Living Links

Self-Guided Program

Grades 6 – 8

FortWhyte Alive

HUMAN. NATURE.

***Please share this kit with other teachers that are coming to the FWA with your group.**

Thank you for booking the "Living Links" Self-Guided program at FortWhyte Alive.

Enclosed is your Living Links Package to help you guide your group during your visit as well as for use in your classroom. The pre-visit activities are intended to provide a proper mind set, vocabulary and background information without affecting the novelty of the experience. Post-visit activities will reinforce ideas from the program and develop higher levels of thinking. Feel free to use these suggested activities or use your own materials.

We suggest printing a copy of the Student's Ecology Journal to consult as you read through the Teacher's Handbook.

There are three parts to this program:

1. **Teacher's Handbook** – (this document) used to guide your group through the building and grounds at FortWhyte Alive. Includes suggested discussions and activities. The handbook will prompt you via a symbol to either the Ecology Journal or the Discovery Kit. The Teacher's Handbook follows these field trip instructions.

2. **Student's Ecology Journal** – this booklet is used to make observations during the visit includes space to complete activities outlined in the Teacher's Handbook. Look for the Ecology Journal symbol in the Teacher's Handbook. **Please print copies of the journal for your students prior to your arrival.**

3. **Discovery Kit** – used as a teaching tool for your program. It is a tactile kit that will illustrate important ecological concepts. You will receive the Kit at FortWhyte Alive– a backpack that includes all equipment required for your ecological studies. Look for the Discovery Kit symbol in the Teacher's Handbook.

PROGRAM GOAL

To gain an understanding of the diversity of natural systems and to investigate the relationships and interdependencies between humans, other animals, plants, and the environment.

OBJECTIVES

The student should be able to:

1. define and understand **habitat**, **biodiversity**, **ecology**, **ecosystems** and **succession**,
2. describe the components of a habitat,
3. give examples of interactions between humans and components of the environment, and
4. explain the interdependency between humans and other organisms and the environment.

CURRICULUM APPLICATION

Grade 6	**Science**	Classification
	Math	Problem Solving, Estimating, Making Connections
	Language Arts	Writing, Listening and Viewing
	Art	Drawing
Grade 7	**Science**	Environmental Interdependency and Interactions among organisms Soil and Soil Management Changes in Matter and Energy
	Math	Making Connections, Estimation, Problem Solving
	Social Studies	The Ecological System
	Language Arts	Writing, Listening and Viewing
	Art	Drawing
Grade 8	**Science**	Interdependency and Interaction among Organisms
	Math	Making Connections, Estimation, Problem Solving
	Language Arts	Writing, Listening and Viewing
	Art	Drawing

VOCABULARY

abiotic	eco-service	habitat	succession
biodiversity	ecology	interdependency	
biotic	ecosystem	microhabitat	

PRE-VISIT DISCUSSION

This is only an example. You will want to adapt the discussion to suit the needs of your classroom.

1. What is a habitat?

A habitat is the region that provides the elements essential to the survival of an organism. For example, a beaver may live in a lodge, but the wetland it has created, as well as where it goes to collect trees are all part of its habitat. Some good questions: "Where would a frog live?", "Where would a cactus grow?"

A **microhabitat** is a very small piece of another habitat. For example, the underside of a log, a hole in a tree or a compost bin may all be considered micro-habitats.

2. What five essential components are present in a habitat?
Divide students into groups to discuss what these elements might be. After a few minutes of discussion have them list the elements for you. The essential elements are AIR, FOOD, WATER, SHELTER and SPACE (sunlight may also be included, since green plants need it to produce food).

3. What comes to mind when you think of ecology?
Write "ECOLOGY" in big letters on the board. Collect a few student ideas and impressions about ecology and write them on the board. Tie these ideas to the definition of ecology. For example, you may have to work with the following ideas: animals, plants, pollution, people, air, water and environment. You may mention that all of these are good ideas and have some relationship to the science of ecology. Show how these are related - people cause pollution, but it affects plants, animals and the environment (water, air, soil). All these things, living and non-living, affect each other. Ecology is the study of these connections.
Write out the formal definition. **Ecology is the study of the interaction of living and non-living components of the environment**. The word originates from the Greek *oikos*, which means "home." Ecology is therefore the study of plants and animals in their home.

4. What things (and events) affect a habitat?
Introduce the terms *biotic* and *abiotic*. We tend to focus on living things, especially animals, but they are only part of the ecosystem - they are the *biotic* component (animals, plants, fungi, protozoa, bacteria). There are *abiotic* components such as soil, minerals, water, air, temperature, wind, sunlight, rainfall and topography which also part of an ecosystem. Habitats can also affect each other. The silt flowing from rivers affects ocean productivity. Mountains change wind patterns on the prairies. People affect and are affected by components of the ecosystem.

5. What are some examples of interactions?
Ask how humans are affected by other biotic things, and abiotic things/events. For example, humans eat other living things, some bacteria may make us sick, but other also make it possible to digest food. The climate affects our way of life, but our pollution is changing the climate.

6. What is biodiversity?
Biodiversity is short for “biological diversity”. Biodiversity is the variety of living organisms, ecosystems and ecological processes of which they are parts. Biodiversity maintains the stability of living populations by making sure that they can adapt to new situations. Maintaining biodiversity provides people with resources such as food and medicine.

Ecological functions are essential services that species and ecosystems provide for other species. Our planet is kept healthy by the services performed by natural ecosystems including water purification and recycling, building soil, providing oxygen and carbon dioxide balance.
For example: - a bee collects pollen for food but it results in the pollination of plants
- when bacteria break down dead matter, they create nutrients for plants
- the eco-service of a wetland is to clean and filter water
Ask your class: What is the eco-service of humans?

PRE-VISIT ACTIVITIES

1. **Food Chains**

Review food chains and food webs. Have the students devise food webs for several different habitats. Compare food webs from different habitats, including some examples from local habitats.

