Science Unit: ***Biodiversity of Local Habitats***

Lesson #: 1 ***Exploring an Ecosystem***

School Year:	2011/2012
Developed for:	Mount Pleasant Elementary School, Vancouver School District
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Grade level:	Presented to grades 5/6/7; appropriate for grades 2 – 7 with age appropriate modifications.
Duration of lesson:	2-3 hours (in class), half day fieldtrip
Notes:	This activity is based on a fieldtrip to a coniferous forest, but can be adjusted depending on ecosystem.

Objectives

1. Define and identify different levels of biodiversity.
2. Explain the source of energy for life and how it flows through an ecosystem.
3. Categorize organisms based on energy transfer through an ecosystem (producers, primary consumers, secondary consumers, tertiary consumers).
4. Explain the importance of biodiversity to ecosystems and humans.
5. Give examples of different types of symbioses (mutualism, parasitism, commensalism) in different ecosystems.
6. Categorize organisms of an ecosystem into main groupings and subgroupings.
7. Categorize organisms based on what they consume (herbivores, carnivores, omnivores, detritivores).
8. Describe human impacts to an ecosystem.
9. Describe activities that can help mitigate their impact on the environment.

Background Information

Integrating classroom and field experiences helps students develop an understanding of the complexity of the natural world and appreciation for how humans are situated in it. Biodiversity is often thought of in terms of numbers of species. It actually intersects all levels of our world from ecosystem to genetic diversity. The importance of this diversity for healthy, resilient ecosystem functioning is a main theme of this unit and should be explicit. There are many ecosystems that can be studied: temperate coniferous forest, pond, bog, intertidal, swamp, and marsh. A number of different ecosystems should be discussed and a visit should be made to at least one. Aspects of ecosystem structure and functioning to include in this unit: species diversity, classification systems, community structure (food chains, food webs, symbioses), reproduction, and importance of decomposition and cycling of matter. Not only should students get a sense of the diversity around them, but human impacts and ways in which we can reduce our impact on the environment should be addressed.

Vocabulary

Abiotic:	A non-living (chemical or physical) element of an ecosystem, such as light, temperature, water, soil, etc.
Biodiversity:	The diversity of life as it applies to all levels from within and between ecosystems as well to species and genetic diversity.
Biotic:	A living element of an ecosystem, such as an animal, a tree, or a fungus. It includes interactions between organisms.

Carnivore:	An organism that can only obtain its nutrients by eating flesh of animals.
Commensalism:	A close relationship between two dissimilar species in which one benefits from the association while the other is neither harmed nor benefited.
Community:	When two or more populations composed of different species interact with each other in the same geographical area.
Decomposer:	Organisms that obtain their food and energy from breaking down complex organic substances from organisms or their parts that are dead or decaying, into simple organic substances they can use. Fungi and bacteria are decomposers.
Detritivore/ Decomposer:	An organism that obtains its nutrients by consuming detritus (fresh and decomposing plant or animal materials as well as organic fecal matter).
Detritus	Fresh or decomposing plant and animal materials (non-living organic material).
Ecosystem:	The combination of community and non-living components (air, minerals, water, etc) defined by a particular environment and flora/fauna composition.
Food chain:	The flow or movement of energy and nutrients from one organism to another, as each organism relies on another as a food source. A food chain is a linear representation that follows the path of energy as organisms eat each other.
Food web:	Shows the flow or movement of energy and nutrients through multiple interactions between organisms. It shows various interlocking food chains since most organisms eat more than one type of food and can be eaten by more than one type of predator.
Herbivore:	An organism that obtains its nutrients by consuming plant tissue.
Mutualism:	A close relationship between two dissimilar species where both benefit from the association.
Omnivore:	An organism that obtains its nutrients by consuming plants and animals.
Parasitism:	A close relationship between two dissimilar species in which one benefits from the association while the other is harmed.
Population:	A group of individuals that belong to the same species living in the same geographical area.
Primary consumer:	An organism that gets their food by only eating producers. Herbivores are primary consumers.
Producer:	An organism that is able to make its own food by using inorganic materials (carbon dioxide, water, etc). Plants, for example, use energy from the sun to generate high energy chemical bonds in sugar molecules in the process called photosynthesis. Producers provide food for other organisms and are usually at the bottom of the food chain.
Secondary consumer:	Organisms that feed on plant-eating organisms (primary consumers). Carnivores are secondary consumers.
Symbioses:	An intimate relationship or association between two dissimilar species. The association can be further characterized as mutualism, parasitism, or commensalism.

