WETLAND ECOSYSTEMS II

INTERACTIONS AND ECOSYSTEMS

STUDENT JOURNAL

7 to 8

MIDDLE SCHOOL SCIENCE GRADES

Ducks Unlimited Canada

CANADA'S CONSERVATION COMPANY

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info ZONE

FOR MORE INFORMATION CONTACT

Ducks Unlimited Canada
P.O. Box 1160
Stonewall, MB R0C 2Z0
Tel: (204) 467-3000
Fax: (204) 467-9028
Toll Free: 1-800-665-DUCK
Website: www.ducks.ca
Email: webfoot@ducks.ca

Lesson one

The environmental puzzle and abiotic factors

ABIOTIC FACTORS

Factors exist in nature which are living, referred to as **biotic**, and those which are not living, called **abiotic**. Abiotic factors include elements such as temperature, moisture, available light, presence of nutrients, inert objects like rocks, and environmental pollutants. Within an ecosystem, biotic–biotic, biotic–abiotic and abiotic–abiotic interactions are constant. Changes in one of the factors often affect the other factors in the environment. For example, increased temperature dries the land more quickly resulting in increased erosion due to the effects of the wind. This factor consequently affects the ability of the land to support plants and animals.

Name the ecosystem that your group discussed and list the abiotic factors. Describe how each of the abiotic factors affect the ecosystem.

ECOSYSTEM

Abiotic factor: ____________________

Effects: ____________________

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Abiotic factor: ____________________

Effects: ____________________

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Abiotic factor: ____________________

Effects: ____________________

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Abiotic factor: ____________________

Effects: ____________________

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Lesson one continued

Abiotic adjustments

Choose one of the factors mentioned. Imagine what would happen if this factor were to change significantly. How would the change to this factor affect other factors in the environment?

Cause–effect

Each time an event occurs it is the result of a cause or causes. The results of a *cause* are called *effects*. For example, a boy is in-line skating without knee pads and falls, breaking his knee. The *cause* is in-line skating without knee pads and the *effect* is a broken knee.

Flow charts

A flow chart is one method used to demonstrate a sequence of events and *cause–effect* relationships. Though flow charts usually start at the first event in a sequence, they may flow in any direction from the event.

Example:

boy asks for in-line skates → parents buy in-line skates → boy puts on in-line skates →

does not put on knee pads → skates down steep hill → hits gravel patch → falls on right knee →

knee breaks → boy rushed to hospital → surgery to repair knee → in cast for eight weeks →

boy misses hockey tryouts → does not play hockey for one year

Develop a flow chart showing what would happen to the ecosystem as a result of a change in an abiotic factor. Begin by recording the abiotic change.

The change in an abiotic factor I have chosen is: ____________________

____

Flow chart

Lesson one continued

In the boxes below, describe or draw a picture of the ecosystem before and after the abiotic change. Add words to describe the changes that have occured.

Ecoystem before change

Ecoystem after change

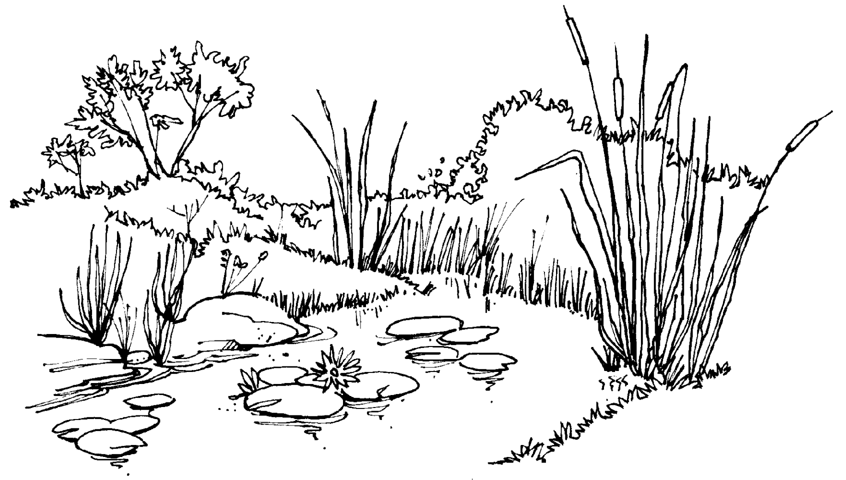
Lesson one continued

What abiotic factors are present in your home environment?

What devices would you use to measure these factors? If you do not know the name of a device, describe what it is supposed to do.

Lesson two

Habitats and wetland types



Marshes

Marshes are the most productive wetlands supporting a wide variety of plants and animals. Typical marshes are characterized by an outer ring of **emergent** vegetation encircling an area of deeper, open water (usually 2.0 metres deep or less) that supports a community of **submergent** and **floating-leaved** vegetation. Marshes receive their water by collecting and holding snow melt and rain water. Although they often have an inlet and/or an outlet channel, they do not necessarily have a defined stream or creek entering or leaving. In some marshes water enters and leaves the wetland underground through the soil.

The predominant marsh vegetation is usually a ring of tall emergent plants in the shallow water and moist soil zones. **Cattail** and **bulrush** are the two most common emergents associated with marshes though many other species may be present, depending upon local soil and water conditions. A variety of submergent vegetation species is also common to marshes. Freshwater marsh plant **communities** are more effective than others in using sunlight to convert water and nutrients into living matter. As a result, they provide **food** and **cover** for many insects, reptiles, amphibians, fish, birds and mammals. Such wetlands are as important to the earth's health as tropical rainforests but many have been lost or damaged by people.

Common **vertebrate** species associated with freshwater marshes include several **fish** species such as minnows, pike and bass. Marsh **bird** life includes many species of waterfowl in addition to blackbirds, loons, grebes, several shorebird species, northern harriers, bitterns, black-crowned night herons and marsh wrens. Frogs (**amphibians**), snakes and turtles (**reptiles**) are commonly found in the marsh and beavers, muskrats and mink represent a small percentage of the **mammals** which are also common. The **pothole** marshes of western Canada, formed by the scouring action of retreating glaciers, are very important for waterfowl. They provide critical nesting and feeding grounds for breeding ducks and geese as well as offering security and rich food resources for migrating, moulting and staging birds. Marshes are also very important to the well being of watersheds because they act as natural filters, absorbing vast amounts of pollutants. They also recharge groundwater sources for well water and reduce the effects of erosion and flooding. Marshes are important in providing people with clean drinking water.

Lesson two continued

Swamps

Swamps are wetlands dominated by trees and shrubs on characteristically saturated soils. They act as natural sponges in forested ecosystems, absorbing flood waters in spring and releasing water during the dry summer months. While non-woody emergent, submergent and floating plants may also be present, **tree** and **shrub** communities dominate. Soils are generally rich in organic matter and deposits of **peat** may be present.

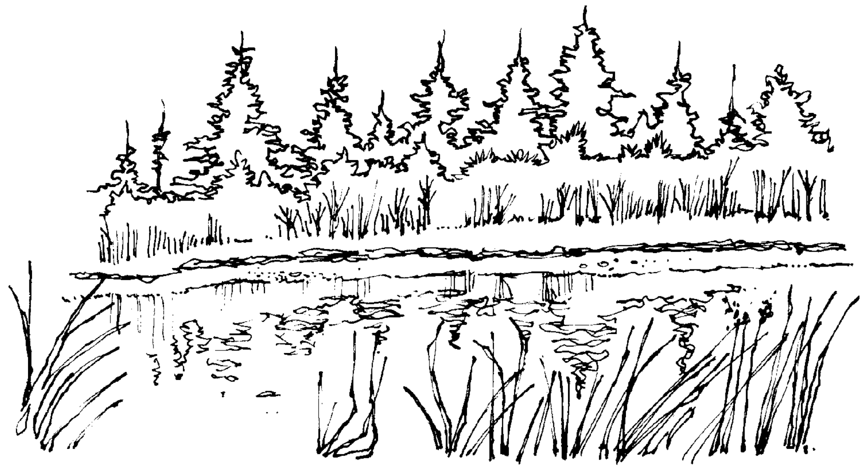
The common tree and shrub species in swamps are maples, oaks, cedars, pines, ashes, dogwoods, alders and willows. Permanent flooding would kill these species.

Swamps provide critical habitat for a number of wildlife species. White-tailed deer, in particular, rely heavily on the food and cover available in swamps. Black bears, foxes, coyotes, wolves, mink, rabbits and hares all depend on swamps for food and cover.

Avian life associated with swamps is diverse. Among the common inhabitants are ruffed grouse, woodpeckers, several species of hawks and owls, and woodcock (eastern North America). Swamps are also home to a great diversity of spring songbirds, including vireos, flycatchers, thrushes and warblers.

The wood duck, one of our most colourful waterfowl species, depends largely on the trees in swamps to find natural nest cavities in which to lay their eggs. Mergansers, buffleheads and goldeneye are other species of cavity-nesting waterfowl which also use swamps. In the fall, a number of other waterfowl, including mallards, use swamps and feed on the nuts and berries found there.

Lesson two continued



Bogs

Bogs are unique and fragile wetland environments, most commonly found in northern latitudes where they form in **glacial kettle holes** or other areas where surface drainage is impeded. The combination of cool water and soil temperatures along with low levels of oxygen and mineral nutrients results in incomplete decomposition of organic matter in bogs. The result is the creation of an acidic, fibrous, spongy soil, called **peat**. Peat has been known to fill basins to a depth of more than 12 metres.

The fact that bogs are **nutrient poor**, with their primary source of incoming nutrients through rainfall, limits the number and type of plants and animals that live there. The surface of most bogs is covered by a carpet of thick **sphagnum moss**, often floating on the near-surface water table. Sedges and lichens, able to withstand the restrictive growing conditions of the bog mat, are common. **Carnivorous plants**, including the pitcher plant and sundew, are relatively common due mostly to their ability to obtain required nutrients from trapped insects. Trees, where present near bogs, are dominately black spruce and tamarack. Labrador tea and bog rosemary are among the most common shrubs.

Relatively few animals frequent bog habitats because of the scarcity of food plants. Shrews, voles and lemmings may be common and attract weasels and foxes. Avian communities are made up mostly of black and ring-necked ducks in addition to great grey and boreal owls and a few sparrow and warbler species. Peat bogs are important to some local communities where the peat is harvested for fuel and gardening products.

Fens

Fens, like bogs, are fragile ecosystems which are more common in northern regions. Fens usually have greater inflow of water and are less acidic than bogs. As a result they are more nutrient rich and can support more species. Unlike bogs, sphagnum moss is not as common and a grass-like plant called **sedge** dominates the cover. Rare flowers including orchids can be found in fens, and grasses and low shrubs are also common. Trees are not as prevalent but may include cedar and tamarack. Fens are often regarded as a **transitional stage** from a marsh to a bog.

Lesson two continued

Complete the table below for each of the four wetland ecosystems.