2. **Soil Investigation**

Investigate soil. Spread soil out thinly in a Petri dish on white paper and look closely. Is anything moving? Now place the dish under a microscope and look again. Gradually add water. Nematode worms, springtail insects and other creatures may become visible. Add alcohol to the suspension to kill them and place them on a slide. If you have a lot of liquid, you can wait until the creatures sink to the bottom. The students may try stains, or draw their specimens. There are thousands of soil creatures that have yet to be fully described. Maybe one of the students will make a new discovery!

These creatures can be classified in several ways, but we usually categorize them by their organism type (insects, nematodes, annelids, arachnids, etc.) or by their place in the food chain (producer, first level consumer, second level consumer or decomposer). Most soil organisms are decomposers.

3. **Current Issues**

Collect information on local current environmental issues and some of the things people are doing to correct these problems. Investigate the problem of introduced species, like purple loosestrife or an introduced chemical, like Malathion for mosquito fogging. How is the ecosystem changing?

Do opinion polls on environmental issues within your class, school, home and community. What environmental concerns do people in your area have? What are people doing for the environment in your area? Students can do a recycling survey by counting blue boxes on garbage day.

4. **Habitat Evaluation**

Evaluate the biodiversity of your own schoolyard. Have the students look for the 5 essential habitat components. What is missing or scarce? Try to identify as many micro-habitats as possible. What variety of species can be found in the schoolyard? Students can mark of a 1m x 1m quadrant and count the number of different plants and insects they find. Is there one or more of the 5 habitat components missing from your schoolyard? Maybe your class can fundraise for a bird bath, bird feeder or flower garden. For more information contact an interpreter to learn more about the Backyard Biodiversity Program at FortWhyte Alive.

SUPPLIES TO BRING

Your group will receive a discovery kit when you arrive at FortWhyte for your use during the program. Other supplies that your students may want to bring are:

- ✓ clip boards
- ✓ pens/pencils
- ✓ extra paper/sketch book
- ✓ 1 Ecology Journal / student
- ✓ bug spray (a must!)
- ✓ long pants (we have poison ivy)
- ✓ field guides

DISCOVERY KIT

Upon your arrival to FortWhyte Aliveplease present yourself to the Front Desk. Our receptionist will hand you a Discovery Kit. Your kit will aid you in making the most of your visit. Your kit will contain:

- ✓ tree slices
- ✓ invertebrate keys
- ✓ a film container of licorice root for a sample taste
- ✓ magnifying glasses
- ✓ dipnets and containers
- ✓ Eco-Scruples: game cards
- ✓ Stakes and flagging tape for marking quadrant
- ✓ Map of FortWhyte Alive

INSIDE THE INTERPRETIVE CENTRE

1. Soil Diorama and Soil Profile

This exhibit shows how people have affected the prairie ecosystem. Compare the modern scene with the historical scene. Which scene has the greatest variety of living things? Biodiversity is important for an ecosystem. A large variety of life forms contributes a stable ecosystem.

Indigenous people also affected the ecosystem. Look for the rings of rocks that mark old tipi sites. The prairie was probably expanded by aboriginal people. Their use of fire to trap bison and to maintain the prairie for grazing killed trees and allowed grasses to thrive in burned areas. Notice the now-extinct prairie wolves. *What was their role? What species has replaced them?*

The farm scene represents a change in our lifestyles. Most Canadians live very well in comparison with the rest of the world. We can afford to alter our lifestyles to reduce our impact on the environment. This scene shows that we can make positive changes without great sacrifices. Many of these environmentally conscious changes also have long term benefits. *Which farm will be more successful in twenty years?*

Discuss soil formation and composition. Look for examples of animals that affect the soil (bison, elk, badgers, insects, ground squirrels and people). Can you think of any others? How does succession occur in the prairie ecosystem? What factors maintain the prairie ecosystem? (fire, rainfall, drought and grazing). Look for evidence of decomposition (bones, plant roots).

2. Aquarium

Let the students explore for a moment before you focus them. Ask students to differentiate between the two tanks. Use the interpretive panel to identify the fish in the tanks. The catfish and the carp have whiskers, and their mouths open on the bottom of their head. They are bottom feeders that eat plants, algae, small fish, and mud-dwelling invertebrates such as mollusks, worms and insects. The bass, the trout and the pike have mouths placed further towards the top of their heads. They lurk deeper in the water, hiding among vegetation, waiting for their prey to pass above them. They eat surface insects and smaller fish.

3. Touch Museum

Study the animals in the touch museum. There are a variety of arctic, parkland, boreal and wetland mammals, birds and reptiles.

OUTSIDE

Use the map to find your way around the trails. Feel free to find your own spots, but please keep to the marked trails.

Ecology Journal
Pages 4 - 5

Students can record interactions they see on their walk on page 4-5 of their journal. Focus on the ways in which humans affect natural interactions within the various habitats. What kinds of relationships can you find between organisms and between biotic and abiotic factors? How have humans affected these relationships?

FOREST SONG TRAIL

Discuss how this area has changed over the years. Compare FortWhyte Alive to other neighbourhoods nearby. Canada Cement, who formerly owned this land, has a policy of minimal impact on the environment. Did their policy work in this area?

Discuss the importance of dead trees in the forest. They could be shelter for small animals, or nesting sites and food source for birds. Look for decomposers (mushrooms, toadstools on wood chip trails, earthworms on paths and burrowing insects) on top logs, underneath logs, or on the ground nearby.

Ecology Journal
Pages 6 - 7

Lead your class into a wooded location. Be sure there are fallen trees and decaying logs present. Have the students complete pages 6-7 in the journal.

This activity illustrates the forest's biodiversity. It is also a great chance to get students to examine the forest microscopically. Have the students roll over a log and examine the microhabitat below it.

Discovery Kit

Use **magnifying glasses** to get a closer look!

Oak tree

Wood products are important in our daily lives. Oak is a highly desirable commodity. Forests are harvested daily to meet our needs and wants. Aspen trees are suitable for pulp and paper, whereas oak and pine are desired as wood for furniture and building materials.

Ecology Journal
Page 9

Have the students complete page 9 of their journal using the tree slices.

By examining the tree rings, students can see the impact that climate has on living things.

Discovery Kit

Look at how trees grow, using the **tree cookies** to illustrate. Stress the dependency of tree growth on climate (sunlight, water, temperature, wind) and topography as an example of biotic - abiotic interactions. The wide, light-coloured rings are spring/early summer growth, and the dark, narrow rings are late summer/early fall growth.