Materials (In Class)

- pictures of organisms observed in lessons (include invasive species
- big sheets of paper or whiteboard
- markers

Materials (Fieldtrip)

- Backpacks
- Boots
- Digital camera
- Water
- Clipboards
- Snacks/lunch
- Notebook
- Raingear
- pencils

In the Classroom

I. Introductory Lesson (Classroom)

Define: Biodiversity: Ecosystem diversity (within and between), Species diversity, Genetic diversity

Original source of energy for living systems = Sun

- In photosynthesis, carbon dioxide molecules in the atmosphere (plus water) are linked together [-C-C-] to make sugar molecules. The energy from the sun is stored in the links between the carbon atoms. When the sugars are consumed the bonds break, releasing energy. The sugars made in photosynthesis are also used to make other essential molecules for life: amino acids, proteins (muscles), enzymes (all the reactions in our bodies), nucleic acids (DNA), etc
- Energy is passed from organism to organism: food webs and food chains

Where do we get our food?

Which group of organisms do we rely the most on for food? Flowering plants (angiosperms): to feed us directly or to feed the animals we eat.
Discuss examples of plants and products. What parts are we eating?

Possible Discussion Activities:
- Categories of plants: ferns, conifers, flowering plants, moss (can be introduced on fieldtrip)
- Dissection of a bean – Discussion Points: What is the function of a seed? What are the parts of a seed? What does a seed become? Where do seeds come from?

II. Fieldtrip (Example – Coniferous Forest):

A pre-visit to the fieldtrip site is necessary to determine places along a trail that concepts will be discussed. Plants of Coastal British Columbia (Pojar and McKinnon) is an excellent resource to identify plants in the Vancouver lower mainland. It has ecological and ethnobotanical information that is useful for developing the fieldtrip presentation.

Topics:

(a) Trail Etiquette – some rules for walking in the woods
- Do not go off the trail
- Do not pick anything except with permission
- Stay with your leader
- What you take in your bring out – no littering (pick up trash if you find any)

(b) What is an ecosystem?
- It is made up of organisms that fulfill different roles and the environment:
Plants are the foundation as they take energy from the sun and convert it into food that other organisms can eat (did this in class).
- An ecosystem is a combination of abiotic and biotic components.

(c) Decomposition and Nutrient Cycling
- Discuss the importance of bacteria and fungi in nutrient cycling
- Decomposition is a very important process – nature's recycling system

- The mushrooms we see are the spore-producing structures; the most important part of the fungus is growing in the soil (or wood or other substrate)
- Fungi are made up of long threads that grow through their food, secreting enzymes and then absorbing the breakdown products – therefore they also release nutrients for other organisms to benefit from.
- Other fungi are associated with plant roots – mycorrhizae (mutualistic symbiosis)

Nurse log (a decomposing log that has other organisms growing on it):
- Provides nutrients that help other organisms grow
- Discuss role of fungi and bacteria in breaking down wood (tough stuff)
- Other organisms are important too:
    - moss retains moisture that helps decomposition
    - pill bugs chew up decaying wood (lift rotting piece of wood or forest debris and find a few to show kids)
    - roots of trees also break the wood into smaller pieces.

(d) Energy Flow through an Ecosystem
- Ask students if they know: herbivores, detritivores, carnivores, omnivores
- Define detritus (bodies or fragments of dead organisms)
- Nonliving influences are also important components of an ecosystem.
Abiotic = nonliving eg. water, minerals, temperature, light

(e) Organisms in the Woods
Only a few examples are offered here. Since this activity is based on a coniferous forest, conifer trees are features. Additional plants should be incorporated.
There are three common conifers discussed below.