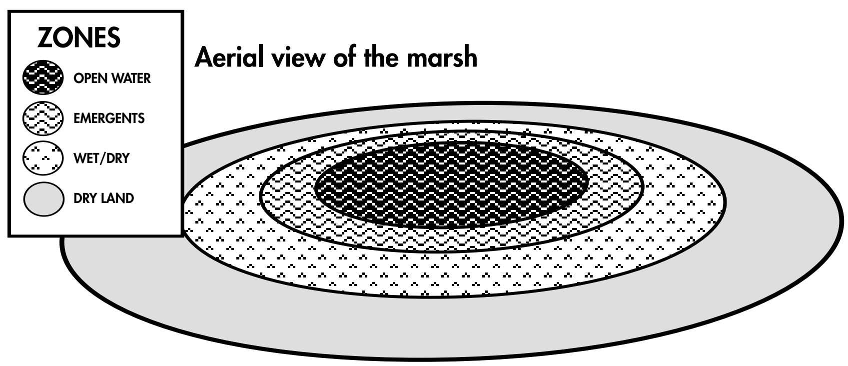
	MARSH	SWAMP	BOG	FEN
Describe the abiotic features of the ecosystem.				
What plant life is most common in the ecosystem?				
What animal life lives beneath the surface of the wetland?				
What animal life lives on the surface of the wetland?				
What animals live around the wetland?				
What happens to life in the ecosystem during the winter?				

Lesson two continued

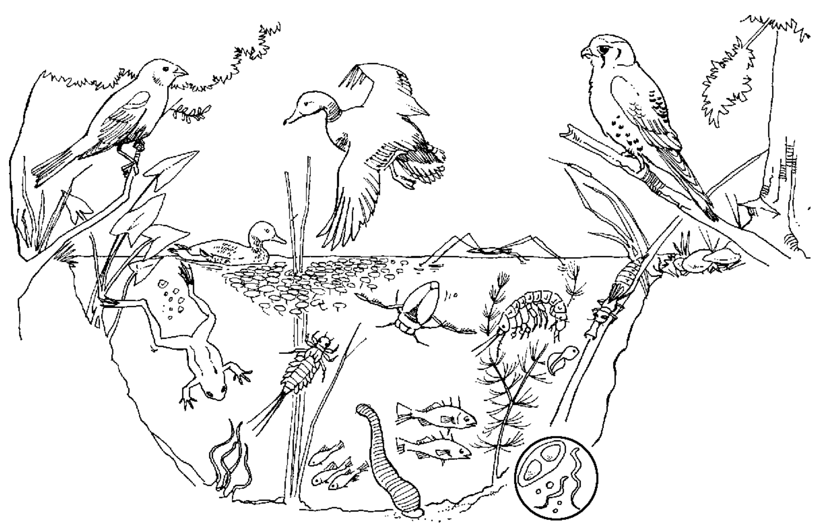
Habitat
A habitat is a **place** where an organism lives. Many different plants and animals, with diverse adaptations for survival, live in or around the wetland and depend on it for **food**, **shelter** and **water**.

Microhabitat
A microhabitat is a more **specific place** where an organism lives. The wetland habitat has different zones (microhabitats) with many organisms found only within one zone and absent from other zones (e.g. an organism such as a bullrush will be found only at the edge of the wetland where water floods the base of the plant, whereas other plants such as duckweed float freely on the surface).

Niche
A niche is the **position** or **status** of an organism within its community resulting from the organism's structural and behavioural adaptations. For example, a duck is mainly a primary and secondary consumer in the wetland due to its large size, ability to swim and its ability to digest both plant and animal foods (**omnivore**). The duck and its eggs may also be eaten by hawks, owls, skunks and coyotes which are mainly tertiary consumers (**carnivores**).



Cross-sectional view of the marsh



Lesson two continued

Answer the following questions about the marsh.

1. Several microhabitats exist within the habitat provided by the marsh. Use words such as *under*, *on*, *beneath*, *over*, *in* and *beside* to describe at least five specific microhabitats that you are able to identify at the marsh site.

Microhabitat 1

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Microhabitat 2

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Microhabitat 3

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Microhabitat 4

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Microhabitat 5

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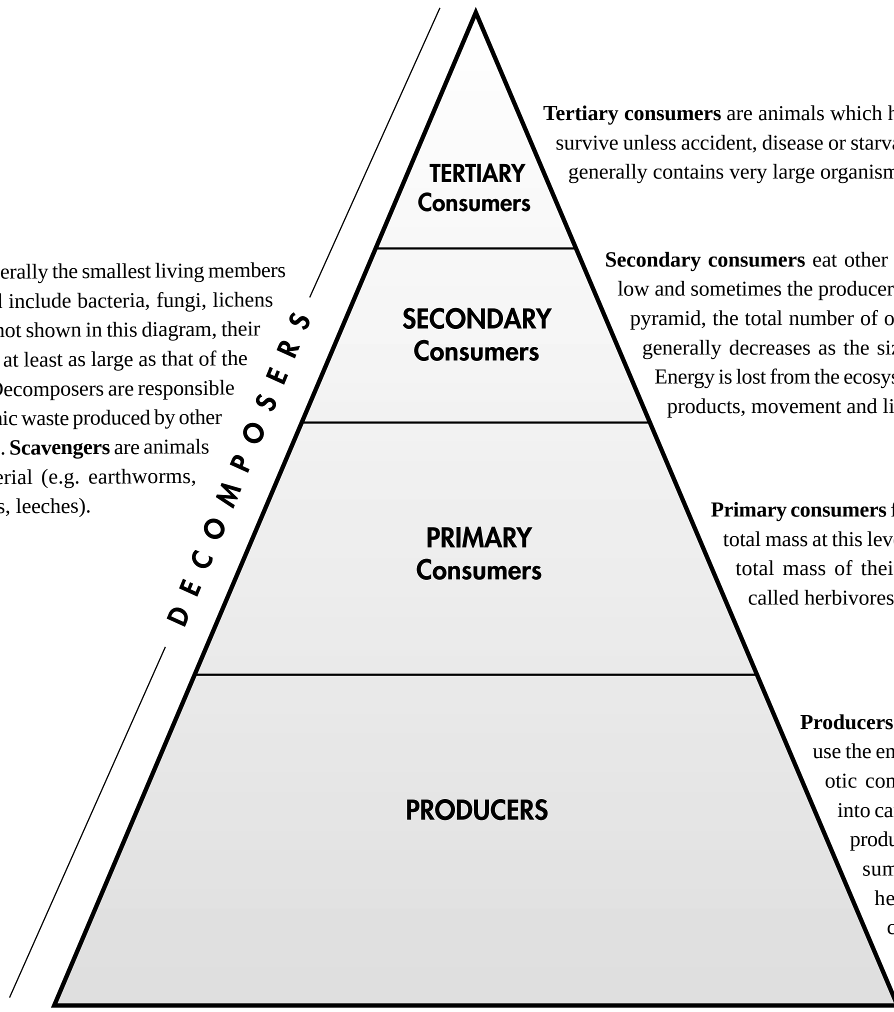
____

2. Select and research an organism that lives in or around a marsh, swamp, bog and fen. Describe its niche in that ecosystem.

MARSH	SWAMP	BOG	FEN
Organism: ___________	**Organism:** ___________	**Organism:** ___________	**Organism:** ___________

Lesson three

Energy pyramid



Tertiary consumers are animals which have few enemies and usually survive unless accident, disease or starvation take their toll. This level generally contains very large organisms.

Secondary consumers eat other organisms from the level below and sometimes the producer level. Toward the peak of the pyramid, the total number of organisms and their total mass generally decreases as the size of the organism increases. Energy is lost from the ecosystem at all levels through waste products, movement and life maintenance.

Primary consumers feed exclusively on plants. The total mass at this level is generally far less than the total mass of their food. These organisms are called herbivores.

Producers (primarily plants) absorb and use the energy of the sun to convert abiotic components of the environment into carbohydrates. The total mass of producers is greater than all the consumers above it combined in a healthy ecosystem. Producers can be very small (algae) or very large (trees).

Decomposers are generally the smallest living members of any ecosystem and include bacteria, fungi, lichens and moulds. Though not shown in this diagram, their total biomass is often at least as large as that of the primary consumers. Decomposers are responsible for recycling the organic waste produced by other organisms at all levels. **Scavengers** are animals which eat dead material (e.g. earthworms, snails, turkey vultures, leeches).

Energy from the sun enters the ecosystem where some of it is absorbed by the abiotic environment, some is reflected and the rest is absorbed by producers.

Lesson three continued

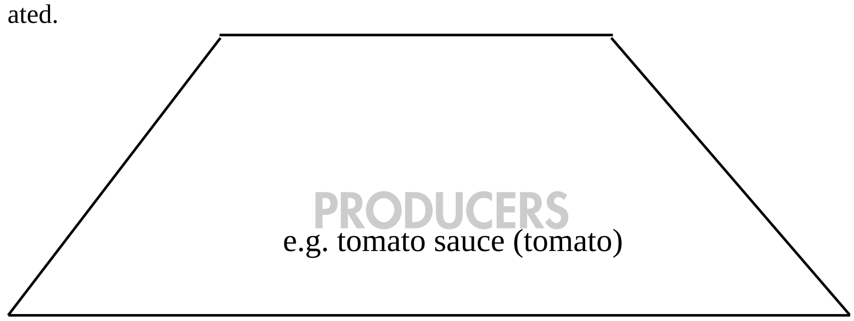
The energy pyramid shows the direction that energy flows through an ecosystem. Energy in the form of light enters the ecosystem by way of producers (plants) through a process called **photosynthesis**. In this process, the light acts as the fuel to combine nutrients, carbon, hydrogen and oxygen into complex chains (called molecules) of carbohydrate.

Organisms require energy from food for growth, movement and reproduction. Mechanisms within the organism are responsible for breaking down and recombining the molecules into new molecules that serve specific purposes for the organism (e.g. tissues and organs). At each stage, the action of breaking down and rebuilding these chains requires energy which is lost to the organism as heat. This oxidation process is called **respiration**.

At each breakdown, by-products (e.g. CO_2) which are often toxic to the organism must be eliminated. As one organism eats another, some of its energy and much of its mass is lost. This process continues with plants capturing the sun's energy, being eaten by a smaller number (and mass) of primary consumers which are eaten by a fewer and lesser mass of secondary consumers. These, in turn, are eaten by a smaller mass and number of third level (tertiary) consumers. Generally food chains within any ecosystem are limited to a maximum of four or five steps as the dissipation of energy between levels is so great that there is not enough energy available to support further levels. Throughout each of the levels in the pyramid, decomposers use waste products and dead organisms as their source of food and energy. These recycled products are then available for primary producers to reuse.

The base of the pyramid for human foods

Wait for instructions from your teacher before you do this exercise. In the base of the pyramid below, write the names of all the human food items which have been correctly placed in the Belongs column of the *Belongs … Does Not Belong* chart you developed with your group. Write the rule that fits the foods in the *Belongs* column. Several of the items placed in the producer column are called processed foods (tomato sauce is processed; a fresh tomato is not). In parentheses ( ) place the name of the organism from which the processed foods are created.



