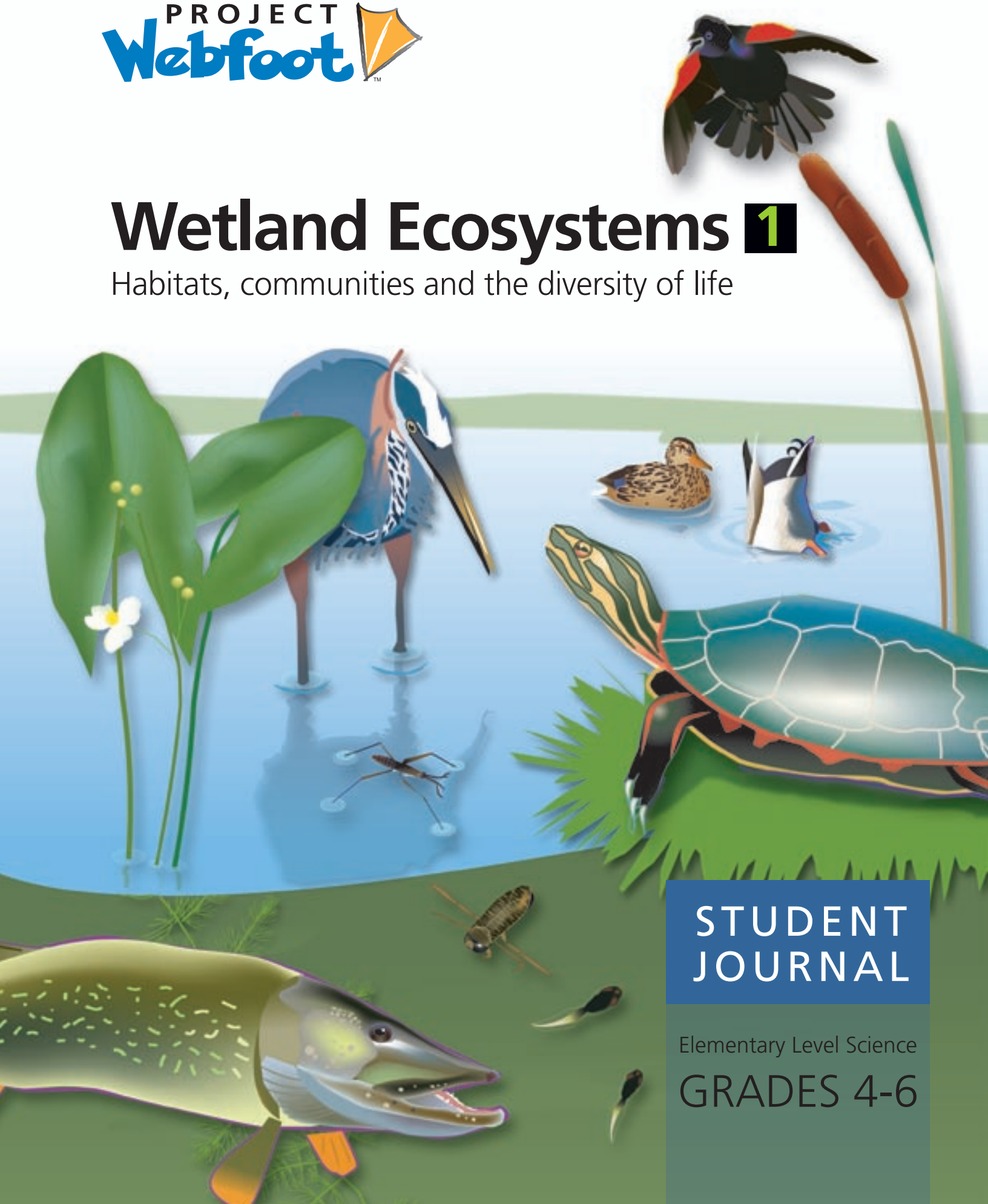
A DUCKS UNLIMITED WETLANDS EDUCATION PROGRAM

PROJECT Webfoot™

Wetland Ecosystems 1

Habitats, communities and the diversity of life



STUDENT JOURNAL

Elementary Level Science

GRADES 4-6

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*info*ZONE

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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.

Plants:

_____
_____
_____
_____
_____

Animals:

_____
_____
_____
_____
_____
_____

Other observations:

_____
_____
_____
_____
_____

Draw a bird's eye view map of the wetland showing important features like vegetation, roads, buildings, etc.