Identify the two main trees of this forest habitat (bur oak and trembling aspen). Which trees are more abundant? Briefly discuss succession in the forest. What will the forest look like in 20 years time? (Oak will replace aspen, unless disturbed.) What could disrupt succession?

Human Impact - Along the Railway Tracks

Note how plant life is recovering from human impact. Pioneer plants, such as poison ivy, dandelions and trembling aspen are called such because they are the first plants to grow in a disturbed area. These plants stabilize the soil and provide shelter for other plants. These pioneer plants will slowly disappear as the region recovers from the disturbance.

Plants require water, sun, air, space and soil to grow. They are pollinated by insects, birds, bats and wind. Why do plants produce seeds? How do plants disperse or spread their seeds? (Wind, water, animals eat or carry them on their fur.)

Discovery Kit

Have students taste **licorice root.** Discuss burs as a seed dispersal mechanism. Why do plants disperse their seeds? What interdependencies are illustrated by these processes?

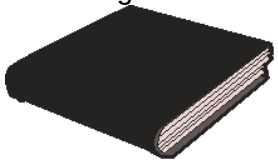
How do animals use plants? (Shelter, food, nesting material) How do people use plants? (Oxygen, food, shelter, medicine, recreation)

Meadow

Look for evidence of succession (aspens encroaching, oak seedlings). What factors might affect the process of succession? (Fire, flooding, earthquakes, habitat destruction by people, drought, grazing)

Ecology Journal

Page 10



Break the class into groups. Have each group mark off a square metre quadrant in the meadow. Within that quadrant, determine the biodiversity of plant life by picking as many different leaves as possible. Record results in the journal on page 10. Press your leaves in your journal and look up their names at school.

What else did you find in your quadrant? Flowers? Animal droppings? Ants? What role do these things play in the meadow ecosystem? Is this a different ecosystem than the forest? How are they different? How are they the same?

Bird Feeding Station

This is a fantastic spot to watch songbirds, squirrels and chipmunks. Have the class sit on the benches; once the station is quiet again, the animals will return and carry on their activities around you. Close your eyes and use your ears to figure out how many different sound you hear.

ACTIVITY: The Habitat Sound Map

We often explore a place or thing exclusively with our eyes. This exercise encourages students to use their other senses to experience a place, specifically, their sense of hearing. Discuss what **onomatopoeia** (ah-no-ma-to-pee-ah) means. Onomatopoeia takes place when a sound is translated into a written word. For example, when a rusty door hinge is opened it sounds like "creeeeeeeek". Meow, chickadee, chug-chug-chug,

pop, and aaa-choo are examples of onomatopoeias. Have the students think of other onomatopoeias that are commonly used.

Ecology Journal
Pages 11 - 12

Have the students sit down and be quiet. They should have their booklets open to page 11-12. Have them write their name at the center of the paper. Now, have them write down every sound they hear on their page like a phonetic map. Whether it is their friend sneezing 3 meters away at 2 o'clock, or a squirrel chattering far off somewhere to the left, this diversity of sounds should be onomatopoeically translated onto their relative position on the paper.

Allow the children to listen and write for two or three minutes. If they are especially focused, extend the time.

Once they have completed the activity, have the students gather round and compare the onomatopoeias they created. Do different people have similar interpretations of a particular sound? Can others guess what sound a given onomatopoeia is (arlooaboo-tchweeeeee!- could be a Red-Winged Blackbird).

WETLAND BOARDWALK TRAIL

Marsh or Swamp

Stop for an overview of the marsh or the swamp, noting physical features such as size, kinds of plants and their distribution. Point out and discuss different wetland plants. Do cattails have flowers? The large brown spike seen in late summer is the female flower; the male flower, which is located higher on the spike, develops first then falls off in mid-summer. How are cattails pollinated? How are the seeds dispersed? What might eat wetland plants? (*Muskrats, waterfowl, aquatic insects, tadpoles, moose*.) What is the difference between cattails and bulrushes? Point out both. Look at the different seeds.

The **marsh** is another good spot to show pond succession. In 100 years, assuming nothing else changes, will this marsh be deeper or more shallow? *More shallow, since dead plants will fill it*. Where will the cattails grow? Where they are now, or up or down the slope? *Since the amount of water is shrinking, the cattails will grow towards the middle*. What about the drier grasses and cottonwoods and willows? *They grow closer to the middle, too, as does the rest of the forest.*

What forms of wildlife live in a wetland? How do various species of wildlife depend upon wetland plants? (*Food, shelter, nesting sites*.)

Discuss the ways in which wetlands are important. Why do we destroy wetlands? What is being done to restore and protect wetlands? FortWhyte Alive was once prairie, then an industrial site, then a few clay pits, and now it is a system of lakes, forests and wetlands. Nature recovers from human impacts with great ease, if given a chance!

Ecology Journal
Page 13

Wetland Biodiversity

Take a few moments to think about the eco-services of a wetland. What does a wetland do for wildlife? What services does it accomplish for humans? Write your notes on page 13

ACTIVITY: Dipnetting

Discovery Kit

Hand out **dipnets and buckets** to each pair of students.

On one of the boardwalk dipnet platforms (shown on map), have students work in pairs to collect aquatic invertebrates (one container and one dipnet per pair). Give students enough time to collect insects, trying different areas; then gather the group together and note differences in the kinds of invertebrates collected. On what biotic and abiotic features of this environment are these invertebrates dependent? How are aquatic insects adapted to swimming? (Oar-like legs, streamlined bodies) How do the insects breathe? (Through gills, by carrying air bubbles, with breathing tubes, by surfacing to breathe) What do aquatic insects eat? (Other insects, plants, small fish, tadpoles, or by scavenging) How can insects survive the winter? (Migrate, overwinter in mud, dead wood, as eggs, larval stage or adult)

Call the group around to look at the contents of a bucket or two. Use the creatures in the bucket and the illustrated key to discuss the marsh food web. Which are herbivores? carnivores? secondary carnivores? Who eats whom? Now, ask the group to look at the bucket and estimate which types (plants, herbivores, omnivores, carnivores, secondary and top carnivores) are most numerous. Imagine taking all the plants and weighing them, then doing the same for the rest of the living things. Why are there more plants than anything else? There should always be more food than can be eaten, or else the animals will run out of food.