Belongs column rule: ____

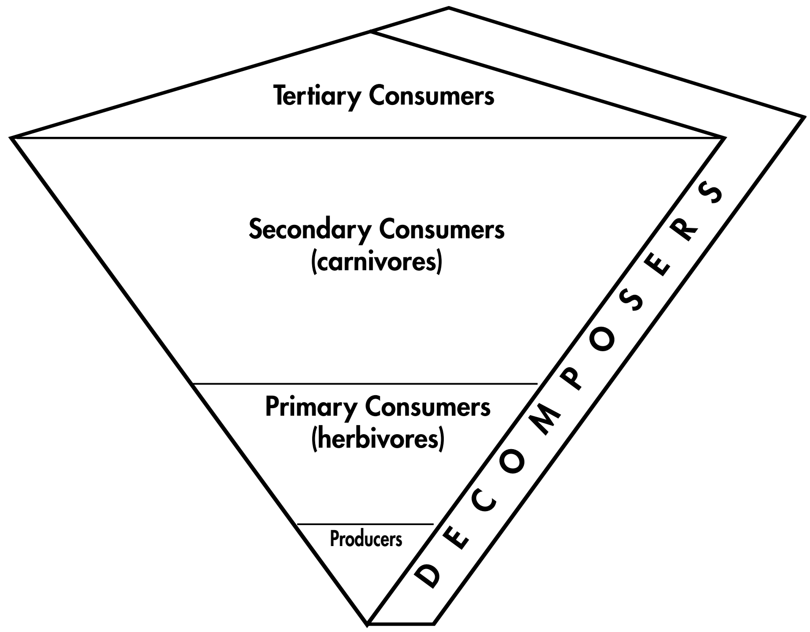
____

Lesson three continued

Energy flow

A group of scientists studying energy flow through an ecosystem had formed a World Wide Web page to share their results and ideas. The scientists often posed problems about their findings which stumped them. Below are two of the problems.

ENERGY LEVEL	KG/m^3
Producers	0.1
Primary consumers (herbivores)	2.5
Secondary consumers (carnivores)	6.9
Tertiary consumers (top carnivores)	0.6
Decomposers	2.0



Problem 1

"Recently, while looking at collections of data by graduate students for some mountain marshes, I found one particularly puzzling set of data. I have included the findings and a drawing of the resulting pyramid above and would appreciate your help in explaining it."

Bjorn Vasservold, Stockholm Sweden

Measurement data is based on a total of 100 cubic metres of water.

As you can see, the data collected and the drawing of the pyramid do not agree with scientific principles for energy flow in an ecosystem. Explain the findings reported.

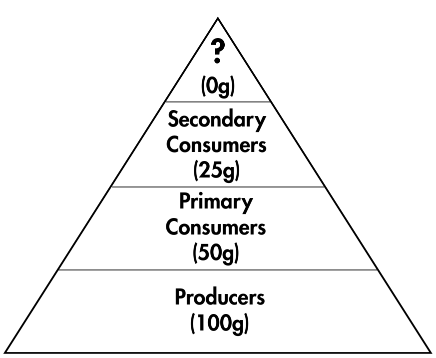
Lesson three continued

What should the pyramid look like in a healthy ecosystem that is sampled correctly?

What needs to be done to confirm or refute (prove wrong) the data shown.

Problem 2

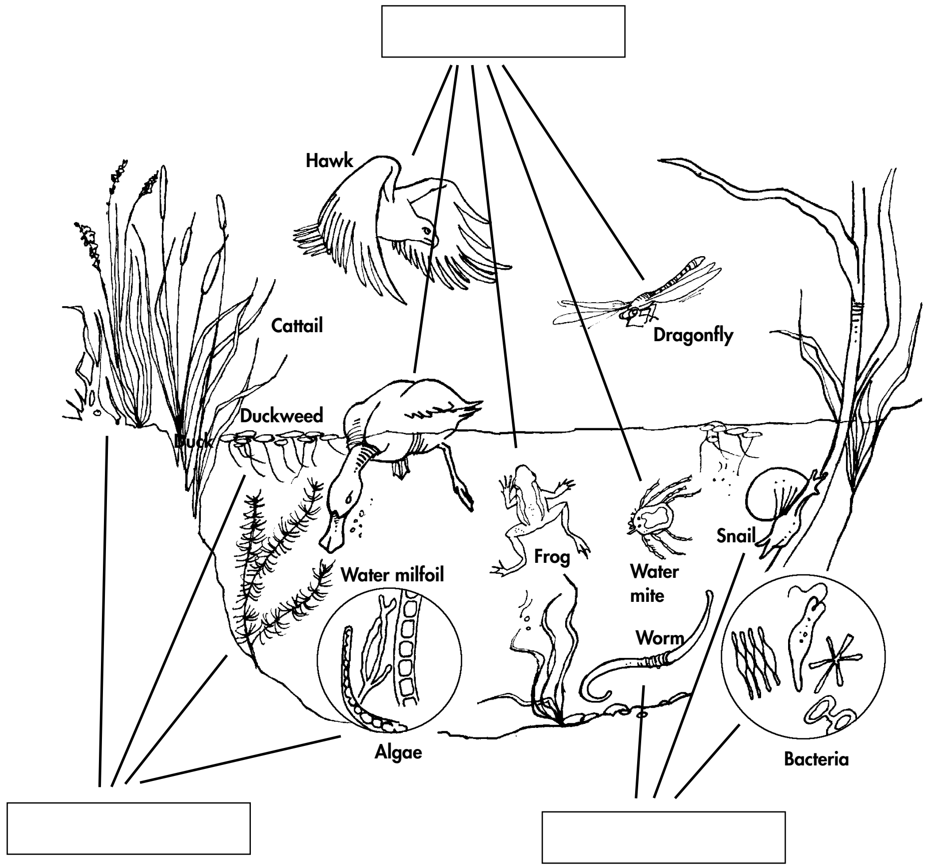
In sampling a different marsh, all levels of producers and consumers were found in the expected ratios. However, there were no tertiary consumers found. Explain why this might occur.



Lesson three continued

Marsh organisms

Label each category of organisms as producers, consumers or decomposers/scavengers. See the profiles describing each of these organisms on the following pages.



Living things require energy, whether it comes from self made sources as in plants (producers) or from other sources as is the case with the animal kingdom (consumers – herbivores, omnivores, carnivores or top carnivores). List two more examples of wetland organisms for each of the following:

Producer cattail
____
____

Herbivore beaver
____
____

Carnivore wood frog
____
____

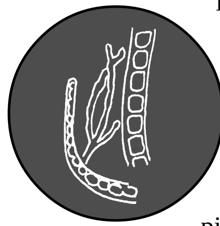
Top carnivore red-tailed hawk
____
____

Omnivore raccoon
____
____

Lesson three continued

Marsh organism profiles

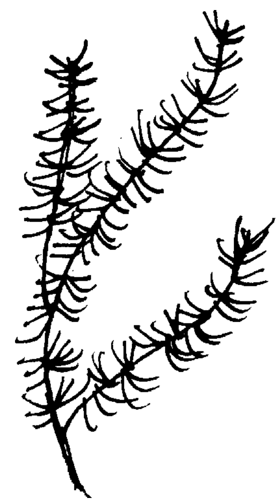
ALGAE

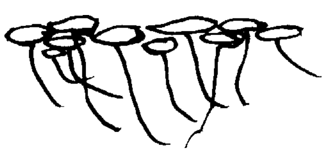


Algae is the simplest form of life in the marsh yet it is the most important producer, carrying on up to 90 per cent of the photosynthesis there. They range in size from microscopic, solitary cells to colonies and clusters of filaments four centimetres in diameter. Algae lack roots, leaves and stems. Some float free while others are attached to rocks, soil or even animals. All have **chlorophyll** although they may appear red, yellow or brown because of the presence of other pigments. Some reproduce **asexually**, where parent cells split to form two new cells, while others reproduce **sexually**, two cells fusing to form a **zygote**. Algae is the first link in many of the marsh's numerous food chains.

WATER MILFOIL

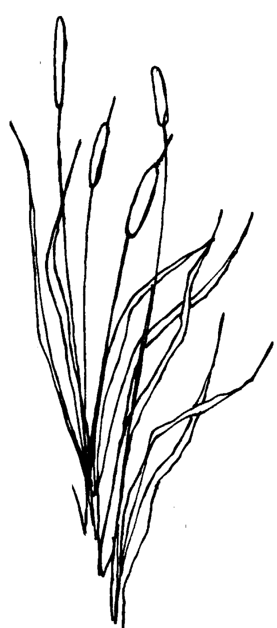
Water milfoil is a common submerged plant, rooted in the bottom of the wetland, that can grow to more than a metre in height. It grows almost to the water's surface, pushing its purple flowers above the surface on a spike. It has very fine, fern-like leaves that are finely dissected. Water milfoil is an important food plant for many insects and is an indicator of continuous flooding in marshes.





DUCKWEED

Duckweed is one of the most common floating plants on wetlands, often so abundant that they cover the surface like a green carpet. Although capable of reproducing sexually, duckweed normally multiply by **budding**, whereby a new plant pinches off from an existing one. Each plant consists of a leaf-like top from which roots hang, though they do not reach the marsh's bottom. Duckweed is an important food source for waterfowl and also provides important cover for many marsh invertebrates.



CATTAIL

Perhaps no wetland plant is as easily recognized as the cattail with its brown cigar-shaped **pistillate** flowers and long, thin sword-shaped leaves. It can grow to more than 2.5 metres in height and is the dominant emergent plant in many wetlands. Cattail can reproduce sexually but most often it spreads **vegetatively** through the propagation of **shoots** arising from **rhizomes**. Cattails are an important food source for many insects, birds and mammals with the leaves, flowers and **tubers** all being consumed. The leaves and stems are also important for muskrats which use them to construct dens, and to marsh birds, including blackbirds and marsh wrens, which use them for nest building.

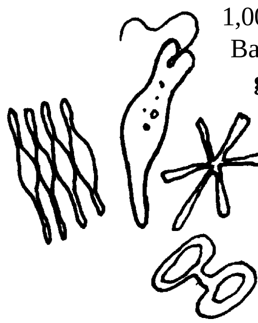
Lesson three continued

WATER MITE

Water mites are tiny arachnids meaning they have a fused abdomen and **cephalothorax** giving them an oval shape. They have eight legs and are closely related to spiders. Water mites are often a distinctive bright red colour and move quickly through the water. Mites are carnivorous, feeding on small worms, crustaceans and insects. They have a narrow beak adapted for piercing and sucking. They pump **enzymes** into their prey and the liquified food is then sucked up, much like spiders do. Though they have **spiracles**, most respiration is probably through the body wall as they seldom come to the surface for air.

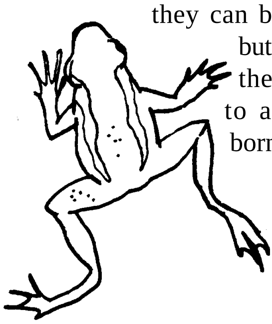
BACTERIA

Bacteria, though often thought of as plants, belong to a kingdom of their own, neither plant nor animal. They are single-celled and among the smallest of living organisms. It has been said that it would take 1,000,000,000,000 average-sized bacteria to weigh one gram. Bacteria move either by current or through the use of **flagella**, tiny projections from their bodies, which they vigorously lash in the water. Bacteria play an important role in the marsh by breaking down dead plant and animal life into simple nutrients which are then available to be metabolized by plants.