SCALE

1 cm = _____

KEY

Suggested individual and group projects

Your teacher may ask your team to do one of these projects. Use the questions on page iv to help you complete your project.

1. Write a short book titled *All About Wetlands.*
2. Make a poster or series of posters showing how wetlands can be preserved, enhanced or restored.
3. Construct a mobile which shows the important parts of a wetland.
4. Develop a cluster, Venn diagram or other chart to share information about wetlands.
5. Write a rap song about the value and importance of wetlands.
6. Build a tabletop diorama of wetland types with labels and explanations.
7. Write a letter to an organization, government department or business involved in wetland activities outlining your ideas on conservation.
8. Read a biography about a person involved in conservation and share information about the person in poem, poster, lifeline or report.
9. Collect five items related to wetlands. Put the items in a box or can and write an explanation for each item.
10. Simulate a letter to a landowner persuading them to protect their wetlands.
11. Produce a mural on wetland preservation, restoration or enhancement and add captions to explain your mural.
12. Write an essay that compares two perspectives about the values and uses of wetlands.
13. Make a map of a wetland restoration plan and write an explanation of your plan.
14. Create a poem about wetlands and their value to you.
15. Write several journal entries from the perspective of a creature living in or around a wetland during a time of change (wetland damage or restoration).
16. Produce a newspaper featuring articles about wetland events (the newspaper can be written from the perspective of organisms living in the wetland.)
17. Create a series of pictures telling about a wetland event or explain important information about wetlands.
18. Create a picture book to teach younger children important concepts about wetlands.
19. Write a story about a wetland and things that happen in and to it.
20. Interview someone with special knowledge of wetlands and share what you learned in a report, newspaper article or poster.
21. Write a script and perform a play or puppet show about life in wetlands.
22. Write about an event that has happened or could happen in your life that is similar to events happening in a wetland.
23. Research a wetland organism and share information in a report or poster.

Project assessment guide

- For each project you are asked to evaluate and complete an assessment chart below.
- Place a check in the appropriate box for each category.
- When you have completed your assessment, total the scores as follows:
  - Each check in the *Not Very* column is worth one point
  - Each check in the *Yes But...* column is worth two points
  - Each check in the *Dead On* column is worth three points
  - Total each column, then add the columns for a grand total for each project.
- Meet with your group to compare and discuss points given for each evaluation.
- Provide a group average of total marks, with recommendations for improving the project.

Questions about the project	**NOT VERY** (1 point)	**YES BUT...** (2 points)	**DEAD ON** (3 points)
Does the project follow the title?			
Is the project clear and understandable?			
Is the project believable?			
Does the project give useful ideas or solutions (i.e. scientifically possible)?			
Do you agree with the solution or the approach proposed?			
Did each member of the group participate effectively in the presentation?			
Is the project interesting?			
Did you learn anything from the project?			
COLUMN TOTALS			
GRAND TOTAL			

Improving your project

Our group has met and recommends the following to improve the project:

Lesson one

Water, water everywhere

Review pages 3 to 4 and 7 to 12 for information to help you with the exercise below.

- In the **first column** of the chart name three wetland ecosystems.
- In the **second column** enter the names of five organisms that you think live under the water of that ecosystem.
- In the **third column** enter the names of five organisms that live on the surface of the water.
- In the **fourth column** enter the names of five organisms that you believe live around the water and need it to survive.

Name or location of a wetland ecosystem	Organisms that live under the water	Organisms that live on the water	Organisms that live beside the water
I	1)		
	2)		
	3)		
	4)		
	5)		
II	1)		
	2)		
	3)		
	4)		
	5)		
III	1)		
	2)		
	3)		
	4)		
	5)		