Ecology Journal
Pages 14 - 15

A key for wetland animals can be found on pages 14-15. Have the students select one critter from their bucket and complete a detailed drawing and description on page 16. Research this creature back at school and find out where it fits into the food web.

Complete pages 17-18 and note how many different species are found in the wetland.

Discuss the importance of insects and other aquatic invertebrates. They are food for many other animals such as frogs, fish, waterfowl, turtles, water snakes and other insects. How many in the group like to eat shrimp? Side swimmers are very similar to shrimp. Ducks can have a shrimp dinner every day! Stress the relationships of biotic and abiotic elements within the marsh or the swamp.

Ecology Journal
Pages 19 - 22

Quality Assessment
Using the **Water Quality Assessment** sheet on page 19-22 test the water quality of the wetland.

Collection
Invertebrates may be used as bio-monitoring tools to determine water quality for several important reasons:

1. Invertebrates are in close contact with water and are directly affected by changes in water quality
2. Invertebrates are relatively immobile and therefore cannot escape any immediate change in the environment
3. Invertebrates have long life cycles and are sensitive to changes in their environment
4. Invertebrates are relatively easy to sample and identify

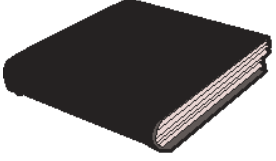
Data Analysis
The Biotic Index you are using today uses extremes in the tolerance level of invertebrates to pollution. The chart on page 20 – 21 depicts some of the major invertebrates and assigns them to one of the three groups depending on their tolerance to pollution.

Group	Water Quality Indication	Group Index Value
1	Good water quality	4
2	Moderately good water quality	3
3	Fair water quality	2
4	Poor water quality	1

1. Examine the contents of your buckets. For each of the group, count the number of different insects present in the sample. Record these numbers on the table provided in the journal.
2. Multiply the number of insects present with the corresponding group index value. Record these numbers on the table.
3. Find the cumulative index value by adding together the three individual group values. Record this number on the table
4. Compare this cumulative value with the Stream Quality Assessment Scale. What is the water quality in the aquatic ecosystem?

WATERFOWL GARDEN TRAIL
This is a great place to view lots of animals up close and personal. For more information on waterfowl, please see the Background Information section.

Ecology Journal
Page 23



Animal Address
Have each student select one animal to investigate. Students will be required to determine that animals address (habitat) and to make observations on all 5 essential components of habitat.

Use page 23 in the journal. How is your animal adapted to living in this habitat? What would happen if this habitat disappeared?

Discovery Kit ***Eco-Scruples***

Play **Eco-Scruples** anywhere there is enough room to sit down such as the meadow, the south deck, or the waterfowl garden.

This game is based on the well-known game of Scruples, but the dilemmas are all related to ecology and human impacts. It is played as follows:

The player is assigned a dilemma (usually by drawing a card). They read it aloud then declare what action they would take. The other players take turns deciding if the first player is telling the truth. The first player reveals whether they were truthful, and gets points according to how many people were fooled.
The message of the game is that these issues are not black-and-white. People one all sides of the issue have good reasons for their views.

SUMMARY

Focus on the earth as a total ecosystem. Discuss how impacts in one part of the ecosystem affect other parts of the system (contamination of ground water, acid precipitation blows across continents, dust and airborne pollutants circle the globe, CFC use in North America destroys stratospheric ozone over Antarctica...). Try to discuss ways students' own lifestyles affect ecosystems around us. Look at the ways we use water and/or energy. Discuss the impact of our cars on the globe. Bring it to a personal level, talk about ways we can help. What can YOU do to help?

POST VISIT ACTIVITIES

1. COMPOSTING

Investigate composting in the classroom. Try setting up small composters in ice cream pails or 2L pop bottles. Each group can try composting with and without air holes, with and without soil, with and without water, and/or with and without regular turning. Why did certain treatments work better than others? Composting requires air and moisture, as well as soil fauna. Sterilized soil does not contribute to the decomposition of materials in a composter. Air and moisture are required to keep soil organisms alive. Since aerobic organisms do most of the work, air is very important. Anaerobic composting is possible (though smelly!) but only those bacteria and yeasts that can live without oxygen digest the material. Biology students may be aware (or this is a good time to remind them) that anaerobic respiration is less efficient than aerobic respiration.

2. POPULATION COUNT

Some students may be interested in wildlife biology as a career. One important and difficult task that wildlife biologists face is estimating animal populations. Ask your students to imagine how hard it is to estimate the numbers of animals in a given habitat. Can you determine how many fish are in a lake without catching all the fish?

Use white dry beans as "animals" in a jar "habitat" (one "habitat" per group). This activity requires a small cup, a marker (or other way to mark the beans) and a jar with 100 to 200 beans. The object of the activity is for the students to devise a means of determining how many beans are present by taking small samples (one to ten marbles per sample, depending on jar size). Some methods that are used in population biology

today are trapping (animals taken are not released), catch-release (animals taken are released after the count), and mark-recapture (animals taken are marked and released).

Only mark-recapture gives a good estimate of the total numbers present. We will use mark-recapture in our "habitat." Take about 30 beans into the cup. Count them and mark them. Mix them in with the rest of the beans (shake the jar). Take about 30 more beans into the cup. The second sample will likely include some marked beans and very many unmarked beans. Ask the students to figure out how to calculate the total number of beans. The formula is:

$$\text{Population size} = \frac{\text{Total of first catch (all marked ones) X Total of second catch (mixed)}}{\text{Number of marked in second catch}}$$

Suppose 20 beans were marked at first. Another 30 beans were taken after mixing, and only three marked beans were found. Population size = 20x30/3 = 200 beans. Once the students have estimated the population, have them count the beans to check their results.

If you have several classes using the same beans, the students could switch white beans for black ones, rather than marking them. This way it is easier to remove the "marked" beans.