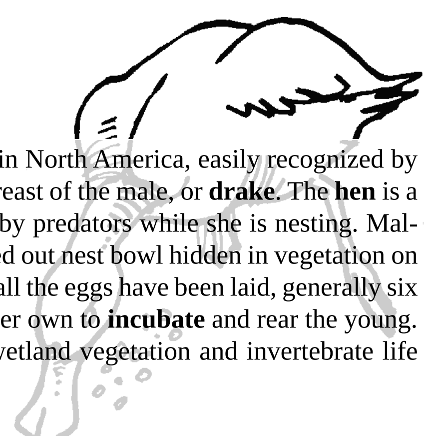


FROGS

Frogs are the most common amphibian, seen in and around most wetland habitats. They are easily recognizable with their squat bodies and large hind legs developed for jumping. Frogs feed on insects, worms and crustaceans, often catching their prey with their long, sticky tongues. Frogs lay their eggs in the water. They hatch to became **tadpoles** which are completely aquatic, breathing with **gills** and having no legs. As tadpoles mature they develop legs and lungs, making them equally at home on land or in the water. Frogs have **permeable** skin which they can breath through, but this also makes them susceptible to air and water-borne pollutants.



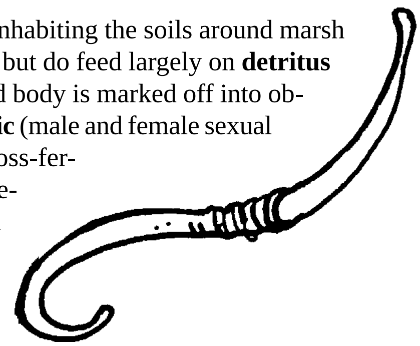
MALLARD DUCK



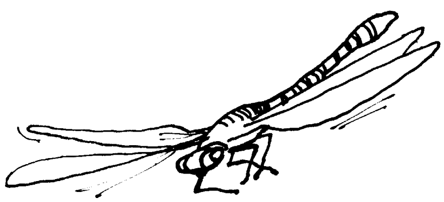
The mallard is the most common duck in North America, easily recognized by the green head and chestnut-coloured breast of the male, or **drake**. The **hen** is a dull brown to help her avoid detection by predators while she is nesting. Mallards generally lay their eggs in a scraped out nest bowl hidden in vegetation on the shore around or near a marsh. Once all the eggs have been laid, generally six to twelve, the drake leaves the hen on her own to **incubate** and rear the young. Mallards feed on a great diversity of wetland vegetation and invertebrate life and are also fond of agricultural grains.

Lesson three continued

WORMS



Earthworms are common invertebrates inhabiting the soils around marsh margins. They are not true decomposers but do feed largely on **detritus** or dead organic remains. Their elongated body is marked off into obvious segments. They are **hermaphroditic** (male and female sexual organs in the same organism) though cross-fertilization is the most common form of reproduction. Earthworms are preyed upon by a wide range of marsh animals including frogs, toads, snakes, fish, birds and small mammals. There are also worms closely related to the common earthworm that are completely aquatic.



DRAGONFLY

Dragonflies are voracious predators of the marsh, the adults easily distinguishable by their relatively large head, narrow body up to ten centimetres long, and two pairs of stout, horizontally-held wings. They feed on a wide variety of smaller insects which they catch on the wing. They are expert flyers, able to hover and dart quickly in a hawk-like manner. They lay their eggs in the water where they hatch into aggressive **nymphs** which feed on other insects, tadpoles and small fish. The nymphs eventually crawl up on shore to transform into adults. A close relative of the dragonfly is the more delicate **damselfly**. Damselflies rest their wings in the vertical position.

SNAILS

Snails are **molluscs** and have a protective shell that harbours their soft bodies. They move by way of a large muscular foot which also houses portions of the digestive tract. Snails, like worms, may not be true decomposers but they do feed largely on dead plant and animal matter. Snails are an important food source for many wetland creatures and are especially important protein-rich prey for breeding waterfowl during the egg laying season.

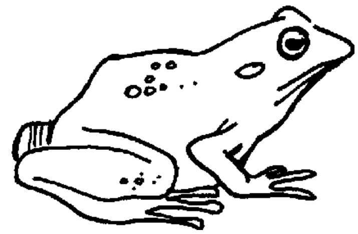
FUNGI

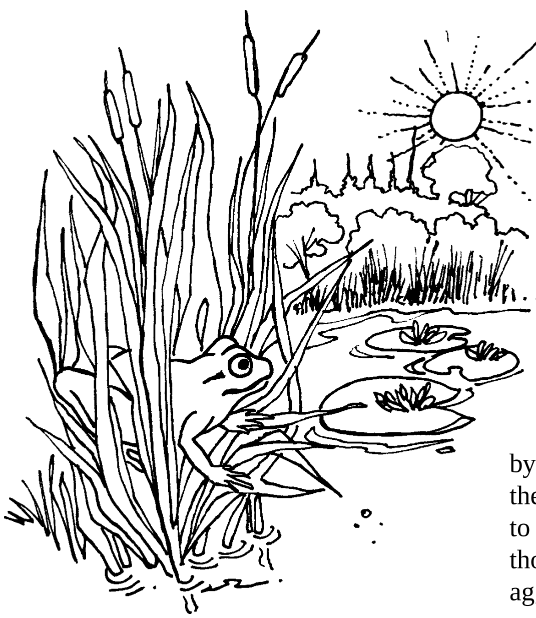
Like bacteria, fungi play an important role in breaking down dead plant and animal matter into basic nutrients able to be reused by wetland plants. Fungi are made up of a large group of **flowerless plants**, often appearing as fluffy white patches, that can be found growing on dead or living plants and animals in the marsh. They lack **chlorophyll**, getting their energy from dead or living plants and animals. Fungi reproduce by **spores** or by the fusion of sex cells. Mushrooms are a type of upland fungi.

Lesson three continued

Relationships in the marsh environment

A day in the life of the frog



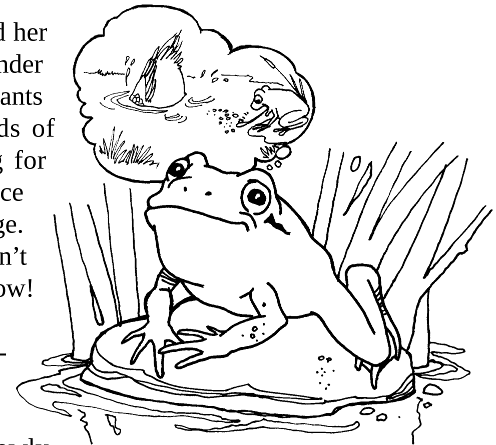


Dawn broke over the earth's dark mantle, illuminating the marsh world on an early summer's morning. The **nocturnal** creatures had retired to their day-time lairs while the **diurnal** animals awoke from their restless slumber. The frog pushed himself to shore and nestled into a natural cavity at the base of a thick stand of cattails, facing the wetland, in the hopes of finding a morning meal. The air came to life with the sounds of the marsh as the sun rose higher in the sky, heating the water's surface.

He didn't have to wait long for his first meal of the day. A large dragonfly **nymph** emerged from the water and crawled up on a cattail stalk to dry out in preparation for his transformation into a gossamer-winged adult. From his concealed position, and aided by the natural **camouflage** of his mottled skin, the frog only had to flick out his sticky tongue to snare the juicy morsel. With a quick swallow it was gone. Sweet revenge, he thought, remembering how as a small tadpole he'd had to be careful to avoid aggressive dragonfly nymphs as they waited in sub-surface ambush.

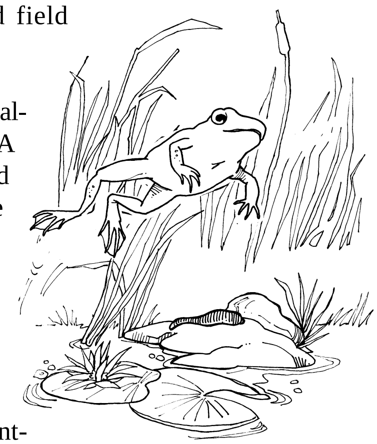
His sense of well being disappeared as quickly as it had formed, however, as a brown blur emerged with a bound from the cattails along the shore on the far side of the marsh. Recognizing the speedy silhouette immediately as a mink, the frog froze. He knew that if he gave away his position with any movement he would as quickly become that mink's breakfast. But the mink had other prey in mind and by the thrashing in the cattails the frog knew that the hen mallard who'd only just started incubating her **clutch** of eight eggs was no more. He watched as the mink dragged her now still body, skull crushed, to a secluded spot away from the marsh where it could feed in peace. The abandoned eggs would soon be found and eaten by crows or skunks.

Lesson three continued

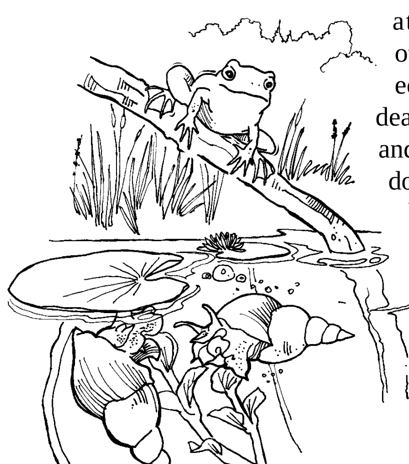


The hen was no threat to him and her daily ritual of dunking her head under the water to feed on submerged plants had always resulted in hundreds of aquatic invertebrates swimming for cover as they abandoned their once secure homes in the thick foliage. Hundreds of meals that wouldn't come to him quite so easily now!

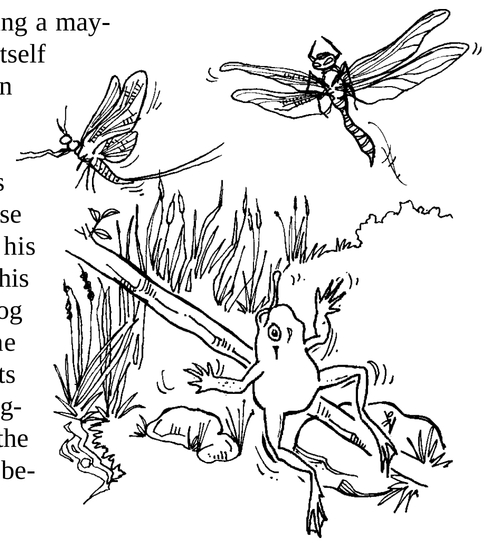
A rustle in the cattails behind him jolted his mind to full alert. A garter snake was slowly winding her way through the vegetation, tongue flicking, as she searched the air for the smell of easy prey. The frog hesitated, unsure whether to dive for the open water in an attempt to escape or to sit tight in hopes he would not be noticed. As he pondered his options, a shadow broke across the open water of the marsh. A northern harrier! The snake, aware of the low flying **raptor**, turned and slithered away using the canopy of the emergent vegetation for escape cover. He remained motionless and the hawk glided low over the wetland and across the adjacent meadow searching now for voles and field mice.



