikers may spot the small water vole hanging out by streams and creeks. The mouse-like vole's tail can be almost 10 cm long. These rodents feast on various plants and roots, including willows and glacier lilies.

Air (CO₂) – a gas that is given off by animals and used by plants during photosynthesis.

Air (O₂) – a gas that is given off by plants and used by animals to produce chemical energy

Soil – a mixture of sand, clay and remains of dead animals and plants that also contain minerals used by living plants

Water – an essential factor for life anywhere on the planet. Used by all animals and plants.

Sun – an essential factor for life anywhere on the planet, extremely important for plant survival.