Extension: If we had a jar with 3 populations of different coloured beans (different "species"), we could try "trapping" and "catch release." In this case, we could determine the percentage of one population relative to another, then use mark-recapture to estimate the total size of one of the populations. From there, we can calculate the totals of all populations.

In addition to the problem of estimating the total population, there are other important areas of discussion. What happens if you do not shake the jar after each sample is taken? Accuracy of the estimate is dependent upon truly random sampling. Marked beans at the top which are taken repeatedly could give false results. This happens in nature. Some animals prefer certain areas, so a biologist must consider the whole habitat. Some species and individuals within a species seem to be easier to catch than others. Imagine a type of mouse that really enjoys eating the peanut butter bait in a live trap, while a type of vole is repulsed by the smell. The results will lead you to believe that there are many more mice than voles. Depending on sample bias, your population estimate may be too low or too high!

Investigate other methods used to estimate population sizes. For example, geese can be counted as they fly over or as they sit on a lake. Caribou can be observed by aircraft. Owl pellets are used to estimate owl populations.

3. HABITAT INVESTIGATION

This program emphasizes habitats found in southern Manitoba, but other habitats can be found in this province and elsewhere. Using books, magazines and films, investigate habitats found in other parts of our province, Canada and the world. Learn about muskeg, tidal flats, lagoons, oceans, tropical rain forests, tundra and other habitats. How

are they similar to local habitats? How do they differ? What flora and fauna lives in these exotic places? What are the characteristics of each?

4. HABITAT HERITAGE- ITS YOUR FUTURE

What is being done in Manitoba to protect habitat? Communicate with the provincial and federal governments and with private habitat protection agencies to discover what is being done. Some private agencies include Manitoba Habitat Heritage Corporation, Ducks Unlimited and the World Wildlife Fund. What is the North American Waterfowl Management Plan? (A joint program of government and private groups.) The World Wildlife Fund has an "Endangered Spaces" program to protect habitat. In addition, small groups such as youth corps, scouts, guides and school environmental clubs get involved at the community level in clean ups, planting initiatives, recycling drives, storm drain stenciling or other programs to restore, preserve and reclaim habitat. Is there a role for YOU in protecting our habitat heritage?

5. HABITAT HUNT AT HOME

Animals often use what people have created. What urban wildlife will you find when you explore your own backyard habitats. Using the Ecology Journals have students observe the wildlife in their own backyards before and after school for a three-day period. Record how many species are seen.

Compare the observation results with the habitat hunt done earlier on the school ground. Did the backyard or the schoolyard have the most animals? Which one offers the most opportunities for wildlife? Which habitat has the most diversity? What was the best time to see animals? Have students explain how their backyards differ from the schoolyard habitat.

6. WILDLIFE SUPERSTATION

Have students brainstorm and design a wildlife superstation for the schoolyard. Identify which species of wildlife you wish to attract, research their habitat needs and prepare a plan of the habitat.

7. MICRO-HABITAT CONSTRUCTION

Create micro-habitats on the schoolyard:

- lay down wooden planks to create a moist, shady habitat for slugs, centipedes and worms
- create stone piles for beetles
- a small woodpile will provide excellent habitat for spiders, and insects

LIVING LINKS
BACKGROUND INFORMATION

WETLANDS

After rain forests, wetland habitats have the greatest biodiversity. Marshes and swamps are very productive habitats, capable of amassing 10 tonnes of organic matter (animal and plant life) for every one acre.

Why do wetlands smell like rotten eggs sometimes? Wetland soil is waterlogged and often heavily sedimented, and therefore contains very little oxygen. Millions of different **bacteria** live in wetlands, feeding on the waste left by animals and plants, as well as each other. These single celled organisms cannot always find enough oxygen to breathe, so

instead some switch over to breathing sulfates. The waste product they "exhale" includes **sulfides**, the rotten egg smell we all know.

Wetland biodiversity is one of the richest, in part, because of the vast number of waterfowl species the habitat supports. Ducks can be divided loosely into two structural/behavioural groups:

Divers- Canvasbacks, Redheads, Scaups, Goldeneyes and Buffleheads are included in this group. Their legs are further back on the body to facilitate diving. They generally feed on plants and invertebrates deeper in the water column, further from the shore. To take off, they must run and patter across the water to gain momentum and lift.

Dabblers- Mallards, Wood Ducks, Gadwalls, Widgeons, Teals and Pintails all belong to this group. Their legs are more central on the body. To feed, they tip upside down, with their behinds poking up into the air. They forage closer to shore and among vegetation, in shallower water. Unlike the divers, they can take off simply by jumping upwards.

Note the conifers in the waterfowl gardens. Evergreens are specifically designed for dry conditions. They have small needle-like leaves with a waxy covering to protect from water loss. They breathe through their leaves via small pores (stomata), and can close them during hot dry periods to slow evaporation. Some conifers prefer to live in boggy or moist soil, like Black Spruce, Tamarack, and Balsam Fir. Why would these plants still need water conservation structures? The majority of conifers have a northern and/or alpine distribution. The long, cold winters in these climate zones lock water up in solid a phase for six or seven months a year, creating desert-like conditions for plants.

AQUARIUM OF THE PRAIRIES

The tank against the back wall depicts an **oligotrophic lake** similar to Falcon, Westhawk, or Big Whiteshell Lake. Generally oligotrophic lakes are **deep**, **clear** and **cold** with very few nutrients. The nutrients they do receive come from precipitation, run-off, streams and rivers, and are either quickly taken up by the existing plants and algae, or buried on the bottom of the lake. Even during the fall turnover, where nutrients are brought up to replenish surface layers with organic material and minerals, nutrients are scarce.

Productivity is low because there is no food for algae to consume. As a result, pelagic phytoplanktons (floating algae) are not numerous enough to actually make an impact on the levels of dissolved oxygen within the lake. Since the phytoplanktons are not there to use the oxygen, oligotrophic lakes will have a constant high level of dissolved oxygen throughout the year.

Oligotrophic lakes like Falcon Lake are greatly impacted by lakefront cottage owners. Dumping phosphates (from laundry and dish detergents) into the lake have caused many summer algal blooms which, under normal circumstances, would normally not occur. By adding nutrients, especially PO_4, algae will grow rapidly and multiply quickly therefore changing the lake ecosystem.