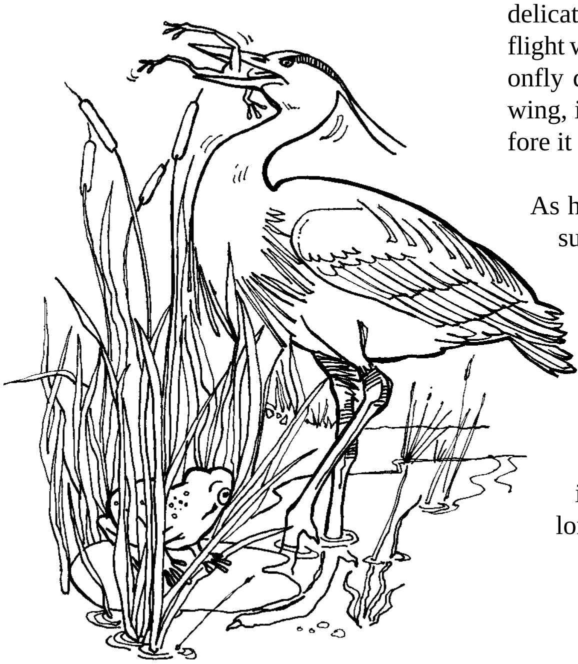
The frog now hopped along the shallow water shoreline of the marsh. A leech wriggled by and was grabbed and swallowed in one motion by the frog. He carried on, stopping in a shallow puddle where several snails were busy living out their slow motion day. He grabbed one, then leapt on. The remaining snail would live for at least another day contentedly feeding on algae and dead plant and animal matter. When digested, used and finally **excreted**, this material would be broken down once again to its **inorganic** form where it could be reused by plants within the marsh.



Lesson three continued



The frog paused, patiently watching a mayfly that had recently transformed itself from a **nymph** to an adult. It sat on a stone on the wetland edge testing its wings for its maiden flight. Just as the frog flicked out his tongue to engulf it, the mayfly arose from the ground. Having lifted his front feet clear from the ground in his effort to catch the mayfly, the frog landed awkwardly, watching the delicate insect rise skyward. But its flight was short-lived as a large dragonfly darted in and caught it on the wing, its life as an adult cut short before it could reproduce.



As he watched, a great blue heron landed in the shallow water, surprisingly lightly for such a large bird. It waded slowly, causing barely a ripple on the water's surface as it searched for easy prey. Suddenly its spear-like bill stabbed into the water. The frog recognized the long legs and webbed feet of another frog in the split second before it disappeared down the long neck of the bird.

He hopped back under the cover of a stand of cattail growing robustly in the nutrient-rich waters. Life and death in the marsh. It was still morning. It looked like it was going to be another long day.

Lesson three continued

The frog and other animals mentioned in the story face difficult situations throughout each moment of life.

1. List at least six life and death situations described in the story.

   a. ______________________________
   ____

   b. ______________________________
   ____

   c. ______________________________
   ____

   d. ______________________________
   ____

   e. ______________________________
   ____

   f. ______________________________
   ____

2. For the situations listed above, explain how each of the organisms is adapted to survive.

ADAPTATIONS WHICH PROMOTE SURVIVAL

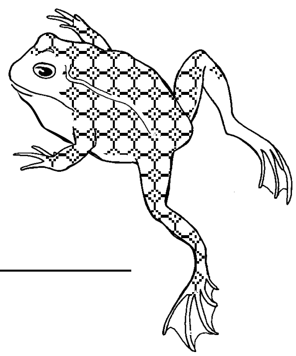
	PREDATOR	ADAPTATION	PREY	ADAPTATION
a.				
b.				
c.				
d.				
e.				
f.				

Lesson four

Adaptations for food gathering

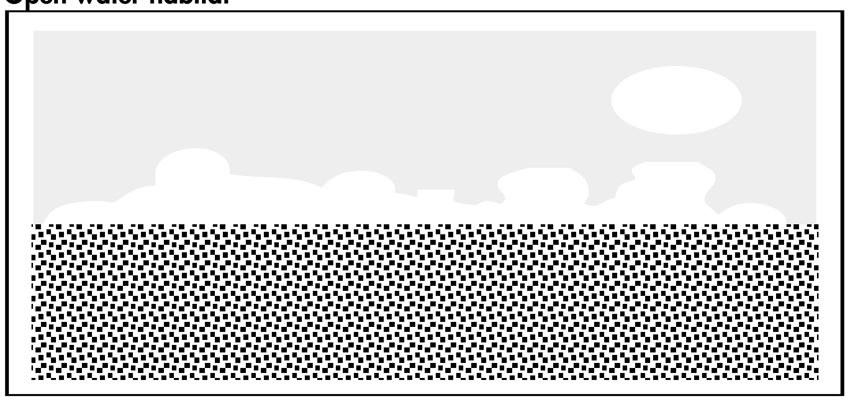
Activity One:

Two closely related marsh organisms are struggling for existence. Each has special features that enable it to get food and avoid specific predators. Invent a name for each organism and write each name below the habitat where you believe it belongs. Explain your decision in the space provided.



Name: ____________

Open water habitat



Name: ____

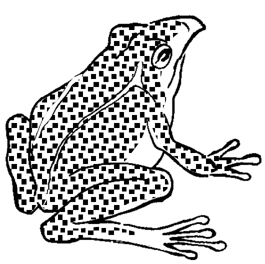
Explanation: ____

____

____

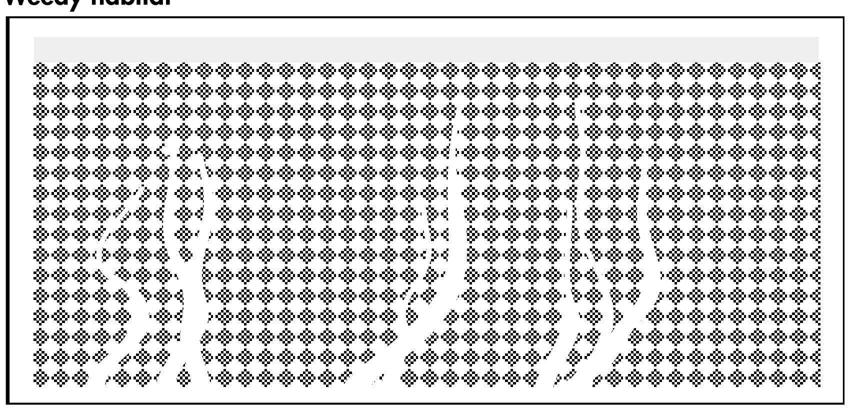
____

____



Name: ____________

Weedy habitat



Name: ____

Explanation: ____

____

____

____

____

____

Lesson four continued

Large predatory fish, like northern pike, live in the weedy part of the marsh. Descirbe an adaptation for the organism you placed in the weedy area that will help to keep it from being eaten by pike. Explain the feature and how it provides protection.

____
____
____
____
____

The clear weedless water makes animals living there a target for predatory birds. Describe an adaptation for the organism you placed in the open water area that will help to keep it from being eaten. Explain the feature and how it provides protection.

____
____
____
____
____

Rules for gathering foods

1. Your team's job is to transfer each food to a paper bowl using your assigned utensil and time how long this takes for each food.
2. You may use only the tools given to you to collect the foods distributed around the room.
3. The tool may be held in your hands only.
4. You may not use any other material or body part to collect the food.
5. Levered tools may not be used as scoops.
6. Calculate the average time taken by your team to gather each food.
7. Post your team's average time to gather each food (three items or scoops of each food type per person) on chart paper and draw conclusions.

Activity Two:

To complete this activity, read the rules on this page and wait for instructions from your teacher. Record the food that each of the tools is best able to collect based on average times for each team. Explain why the tool works.

Drinking straw ______________________________________
____

Small strainer ______________________________________
____

Needlenose pliers ___________________________________
____

Chopsticks ____
____

Plastic fork ____
____

Nut cracker ____
____

Long bamboo skewer _________________________________
____

Long-handled wooden spoon ___________________________
____

Lesson four continued

Once your teacher has provided instructions, give three examples of efficient/inefficient animal adaptations (e.g. a hawk's beak is a good tool for tearing flesh but not good for catching bugs).

Example 1 ____

____

____

____

Example 2 ____

____

____

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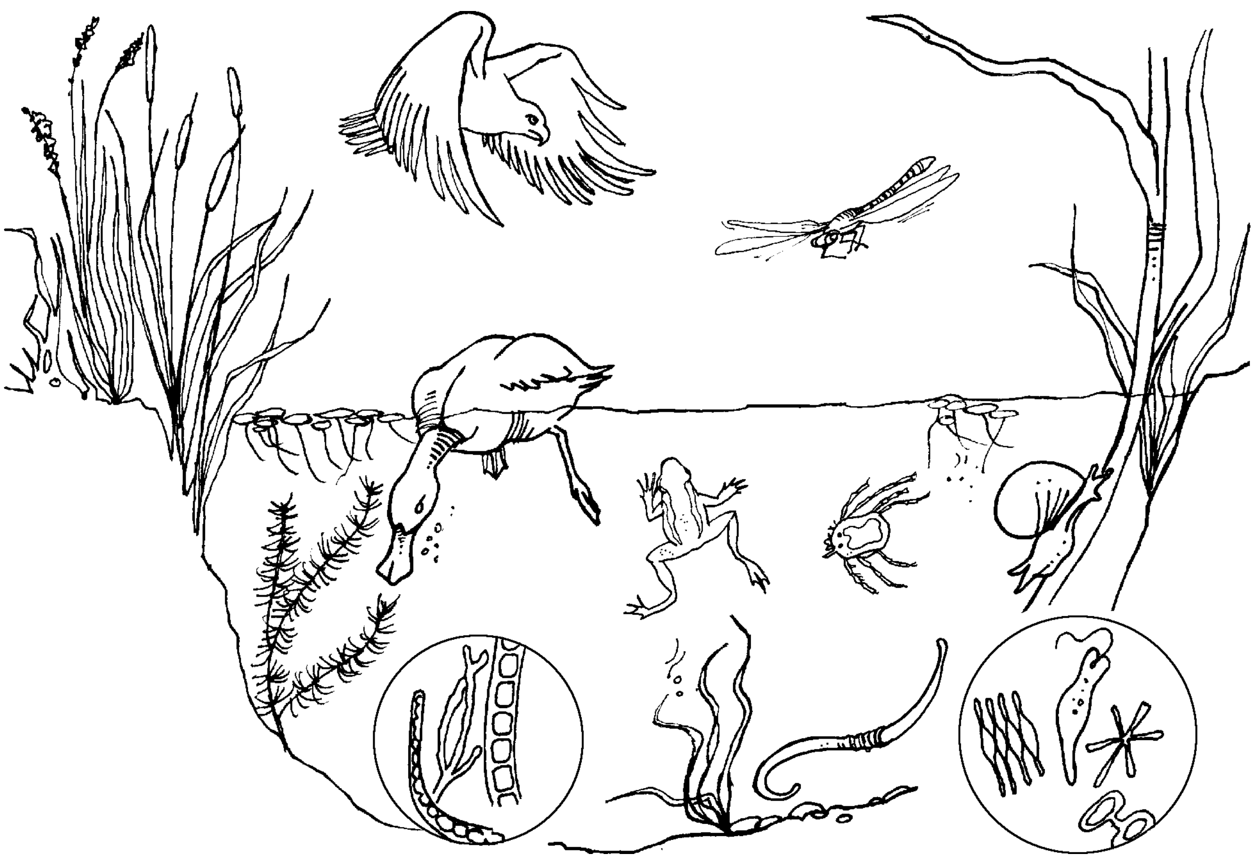
Example 3 ____

____

____

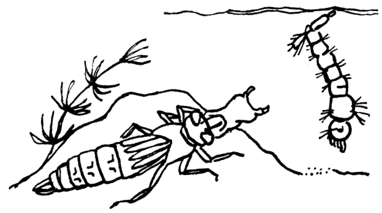
____



Lesson five

Food relationships

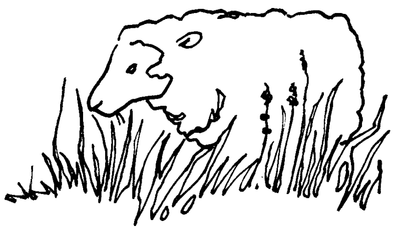
Food relationships are referred to as predator–prey, producer–consumer and parasitsm (parasite–host) relationships.