Lesson one continued

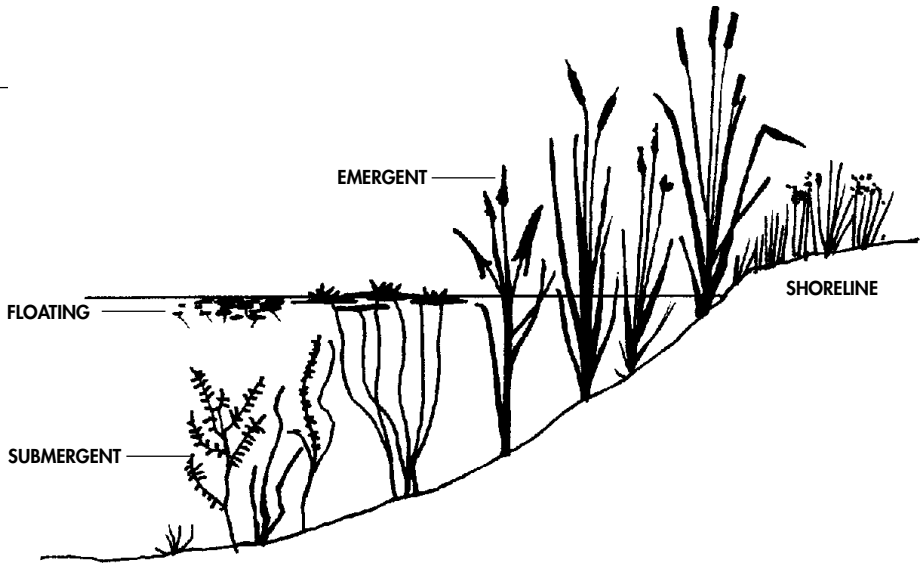
Living and nonliving in the wetland

In the following chart list some of the living (biotic) and nonliving (abiotic) things that you think would be found in a wetland ecosystem. Circle the things that might be there because of people.

NONLIVING THINGS (Abiotic)	LIVING THINGS (Biotic)

Lesson two

Together we stand, divided we fall

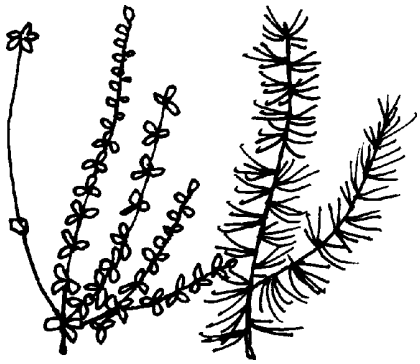


There are four wetland ecosystem types – **marshes**, **swamps**, **fens** and **bogs** – and each of them is different. In the *Wetland Ecosystems Journal* for middle school (grades seven and eight) you will discover how they differ and how they are similar.

Of all the wetland types, the **marsh** is the most productive. Marshes are shallow wetlands less than two metres deep. In different areas of the marsh, different plant communities thrive. In deep water areas, **submergent** and **floating leaved** plants grow. In the shallower portions of the marsh, **emergent** plants can be found. Marshy areas like this may also develop in the shallow parts of lakes and streams.

Submergent plants grow in deeper water, further from shore. The whole body of these plants grows under the water except when they flower. Like emergent plants, their roots are anchored in the soil at the bottom of the marsh. Common submergent marsh plants include **pondweeds** and **water milfoil.**

SUBMERGENT PLANTS



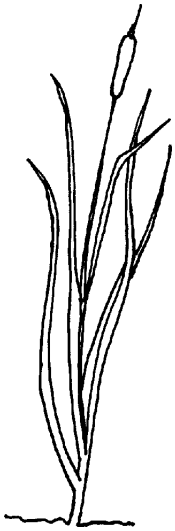
Pondweeds come in a variety of shapes and sizes. The seeds, leaves and roots of pondweeds are an important food source for many birds.

Water milfoil has very fine leaves and is especially important as both a home and a food source for many aquatic **invertebrates**.

FLOATING PLANTS

A common **floating leaved** plant is duckweed. **Duckweed** has very small floating leaves and fine roots which dangle beneath it in the water. It often forms a bright green carpet across broad areas of the marsh. It is easily pushed around by wind or waves and is important as a home for many insects and as food for ducks. **Water lilies** are rooted in the soil and have showy white or yellow flowers.

Lesson two continued

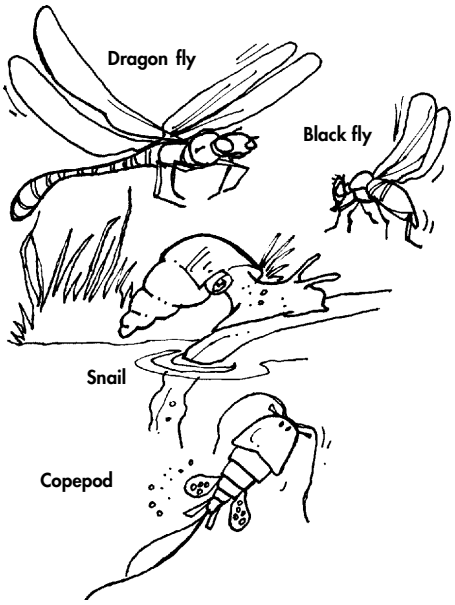


Emergent plants are rooted in the soil in shallow areas of the marsh, but their leaves and stems grow up in the air above the water's surface. The **cattail** and the **bulrush** are the two most common emergent plants. Cattail has flat, sword shaped green leaves and a cigar shaped spike on top which turns chocolate-brown in late summer. It provides a home and food for many different marsh animals. The bulrush is also tall and thin but has a round stem. It, too, is important as a home for many marsh animals including **muskrats** and **marsh wrens**, and its seeds are important food for several species of water birds.