Common cold water, oxygen loving species of fish are:

- Walleye
- Northern Pike
- Channel Catfish
- Sauger (will tolerate warm water)
- Smallmouth Bass
- Freshwater Drum
- Fathead Minnow (food for the larger fish)

The small tank depicts a **eutrophic lake** environment, similar to the Red and Assiniboine rivers, Lake Manitoba, Lake Winnipeg, and Dauphin Lake. Eutrophic lakes are generally very **shallow**, **warm**, **murky**, and loaded with photoplankton (algae). Usually these lakes or rivers have mud, clay or sandy bottoms, unlike oligotrophic lakes which have granite bottoms. They are very productive bodies of water because they are rich in nutrients. Nutrients are *not* hoarded on the bottom of the lakes (because they are so shallow) and are therefore utilized by plants and algae, particularly blue green algae.

As little algal bodies die, they breakdown and become available as nutrients. As well, the **fall turnover** will replenish the surface layers (photic zone) with nutrients from the bottom. However, nutrients are not the limiting factor here. Since eutrophic lakes are very warm, the levels of dissolved oxygen are low. By fall, oxygen levels are nearly depleted. During the winter, anaerobic bacteria (those that live without oxygen) flourish, resulting in huge fish kills. People who are dependent upon the fishing industry, pump oxygen into the lakes or somehow reduce the number of bacteria.

Eutrophic lakes also run the risk of large **fish kills** during the summer. Shallow bodies of water warm up quickly to temperatures often intolerable to fish. The warmer the water, the less dissolved oxygen available. During many hot summers you will find dead floating fish in the lakes or washed up on shore.

Eutrophic rivers and lakes are common across agricultural land throughout southern Manitoba. These bodies of water are often fed by **surface run-off** from surrounding farmland. Carried in this excess water are pesticides, herbicides, manure, silt, and eroded soil. All of this impacts river or lake ecosystems. Too much organic material chokes out the existing fish. Only tolerant fish such as the bottom feeders (suckers, catfish) will survive.

Common warm water, low oxygen tolerant fish are:

Carp	Channel Catfish	Goldeye
Sturgeon	Sauger	Yellow Perch
Northern Pike	Rock Bass	Largemouth Bass
Walleye	White Bass	

Keep in mind that some fish will be found in both environments.
Examples are:

Channel Catfish	Walleye	Sturgeon
Yellow Perch	Northern Pike	

BIODIVERSITY

Biodiversity is the variety of life on Earth, or a given part of it. There are an estimated 10-100 million different species of life on our planet, many have yet to be discovered and named. Biodiversity has four components:

A. Genetic Diversity

Genes transmit characteristics to offspring. The mechanism of inheritance is influenced by natural selection. Individuals who are best adapted to a habitat and climate are selected more successful at reproducing.

Genetic diversity ensures the stability of a population. An unfortunate example of a population of animals that has inadequate genetic diversity is the cheetah. Because there are so few cheetahs left, the population is severely inbred. Sibling and other closely related animals mate with each other. As a result, there is very little genetic variation among cheetahs. If a disease were to attack the population, it is possible that all the animals would die because they are all equally susceptible to the illness.

B. Species Diversity

The most familiar form of biodiversity, the variety of different species on Earth. According to some sources, the number of species lost globally every year due to human activities is 27 000. Each species has taken approximately one million years to evolve.

Life on Earth is interconnected, and different species depend on each other for survival. If we continue to cause extinction at this rate, the ecological integrity of the planet will be undermined, and entire food chains and related systems will collapse. In other words, a sort of domino-effect extinction on a mass scale will occur.

C. Habitat Diversity

A habitat is the natural dwelling place of a living thing. An ecosystem is a natural unit with living and non-living parts occupying a defined area living things occupy habitats in different ways. Some animals require a lot of habitat that is unfragmented by housing developments, roads, or farmland. They become endangered or extinct when their habitat is divided into small pieces. Others require very little space to fulfill their needs.

By nature, a living thing can survive in a healthy habitat because it is adapted to do so. Organisms require their natural habitat to exist. By eliminating habitats, we eliminate species.

D. Ecological Function Diversity

Living organisms act with the purpose of supporting themselves and their offspring. Their activities often serve other species.
example 1: fungi feed off the sap of tree roots while providing the tree with precious nitrogen
example 2: bees collect pollen and nectar from plants, in turn pollinating the plants
example 3: invertebrates and bacteria break down dead plant matter, in turn creating nutrients for plants

PLANTS

Factors that influence the type of plants that grow in an area include:

a) CLIMATE (rainfall, temperature, wind, sunshine)
b) SOIL QUALITY AND TYPE
c) drainage of soil (swamp, bog, flatland)
d) topography (rolling, steep, flat, mountainous)
e) existing vegetation (which may shade out other plants)
f) altitude (height above sea level)
g) air quality (pollutants, salt from ocean spray)
h) water quality (acid rain, dissolved nutrients)
i) grazing animals

Climate and soil type are the most important factors that determine the plant growth in a region.

Plants are both producers and caretakers in our environment. They play a major role in maintaining environmental quality by producing oxygen, absorbing carbon dioxide, reducing noise, preventing soil erosion, and collecting snow which later melts into water. Plants also provide us with food, clothing, shelter, wood products and are the basis of many medicines.

Plants produce their own food by a process called photosynthesis, a series of chemical reactions that results in sugar production and food for the plant. This requires carbon dioxide, light and water. Air provides the carbon dioxide, as well as oxygen for respiration. Light from the sun provides the energy for the chemical reactions. Water is essential in photosynthesis and is also used to transport nutrients from the soil and through the plant itself. A bit of plant trivia - plants do use oxygen as well as carbon dioxide; they just produce more oxygen than they use.

ECOLOGY

Ecology can be defined as the study of the interactions between plants and animals and their physical environment. It is taken from the Greek word *oikos* meaning home, house or household.