PREDATOR–PREY

The predator–prey relationship exists between two animals in which one animal (predator) obtains its energy by catching, killing and eating the other animal (prey). For example, a dragonfly larva catches, kills and eats a mosquito larva. List two more predator–prey relationships for wetlands.

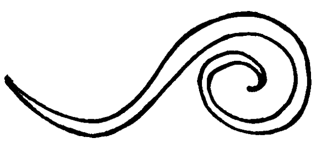
1. ____________________
2. ____________________



PRODUCER–CONSUMER

This term describes the relationship between a plant (producer) and a herbivore (consumer) that eats it for food. For example, a sheep eats grass. List two examples from a wetland ecosystem.

1. ____________________
2. ____________________



PARASITISM (parasite–host)

Parasitism describes the relationship between organisms (both plants and animals have parasites) in which one organism (parasite) draws its food energy from another organism (host) without killing it outright. Generally parasites do not kill their hosts because their own survival depends on the survival of the host. Roundworms are parasites that infest crustaceans or other worms.

Lesson five continued

Life relationships in the wetland

The relationship of one organism to another can be positive (+), negative (–) or neutral (0). In any relationship, each organism can be affected differently. Identify and describe one of each type of these relationships for non-wetland ecosystems of your choice. Name the ecosystem.

00 NEUTRALISM

Neither organism is affected by its association with the other.
e.g. red-winged blackbird–snipe

____

– – COMPETITION

Both organisms are adversely affected in the struggle for food, nutrients, living space or other common needs.
e.g. hawks and owls may compete for prey and nest sites

____

+0 COMMENSALISM

A relationship in which one organism benefits while the other is not directly affected. The beaver creates wetland habitats.
e.g. duck–beaver

____

++ MUTUALISM

A relationship in which both organisms benefit from the growth and survival of each other. In fact, neither can survive under natural conditions without the other.
e.g. termites–anaerobic gut bacteria which aid in digestion

____

+– PARASITISM AND PREDATION

These organisms appear to be different in nature but, in fact, one population adversely affects the other. One organism directly attacks the other though it is dependent on that organism for survival.
e.g. predation: hawk–duck; parasitism: tapeworm–lake trout

____

Lesson five continued

Wetland examples:

PARASITISM

- phycomycetes is a fungi that lives on algae and other fungi
- some leeches are external parasites of many other wetland animals including fish, turtles ducks and snails
- nematodes or thread worms will live within the body cavity of fish and molluscs
- many wetland mammals, including foxes and raccoons, are parasitized by ticks and lice.

MUTUALISM

- bees and many other flying insects feed on the nectar of marsh plants but carry their pollen away, helping the plants to reproduce
- some algae live in the stomachs of protozoans aiding with their digestion
- some bacteria live in nodules on the roots of marsh legumes, but aid the plant by fixing nitrogen from the soil which the plant uses to help it grow

COMMENSALISM

- marsh wrens build their nests on the stalks of cattails but do not harm the plant
- many species of algae and invertebrates, including mites, crustaceans and insects, live in the pores of freshwater sponges
- many species of birds will burrow into the giant stick nests of ospreys to lay their eggs under the watchful but uncaring eye of the fish hawk
- algae will often cling to the side of turtle shells or crustacean shells without any apparent harm

PREDATION

- dragonfly larva prey on other aquatic insects, tadpoles and small fish
- mallard ducks feed on a wide variety of aquatic animals like snails and mayfly larvae
- frogs prey on crustaceans, worms, insects and tadpoles
- northern harriers feed on frogs, snakes, water birds and rodents

COMPETITION

- red-winged and yellow headed blackbirds compete for favourable nest sites in the emergent zone
- fish species compete for the best places from which to ambush passing prey
- foxes and mink compete for prey foods including frogs and nesting waterfowl
- predaceous diving beetles and giant water bugs compete for food resources in the wetland, primarily other aquatic insects and crustaceans.
- different waterfowl species compete for loafing sites on a wetland where they can get out of the water to preen and sleep in safety.

Lesson five continued

Other relationships exist such as 00 (neutralism) in which neither organism nor population is affected by the association of the two, and –0 (amensalism) in which one population or organism is affected adversely and the other population or organism is not affected. Can you think of another example of these relationships in the wetland ecosystem?

00 Neutralism ______________________________

-- Competition ______________________________

+- Parsitism ______________________________

+- Predation ______________________________

++ Mutualism ______________________________

+0 Commensalism ______________________________

Of all the relationships existing in the wetland, which of the above would be affected most by removal of one of the organisms entirely from the wetland? Explain why you think so.

____

____

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____

____

Lesson five continued

Food relationships activity

Rules of play

Divide into teams of two players each. Each team will be given 12 squares with relationship symbols on them. Fold each piece of paper in half with the symbol side in and place them in a hat, box or other container. One player on each team draws a piece of paper from the container and shows the symbol to the other player on the team. The second player draws another piece of paper from the hat and shows it to the first player. Player two is given the chance to name the relationship indicated by the two pieces of paper (i.e. if player one draws a + and player two draws a 0, what is the name of the relationship symbolized by +0?). If player two is unable to name the relationship, player one may try. Once the relationship is named, player one may try to name an example of one organism in the relationship shown (e.g. duck). The other player must name the other organism in the relationship (e.g. beaver). If either is unable to answer, the other player may supply the answer. One point is given for each correct answer. The player with the highest score after four rounds is the winner.

Example:

Player one draws +, player two draws -. Player two correctly says "predation" and receives one point. Player one correctly says "red-tailed hawk" and receives one point. Player two incorrectly responds "fish" and does not receive a point. Player one says "duck" to correctly complete the relationship and receive one point. Player one has a total of two points while player two has only one point for the round.

SYMBOL	PLAYER ONE	PLAYER TWO

Lesson six

Factors affecting aquatic plant populations

- Work in a group of three to five students.

- Each group will receive the following materials:
  - pond plants such as duck weed, algae, etc. (species and variety to be determined by teacher)
  - six baby food jars with plastic wrap for lids
  - water (pond or dechlorinated) to fill baby food jars
  - measuring containers (graduated cylinder or medicine cup)
  - ruler for measuring distance from light source
  - fertilizer or soil
  - masking tape (or sticky label) for labelling experiments

- With your group, decide on a single factor to test for its affect on the growth and reproduction of the supplied wetland plants (if the *effects of fertilizer* is chosen, each member of the group could choose different concentrations of solution to test in comparison to a control with *no fertilizer*). Other factors might include temperature, light, water turbidity, salinity, etc. Blot dry your plant material and weigh out the same amount to test in each sample. Record your pre-experiment plant weights.

- Each member of the group must write an hypotheses about what they believe the result will be of the group's experiment. Indicate which samples will produce results most closely meeting the challenge (outlined by your teacher) to double the population (biomass) of plants in two weeks.

- At the end of the experiment remove the plants from their container, blot off excess water, measure biomass on a weigh scale and compare the results to the control and to pre-experiment weights.

- When the investigation is complete each member of the group must provide an explanation of how the observed findings, if implemented in a natural ecosystem, would affect populations and what the likely environmental consequences of this would be.

Lesson seven

The human equation

In the chart below list things done by people that may cause permanent or temporary changes to the wetland environment. In the second column, list some things, not done by people, that cause natural changes to the wetland environment.

CHANGES CAUSED BY PEOPLE	NATURAL CHANGES

1. What is common to the things that might cause permanent changes?

2. What is common to the things which do not cause permanent changes?

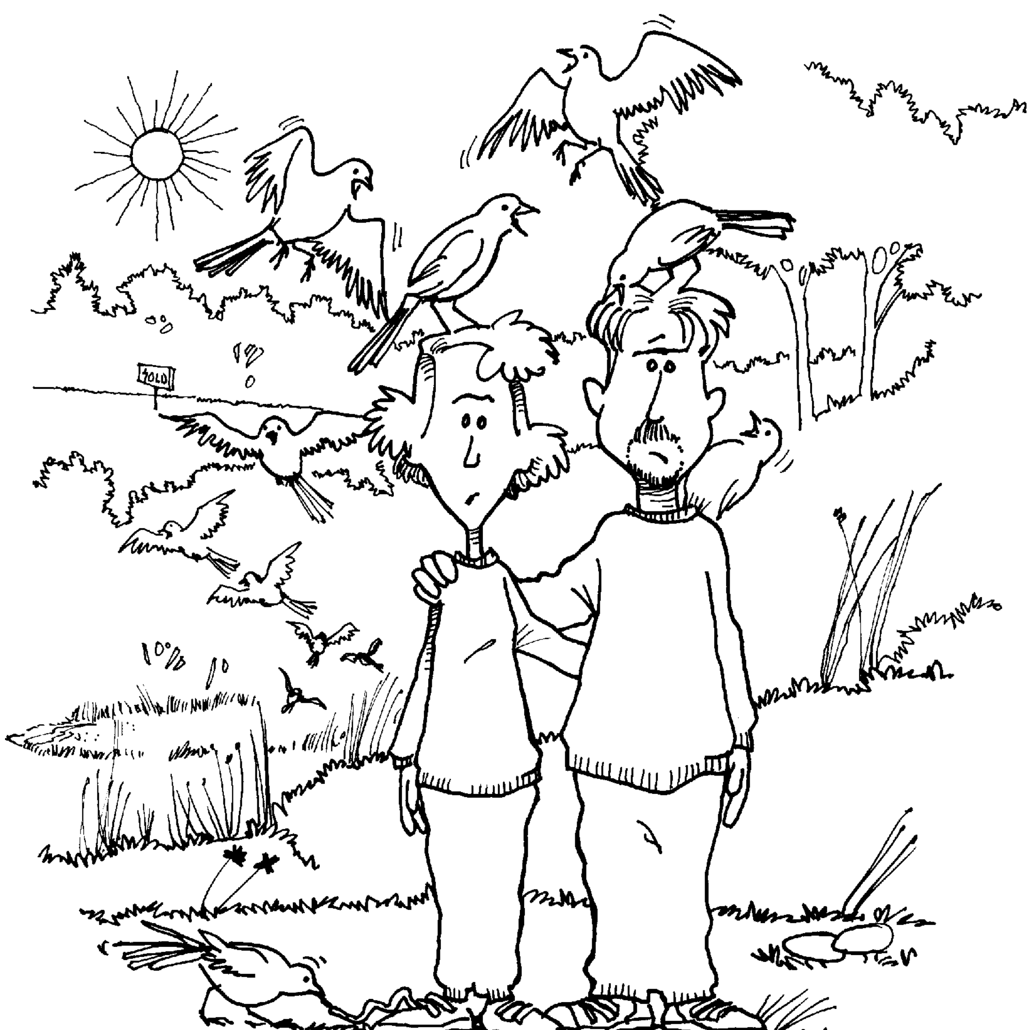
3. Check off the things that might cause beneficial changes.