Marshes are important outside their own borders, too. They trap spring water to help **reduce flooding**, **recharge groundwater** during drought and **cleanse** water for use in agriculture, industry, for drinking and recreation. **Wetlands are important for both our environment and our economy.**

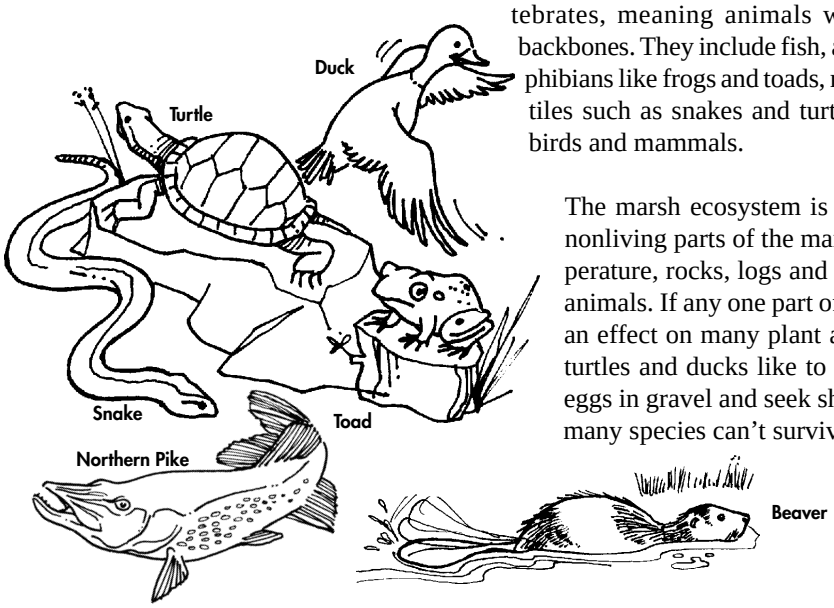
Invertebrates

Many small animals, called **invertebrates**, make their home in the marsh. Invertebrates are animals without a backbone and can be so small that you need a microscope to see them or much larger like snails, dragonflies, beetles and flies. Some common types of invertebrates include insects, worms, amoebas, sponge hydras, leeches, mites, crayfish and clams. Invertebrates are important as a food source for many larger animals that live in or feed at the marsh.



Vertebrates

These larger animals are called vertebrates, meaning animals with backbones. They include fish, amphibians like frogs and toads, reptiles such as snakes and turtles, birds and mammals.



The marsh ecosystem is very complex. All forms of life, as well as the nonliving parts of the marsh like water chemistry, soil, gravel, water temperature, rocks, logs and dead organisms affect the survival of plants and animals. If any one part of the marsh is damaged or disappears, it can have an effect on many plant and animal species that live there. For example, turtles and ducks like to rest safely on rocks and logs, and fish lay their eggs in gravel and seek shaded cover under logs. If the water is too warm, many species can't survive.

Lesson two continued

Wetland relationships

This activity is based on the exercise where you match hexagonal (six-sided) discs showing relationships between things in a wetland. Use the spaces below to describe the relationships you found between two living things or between an abiotic (nonliving) and a biotic (living) thing.

Example
In a wetland ecosystem water affects a duck by providing pond plants and small organisms for food.

1. In a wetland ecosystem _____ affects _____
   by providing _____ .

2. In a wetland ecosystem _____ affects _____
   by providing _____ .

3. In a wetland ecosystem _____ affects _____
   by providing _____ .

4. In a wetland ecosystem _____ affects _____
   by providing _____ .

5. In a wetland ecosystem _____ affects _____
   by providing _____ .

Lesson two continued

As strong as the weakest link

Many things can happen to ecosystems that affect the organisms living there. Choose one organism from your chart of living things in a wetland ecosystem (page two).