Ecosystems

The study of ecosystems focuses on all the **biotic** (living) and **abiotic** (nonliving) components of the environment and the relationships that link them. Biotic components include plants, animals, bacteria, and fungi. Abiotic components include soil (soil moisture, minerals, texture, nutrients, etc), climate (sunlight, precipitation, temperature, wind, humidity), topography, and altitude.

Ecosystems are systems in which there is interaction and interdependency between living components and their immediate physical, chemical and biological environments. A *system* is a complex whole, a set of connected parts, an organized body of things. The heart is not a system, but the heart, veins, venioles, arteries, arterioles, capillaries and blood make up a complete circulatory system. Similarly, the ecosystem is a complete set of interconnecting things; a complex whole. It contains all that is required to operate on its own - producers, consumers, decomposers, and all the necessary environmental factors to keep these organisms alive. Like the circulatory system, an ecosystem does not live alone, but it depends on other systems. All the world's ecosystems make up the living Earth (the biosphere).

Interdependency

Interdependency is defined as the relationships that occur between organisms and the various elements within their environment, and their reliance on each other. Food chains can be used to illustrate this concept. A food chain shows the transfer of energy in the form of food from one organism to another.

An example of a meadow food chain at FortWhyte Alive is:

grass → vole → shrew → weasel

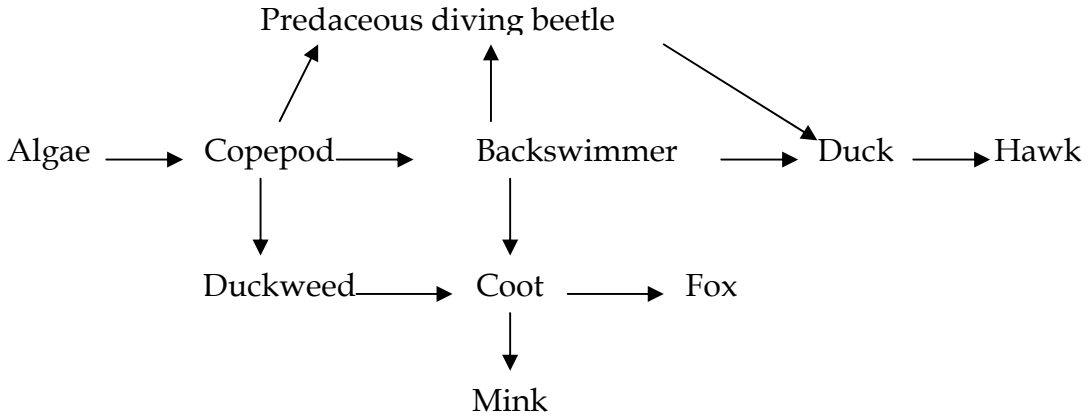
An example of a marsh food chain at FortWhyte Alive is:

algae → copepod → backswimmer → duck → hawk

Food chains all begin with plants which produce their own food. They are called producers or autotrophs. All other living organisms either feed on plants directly or consume other organisms that do. They are called consumers or heterotrophs. Decomposers are a special type of consumer - they feed on dead matter.
An autotroph is an organism (green plant) that uses solar energy to photosynthesize food (sugar and starch) from carbon dioxide and water. Auto = self; troph = nourishment. A heterotroph is an organism that cannot manufacture its own food and must consume other animals and/or plants. hetero = different.

Each stage in the food chain is fairly specific. Some teachers prefer to show "decomposers" at the end of the food chain, but they should instead name one particular decomposer such as "carrion beetle." In the above meadow example, there would be springtails, beetles, maggots, earthworms, nematodes, bacteria, fungi, centipedes, millipedes, slugs, and many other kinds of organisms involved in decomposition. Since there are so many different species of decomposers involved in the complex process of decay and soil formation, this makes the food chain look more like a food web. If you include decomposers, then add soil and make a food loop instead, or draw a food web. Decomposers play an essential role in recycling nutrients to be reused by the green plants.

Food chains are simplified versions of what really occurs in most habitats. A food web is a complex, interlocking series of food chains which more accurately reflects the interdependencies between plants and animals. You can build on the food chain and create a web, like so:

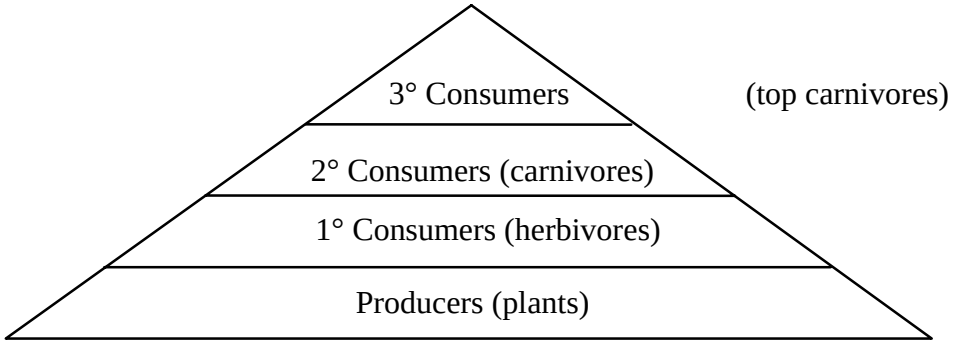


A pyramid can be used to show relative numbers, biomass (living material weight), or energy transfer within an ecosystem. At the base of the pyramid there is a very large amount of energy available in the form of plants. As this energy is transferred upwards, some is lost to heat, respiration and waste. This means there is less available energy for the next higher grouping (or trophic level) of organisms. As a result, the numbers of organisms decline as you move up the pyramid. There is not enough energy available to support a large population near the top. Imagine that the pyramid was reversed - there would be millions of owls but only two or three grass plants. There would not be enough

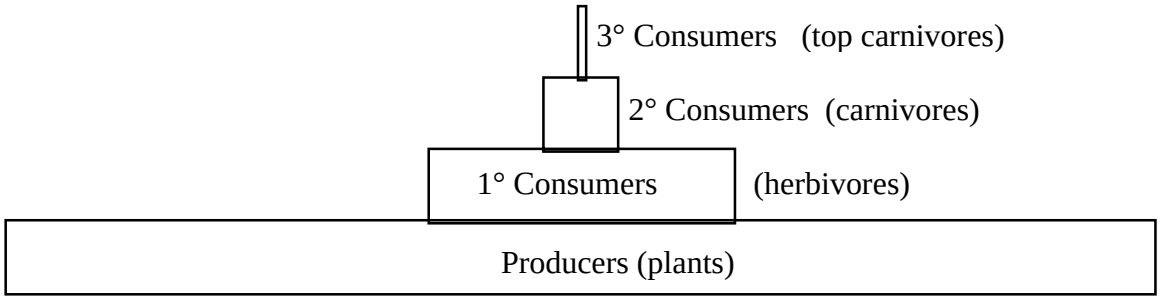
food for one mouse for one day! The base of the pyramid - the plants - must be able to support all the other living things. Each level must support the next.