Lesson seven continued

Project

Kelly and Anne Peterson looked out over the land that would be their farm home and their livelihood for the next 60 years. The morning sun sparkled through the dew on the leaves and waves of warmth rose from the earth. From this place they could see where they would build their first home, high up on a rise above the marsh which stretched over 14 hectares.

From the marsh, the trill of dozens of red-winged blackbirds could be heard and several broods of mallards and blue-winged teal could be seen feeding. On one side of the marsh was a mature forest of elms and oak trees, rooted firmly in the rich soil. Deer, raccoons, owls, mice, rabbits and garter snakes were just a few of the species that inhabited the trees and undergrowth of shrubs and grasses of the forest. On the other side of the marsh was a 46 hectare field of tall grass prairie that had never been farmed. Many species of birds fed in the prairie and many female ducks nested there, as well.



Lesson seven continued

In one or two sentences describe the dilemma that faces Kelly and Anne as they consider their future on their new land.

____
____
____
____
____

There are two sides to every issue. In the boxes below or on a separate sheet, list reasons supporting each side of the dilemma you described above. Be sure to name each side of the issue at the top.

SIDE ONE:	SIDE TWO:

Lesson seven continued

In the box below or on a separate sheet of paper, give your opinion about what the Petersons should do about their dilemma. Predict what you think their property will look like in twenty-five years if they follow your advice.

Field trip
Activity one

Wetland maps

Make two drawings to scale of the wetland site – one, a bird's eye view, the second a cross-sectional view through the middle of the wetland.

Draw a bird's eye view map of the wetland and surrounding shoreline showing important features like buildings, roads, open water areas and plants. Show the location of your transect and sampling sites (see page 40).

N

SCALE

1 cm = _____

KEY

This cross-sectional drawing will show the relative slope of the land and water surface of the wetland. Draw it as if you are standing at ground level, a good distance from the wetland, and looking from the middle of the wetland to approximately 50 metres up one side into the uplands. Record the major features.

N

SCALE

1 cm = _____

KEY

Activity one continued

Field trip notes

Name: ______________________

Grade: ______________________

School: ______________________

Date: ______________________

Location: ______________________

____

____

____

Temperature: ________________ °C

Wind Speed: ______________ Km-h

Wind Direction: ________________

Cloud Cover: ___________ per cent

Cloud Type: ___________________

Observations at the wetland

List the plants and animals you saw. Include any animal signs as well (e.g. tracks, nests, burrows, etc.)

Plants:

____

____

____

____

____

Animals:

____

____

____

____

____

____

Other observations:

____

____

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Activity one continued

Based on your maps of the wetland site and field notes, answer the following questions:

1. Is there natural vegetation surrounding the wetland on all sides?

2. Are there roads, buildings or other structures near the wetland that might be a source of pollutants entering the wetland?

3. Is the slope of the land around the wetland steep? Could that lead to soil erosion into the wetland during heavy rain or snow melt?

4. Is there a stream entering or leaving the wetland? Is the water clear or appear polluted in any way?

5. Are there agricrultural operations near the wetland that may affect water quality (e.g. feed lots, chemical storage, manure piles, etc.)?

6. Are there industrial or recreational operations near the wetland that may adversely affect water quality (e.g. golf course, cottages, factories)?

7. Is the wetland suffering from too much water or too little water? (Note: If the wetland is too deep – greater than 2 m – aquatic vegetation will be sparse and if it is too shallow – less than 0.5 m – the wetland will be overgrown and have too little open water. The ideal situation for most wildlife is a 50:50 ratio of plant life to open water. This is called **hemi-marsh**.)

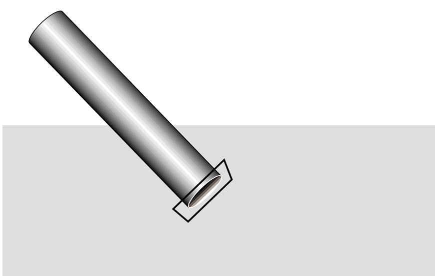
8. If you have observed impacts on the wetland, list some things you might do to improve the water quality:

Field trip
Activity two

Down waterscope

Choose a location for viewing under the water with the waterscope.

When looking through the waterscope you will likely not see any organisms immediately. Be patient and watch quietly for movement in the sediment and around vegetation. Once in position try to keep the scope as still as possible or move very slowly to avoid disturbance.



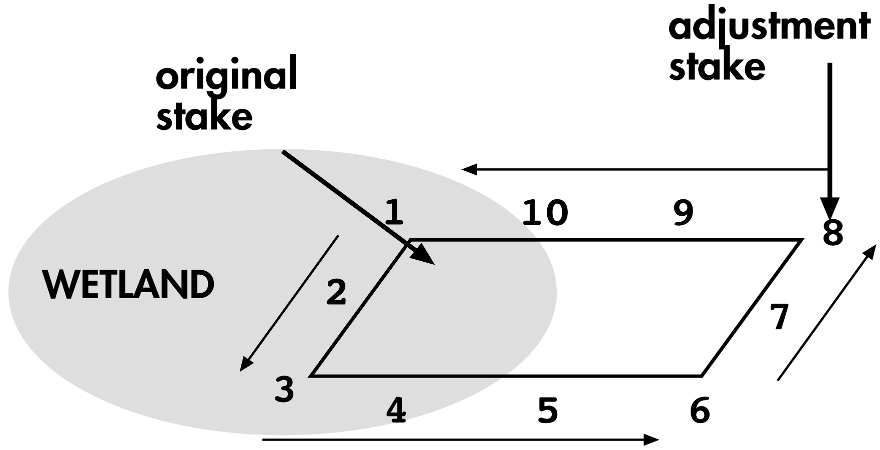
Make a drawing of the plants, animals and abiotic things you see through your waterscope. Include additional observations you make (e.g. colour or movement).

Field trip
Activity three

Wetland sampling transect

Lay out your wetland transect as shown in the map below. Use the numbers on the map when identifying sampling locations.

Place marked stakes at three-metre intervals using a tape measure.



How hard is the soil at each location that the stakes are placed (soft, firm, hard)?

1) ______________________________ 2) __________________________
3) ______________________________ 4) __________________________
5) ______________________________ 6) __________________________
7) ______________________________ 8) __________________________
9) ______________________________ 10) __________________________

When you have completed setting your transect, complete the following tasks and record your data in the table on page 43 (see Activity Four for further directions on data collection).

- temperature measurements
- soil collection
- water clarity (optional)
- pH measurement
- organism collection

Answer the questions on pages 42 about your data.

Field trip
Activity four

Data collection and analysis

Measuring temperatures

- Tape a thermometer to a hockey stick shaft approximately five cm from the bottom of the shaft.
- When attaching the thermometer, be sure that neither the bulb nor temperature in the 0 to 25˚C range are covered by the tape.
- Lower the apparatus into the water until the shaft touches the bottom of the wetland.
- Keep the thermometer below water for at least thirty seconds.
- Raise the thermometer and read immediately (measurements not taken within five seconds of raising are not valid and must be repeated).
- Take temperature readings at the water surface and at the surface of the soil in upland areas.

Sub-surface soil sampling

- Remove the lid and label from a can of soup.
- Use duct tape to attach the can to the bottom of a hockey stick shaft with the open end facing down.
- Use the apparatus to scoop up loose soil from the bottom (don't dig down with it).
- Without too much splashing, bring the scoop apparatus to an upright position outside the water. It will likely take a few tries before you are able to collect soil adequately in a single scoop.
- Place the contents of the scoop in a ziplock bag labelled indelibly with the location from which the sample is taken (bags should be pre-labelled before they get wet). In the lab, inspect the soil for texture and presence of invertebrate life (optional) using a disecting microscope and white pans for the samples.

Measuring water pH

- pH is the term used to describe the amount of acid or base in a solution.
- pH is measured on a 14 point scale with 7 being neutral, 0 being an extremely strong acid and 14 being an extremely strong base.
- Living organisms are very sensitive to changes in pH.
- Place a pH strip in a sample of water from the wetland for approximately 10 seconds.
- Remove the strip and allow time for the reaction to take place (approximately one minute).
- Compare the colour of your strip to the comparison strips on the test kit package.

Water clarity/light penetration (optional)

- If the water in your wetland is deep enough, use a Secchi disc to measure light penetration. You can make a simple Secchi disc using a paint can lid divided into two black and two white quadrants. Punch a nail hole through the centre of the lid and pull a piece of rope through the hole. Tie a knot in the end of the rope.
- With the aid of a canoe or chest waders, move to the deepest part of the wetland without disturbing the sediments.
- Use caution and act safely.
- Lower the disc on a calibrated rope until it disappears and then raise it up slowly until it just reappears to give a relative measure of water clarity.
- Record the length of rope from the disc to the water surface.
- Compare readings for several locations in the wetland.

Activity four continued

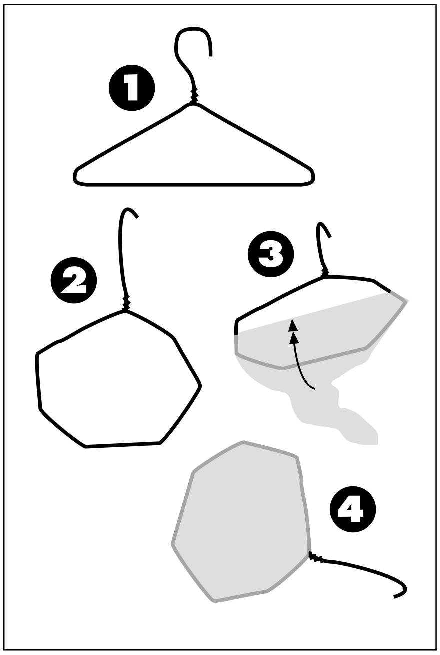


DIAGRAM A1.1

Sampling organisms

- Carefully bend a wire coat hanger as indicated in diagram A1.1.
- Cut the leg from a pair of pantihose and pull it over the wire frame tightly.
- At each site sweep the net through the water or upland vegetation approximately six times. As you get to the end of a sweep turn the net so that collected organisms remain trapped in the front of the net.
- Fill a bucket with pond water. Remove trapped wetland organisms by gently washing the leading surface of the net in the water.
- Place upland organisms in small jars for viewing.
- When finished observing invertebrates, release them gently back into their normal habitats.

Based on the data collected using the above methods, answer the following questions:

1. Is the surface water temperature similar at each location?

____
____

2. Is the bottom water temperature similar at each location?

____

If not, suggest why (consider amount of shade, wave action, etc.).

____
____
____
____

3. Are the surface and bottom temperatures different at each location?

____

If yes, suggest why.

____
____
____
____

4. In the upland areas is the the surface temperature similar at all locations?

____

If not, suggest why.

____
____
____

5. Is the soil moisture similar at all upland sites?

____

If not, suggest why. ______________________________
____
____

Activity four continued

In the chart below enter data as you gather it for your team's transect location. Describe soil moisture as *flooded*, *wet*, *damp* or *dry*. Describe surface light conditions as *full shade*, *partial shade* or *full light*. Check for the presence of organisms and list an example of an organism for each zone. If you do not know the name of the organism, include a brief description or sketch.