- Big Red Cedar *(Thuja plicata)*

- Ask what type of plant this is (conifer)
- General structure: roots, stems, leaves (scales)
- Reproductive structures (there will be some seed cones to show them) – ask where pollen comes from (small cones)
- Bark – protects the inside of the tree

- Douglas-fir (*Pseudotsuga menziesii*)

- Needles (are leaves)
- Cones have cool mouse bum shaped bracts.
-How is it different from cedar?

- Compare bigleaf maple (*Acer macrophyllum*) with Western Hemlock (*Tsuga heterophylla*)

- Hemlock is a conifer (no flowers)
- Hemlock is similar to the Douglas-fir (needles)
- Examine cones (compare with Douglas-fir)

(f) Symbioses in the woods
- Close associations between organisms (usually 2)
- Emphasize the importance of understanding interactions

Types of symbioses – relationships organisms have with each other:
mutualism – both benefit
- pollination – plants and animals
- mycorrhizae – roots and fungi (plants gain nutrients from fungus, fungus gains carbohydrates from plant)
- alder - bacteria in roots fix nitrogen that the tree can use, alder provides sugars to the bacteria

parasitism – one benefits the other is harmed
- aphids, spittle bugs, some fungi

commensalism – one benefits, while the other is unaffected
- mosses on a tree, licorice fern on a tree, lichen

(g) Human Impacts

Evidence of deforestation
- Find big stump with springboard notches, evidence of fire
- Research history of local area

Invasive species (e.g. holly, Himalayan blackberry, etc)

III. Biodiversity Lesson (Classroom)
This brings the elements of biodiversity in a more structured format. Students will build on what they have observed and learned on the fieldtrip. A worksheet can be used during the lesson (see attached).

(a) Biodiversity:
Ecosystem
Species
Genetic

Why is diversity important? Example: susceptibility to disease.

(b) Categorizing organisms observed on the fieldtrip (and other activities).

Example:

Lichens are a combination of different organisms so are not put in one category

1. (c) Categorize organisms based on what they consumer (herbivores, carnivores, omnivores, detritivores).
   Why are fungi not considered detritivores? [They secrete enzymes into the environment and absorb the breakdown products. Detritivores consume particulate material.]
2. (d) Review the flow energy through an ecosystem (sun as the source).
3. (e) Present a food chain and then a food web (which shows the food chain)
4. (f) Categorize organisms based on energy transfer through an ecosystem (producers, primary consumers, secondary consumers, tertiary consumers).
5. (g) Discuss examples of different types of symbioses (mutualism, parasitism, commensalism) students observed during the fieldtrip.

Food Web Activity:
1. Pictures of different organisms in the ecosystem(s) are organized on a large piece of paper into a food web. The pictures are glued down and then arrows are drawn to the flow of energy (which organisms are consuming others). Students can decorate the paper as well as label the organisms depending on time.
2. For older students different life stages of the same organism can be included (e.g. a picture of a salmonberry flower and a picture of salmonberry fruit). Students are instructed to match these up before beginning food web construction. The incorporation of an invasive species can lead into discussion about introductions of non-native species. Fungi add a complication as they will decompose dead components of all other organisms in a food web.
3. Follow-up discussion:
4. Which levels of biodiversity have been illustrated (species diversity and an aspect of ecosystem structure: interactions)

Closure Discussion

1. Why is biodiversity important?
2. Identify threats to biodiversity. [Not all are human (e.g. fire, disease, other natural events)]
3. What are some things you can do to reduce your impact on the environment?

References

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Extension of Lesson Plan

1.Visit Beaty Biodiversity Centre (http://beatymuseum.ubc.ca/schools)

2. Have students explore their own neighbourhood for different communities in terms of diversity of organisms and interactions.

3. Explore other ecosystems to examine species diversity, interactions, biotic and abiotic factors, and energy flow.