There are two ways to draw a food (or energy) pyramid. One is triangular like its namesake. The other style shows things in proportion to the amount of energy within each level. This type of pyramid better illustrates how each level has much more energy than the level above it. Also note that some animals fit into more than one category. An omnivore would be both a first and a second level consumer.

A Conventional Food Pyramid Diagram



A Proportional Food Pyramid Diagram



SOIL

Soil is composed of inorganic and organic components. The inorganic component is formed by the weathering of rock through erosional processes such as rain, chemical reactions, and ice, which break the rock into smaller particles. Water combines with carbon dioxide from the air and from microorganisms to form a weak acid. The action of the acid and leaching process (the dissolving and downward movement of minerals by water) continues the breakdown of the rock. As plants and animals die, they decompose and contribute organic matter to the developing soil.

Topsoil is the upper layer of soil, composed of minerals (derived from rock) and organic material (derived from dead plants and animals). The rich organic component of topsoil helps make it ideal for plant growth by:

a) providing the necessary nutrients and
b) increasing the soil's ability to hold water and air.

Humus is the dark, rich surface layer of soil comprised of decaying plant and animal remains that are broken down by decomposers. Soil fertility is determined by pH (degree

of acidity or alkalinity), particle size, and the mineral and organic content of the soil. Most nutrients in the soil are attached to clay particles.

Some organisms enrich the soil. Legumes (peas, beans, wild licorice, clover, vetches, alfalfa) have nitrogen-fixing bacteria living on their roots. They can improve the fertility of the soil by increasing its available nitrogen. This natural method of fertilizing soil is being used by many farmers today (see the soil diorama, where the back of the left-hand field is planted with dark green lentils).
Commercial fertilizers contain phosphates, nitrogen and potassium (and sometimes sulphur) in various forms. The numbers like "16-0-0" or "10-4-6" refer to the percentages of each nutrient in a fertilizer (N-P-K-(S)). Commercial fertilizers are mostly synthetic. Potash mines provide potassium, natural gas purification provides sulphur, etc.

In nature, potassium is from the breakdown of granite and the decomposition of plants, nitrogen comes from nitrogen-fixing bacteria and from protein sources (i.e. the once-living) and phosphates are provided by rock breakdown and/or decomposed plant matter.

Soil Erosion
Soil erosion is the removal of surface soil by the actions of wind and water. Water erosion removes soil, plant nutrients and organic matter, changes the surface texture of the soil, and breaks down soil structure. In severe cases, gullies form on steeply sloping land that is most vulnerable to water erosion. Topography and precipitation are major factors in water erosion. Vegetation is very important in the prevention of erosion, since it anchors the soil and diverts the flow of water, as well as slowing the water and increasing infiltration.

Wind removes the topsoil and wears the particles down into fine powder. The degree of wind erosion depends on wind velocity, vegetative cover, soil moisture and surface roughness. Human activities that increase water and wind erosion include clearing land for farming and for timber harvest, overgrazing, poor agricultural conservation practices (see the soil diorama), and compaction (by heavy machinery).

Decomposers
Decomposers are organisms that return nutrients to the food chain by breaking down dead plant and animal matter and fecal matter. Decomposers include mites, millipedes, earthworms, bacteria, fungi, maggots, beetles, slugs, etc. Decomposers such as earthworms ingest organic matter, break it down into smaller pieces, mix it with soil, and excrete it, thus increasing the nutrient quality of the soil. In dead trees fungi, bacteria and wood-eating insects such as beetles are the first to move in. Their tunnels provide access for other insects and small animals which continue the decomposition process.

SUCCESSION
Succession is the orderly replacement of one community (a community is characterized by its dominant plant species) by another. Succession progresses through stages called serals, to a stable, final community called a climax community. Areas may not reach the climax stage due to interruptions by humans (clearing land for buildings and/or agriculture) or by natural events (fire, flood, drought, grazing). The meadow community is characterized by grasses as the dominant plants. The aspen forest features aspen as the dominant plant. The oak forest is the climax stage of woodlands in this region.

Terrestrial succession, the typical progression on land, begins with grasses, followed by shrubs, ending in a climax forest (the species depends on climate and soil). In areas of low rainfall, grassland may be the climax community, as was the tall grass prairie in parts of southern Manitoba. Each plant species modifies the environment, adding and taking away nutrients, storing water, providing shade, modifying wind patterns, etc. The speed at which succession occurs depends on the growing conditions (soil, water, sunlight, grazing, and temperature). And rules are made to be broken - some stages may be missed, or may appear in altered form.
Aquatic succession involves the transition of a wetland to a terrestrial community. Both aquatic and terrestrial succession can be seen at FortWhyte.Alive.

The meadow shows evidence of ongoing succession with the encroachment of the trembling aspen towards its centre. The dominant plant species in the meadow (grasses, shrubs, wild licorice, prairie wild rose, and snowberry) will eventually be taken over by aspen trees. Small, young aspens can be seen near the centre of the meadow, with the older aspen further back. The eventual climax community will be bur oak, which gradually replaces the aspen.

The marsh provides an example of aquatic succession. Surrounding the marsh are willows and cottonwood trees. These two plant species are invading the marsh, slowly causing it to become smaller. Cattail is the dominant plant species in the marsh that would be replaced by willow and cottonwood. Cattails collect soil, which settles out and allows other plants to move in. Each year, dead cattails fall into the marsh, which becomes shallower as vegetative matter collects and decays.