Water pH (shoreline area) ___________________
Average water pH (deep water area) _________
Average Secchi disc readings ________________

SAMPLE LOCATION		Temperature °C	Soil moisture	Light conditions	Producer present in sample	Consumer present in sample	Decomposer present in sample
1	Surface						
	Pond bottom						
2	Surface						
	Pond bottom						
3	Surface						
	Pond bottom						
4	Surface						
	Pond bottom						
5	Surface						
6	Surface						
7	Surface						
8	Surface						
9	Surface						
10	Surface						

Field trip
Activity five

Random sampling

This activity can be carried out in the field or in the classroom.

For random sampling, organisms are collected using a predetermined procedure such as the transect system used in Activity Three (ideal for sampling plants). Another technique called capture/recapture is used to estimate the number of animals in a population which you can not easily see and count. This measurement can be repeated to see if populations are rising or falling and to determine what, if any, human intervention might be needed.

To estimate the population of a species, take the first random sample – collect organisms, tag them (or identify them in another way) and then release them. Record the total number of organisms collected and tagged.

The next day, take a second sample from the same place as the first sample using identical sampling techniques. Record the total number of organisms collected and the number of previously tagged organisms collected.

Multiply the total number of organisms collected in the first sample by 100 and divide the resulting number by the number of previously tagged organisms collected in the second sample.

Example:
There are 46 organisms collected and tagged in the first sample. On the second day, the sample of 60 organisms collected includes nine organisms that had been previously tagged in the first sample.

(46 x 100) / 9 = 511

Therefore, there are 511 organisms of that species that are likely to be present in the total population.

Complete the following problem:
Eighteen frogs were collected, tagged and released on the first day of a population count in a wetland. On the second day, 28 frogs were collected. Twelve of these frogs had been tagged before. How many frogs were in the wetland?

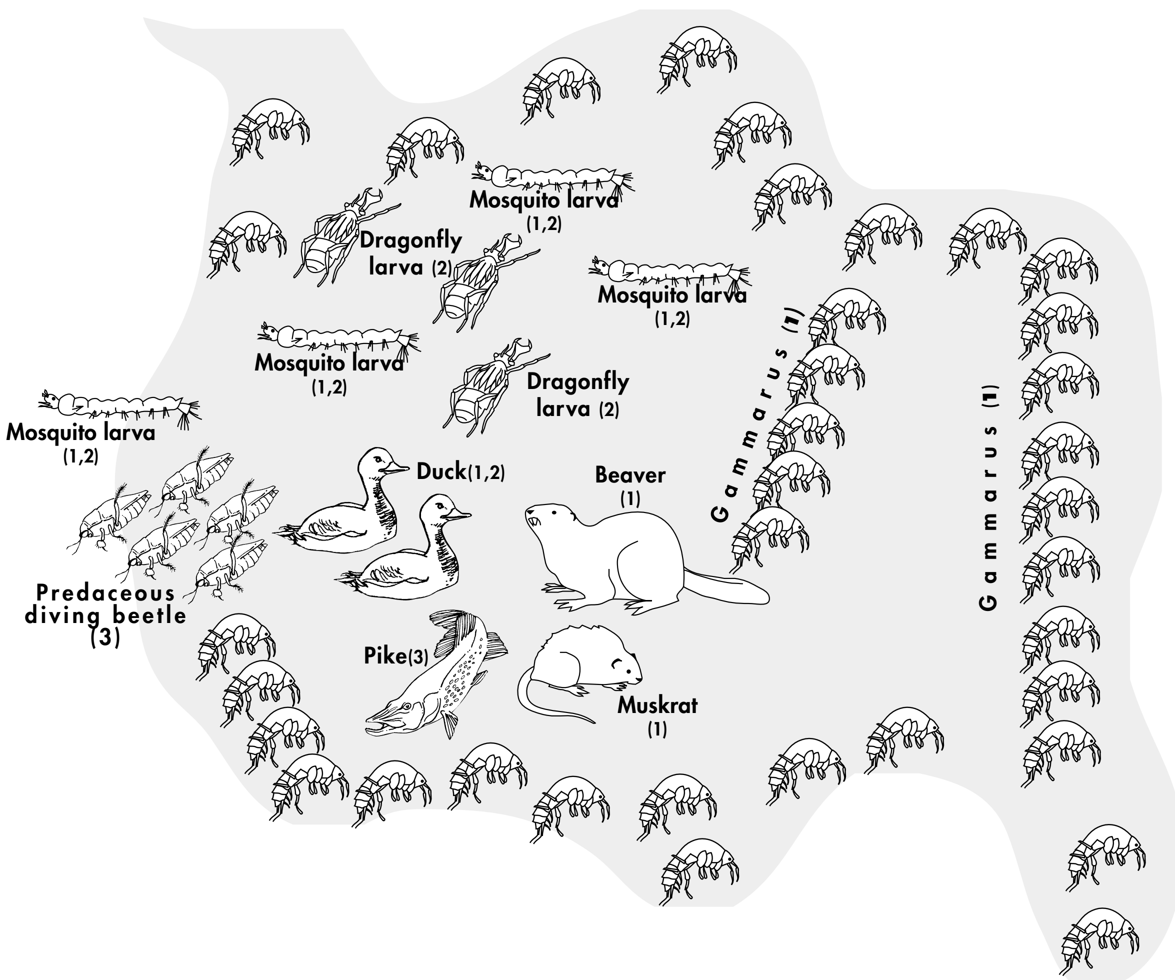
Total number collected and tagged in sample one = _______ A
Multiply by 100 = _______ B
Divide B by number of tagged frogs collected in sample two = _______ C

C equals the total population of frogs present in the wetland.

Complete the following field exercise (optional)
In a marked out 100 m x 100 m field the class can collect a sample of insects using sweepnets (e.g. grasshoppers). Mark each insect with a small dab of nail polish. Place the insects in a holding cage while the nail polish dries. Release all of the marked insects randomly back into the staked out field. Repeat the exercise the next day and, using the methods described above, complete the calculations to estimate the total population.

Activity five continued

The following diagram shows the distribution and population of a number of wetland species. Each identified organism is labelled as a primary consumer (1), secondary consumer (2) or tertiary consumer (3).



Explain why you think such large numbers of Gammarus (primary consumers) can be found at one end of the wetland and so few are found at the other end.

____

____

____

What is the number and distribution of producers and decomposers you might find in this ecosysem? ____

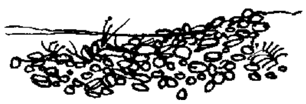
____

What is the source of energy for this ecosystem? ______________________

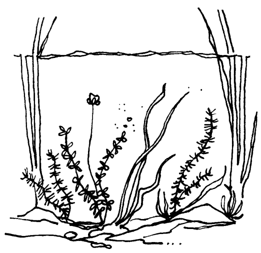
____

Field trip
Activity six

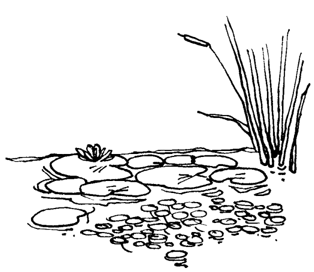
Survival in the wetland



LITTORAL ZONE
Area of shallow water



BENTHIC ZONE
Area at the bottom of the wetland



LIMNETIC ZONE
Area in or on top of the deep, open water

Do you think the colour of producer organisms and the abiotic environment affect the colouration of consumer organisms? Give an example which supports your answer.

____
____
____
____
____
____

Though several microhabitats exist within a wetland ecosystem, organisms can be found in one of three main areas of the wetland: on and in the sediment layer at the bottom of the wetland (**benthic zone**), clinging to and swimming around aquatic plants (**littoral zone**) or in or on top of open water (**limnetic zone**). Organisms in these areas have special adaptations for survival in their zone. Some more complex organisms have the ability to live in more than one of these microhabitats and may need to access all three areas in order to obtain food.

As you find organisms in your field sampling in Activities Three and Four, collect them in the egg cartons using the organism identification charts provided by your teacher. Make a list of the species you find in each of the three wetland zones.

LITTORAL ZONE	BENTHIC ZONE	LIMNETIC ZONE

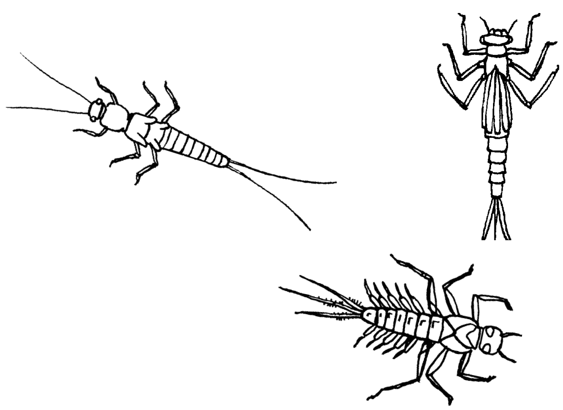
Activity six continued

Air for the taking

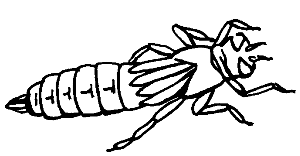
The ability to stay under water for extended periods of time, whether to get food or avoid becoming food, is essential to the survival of many wetland animals. Staying underwater can have severe drawbacks, like drowning, unless an organism is specially equipped for the job. Many wetland organisms have **gills** (comb-like apparati that filter oxygen from the water) but many others do not.

Here are some wetland organisms and the methods they use to enable them to stay submerged for extended periods of time. In your sampling use your magnifying lens to identify the structures used by each wetland organism to obtain oxygen. How do other wetland organisms like minnows, ducks, frogs and muskrats obtain oxygen?

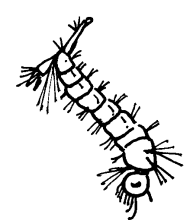
Water boatmen, predaceous diving beetles and backswimmers encase themselves in a layer of tiny air bubbles that they carry with them wherever they go. When they require air they simply absorb it through the **spiracles** on their sides. Try placing a small piece of wool or silk gently in water. Notice that air bubbles cling to it in the same manner as they do in these organisms.



Nymphs of mayfly, damselfly and stonefly have external (outside the body) gills, though each of them looks very different. The gills on mayflies are located along the abdomen like tiny leaflets. The gills on stoneflies look like tiny tufts of white hair under each leg. The damselfly's three gills protrude like feathers from its hind end.



Dragonfly nymphs also have gills, but they are unlike the gills of the mayfly, damselfly and stonefly nymphs. The gills of the dragonfly nymph are located inside the body. The dragonfly pumps water in and out of its back end, taking oxygen-laden water to its **internal gills**.



Mosquito larva use a hollow, tube-like snorkel which they hold at the surface to gather air.

Activity six continued

Adapting to environmental conditions

Each species living in a wetland has developed special adaptations for its survival. Several environmental factors are listed below that affect an organism's survival in a wetland (e.g. water temperature). Draw an organism that demonstrates adaptations to the environmental factors listed. Provide one more environmental condition and draw an organism which demonstrates an adaptation for the condition. Use reference material and in your drawing list the characteristics which have been adapted for that particular condition.

WATER TEMPERATURE

OXYGEN

FOOD GATHERING

____

Activity six continued

They're all in it together

From your observations at the wetland, develop three food chains from producer to final consumer. Include the source of energy in the ecosystem and the direction that the energy flows from one level to the next. If there is interlinking in the food chains (food web) indicate this by drawing arrows between linked organisms indicating the direction of energy flow. You may use words only or words and diagrams.