Organism chosen _____

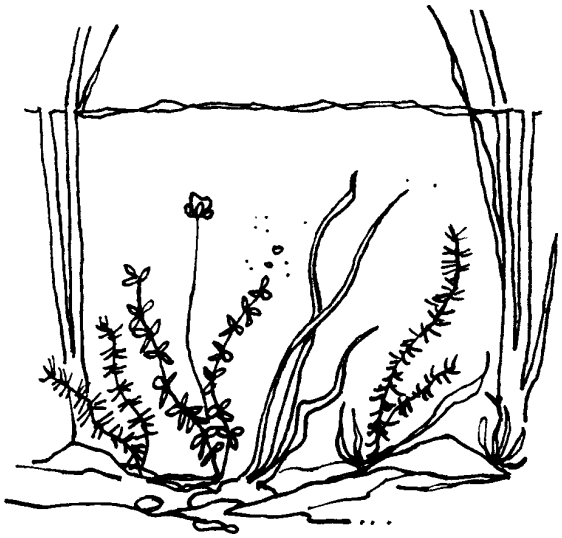
Imagine that it suddenly disappears from the wetland ecosystem. Explain what may have caused the organism to disappear:

Explore how the disappearance of this organism will affect other organisms:

Lesson three

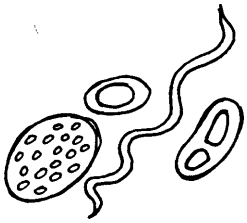
Wetland zones and the cycle of life

Organism identification chart



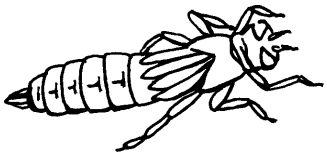
Bottom Zone
The bottom or **benthic** zone is the soil layer at the bottom of a wetland. Many plants and animals live here.

BACTERIA



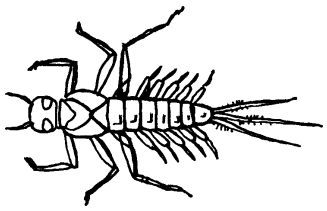
Bacteria are important wetland **decomposers** – organisms that help break down dead plants and animals for reuse. Bacteria are microscopic, among the smallest of living things, and can be found in the **mud** or **water column** of wetlands. There can be up to one million bacteria per cubic centimetre.

DRAGONFLY NYMPH



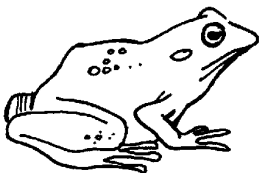
Though most people recognize the flying adults of this wetland insect, few know that the **nymph** may spend up to two years living on the marsh bottom. They are aggressive **predators** that feed on insects and other invertebrates, tadpoles and even small fish.

MAYFLY NYMPH



One of the most common wetland insects, **mayfly nymphs** can burrow into the **mud**. Most mayfly species are easily recognized by their three hair-like tails. The nymphs feed on plants found on the bottom of the wetland. Adult mayflies have wings and do not feed. They are eaten by fish and birds.

FROG



Frogs are **vertebrate amphibians** which **hibernate** to get them through the cold winter months. They will burrow into the soft **mud** and remain inactive until spring. During this time they breathe through their skin and do not need any food.

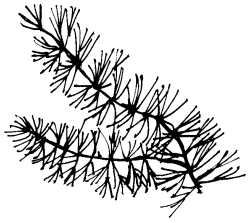
Lesson three continued

Deep Water Zone
The deep water or **limnetic** zone is the area in or on top of the deep, open water in a wetland.

BLADDERWORT

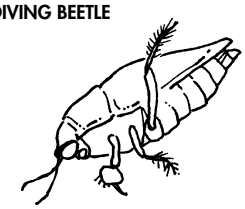
These are small **carnivorous** marsh plants. Most have bladders which are like tiny air sacs that help keep the stem afloat and trap small organisms for food.

COONTAIL



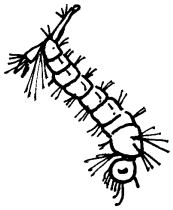
Coontail is often the most common **submergent** plant in newly formed wetlands. It has three-forked leaves that grow in whorls around the stem. Coontail does not need to be rooted in the soil to grow well.

PREDACIOUS DIVING BEETLE



These large beetles are brown or black in colour and one of the most common of the aquatic beetles. They **prey** upon any small animal they can catch.

MOSQUITO LARVA

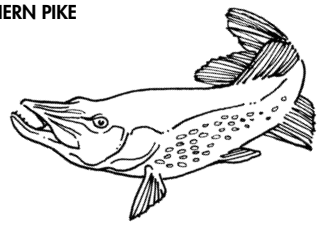


These small, wormlike animals move **through the water** with a wriggling motion. They **feed on algae** and other microscopic organisms. Their **pupal** stage can also be found in the deep water zone. Flying **adult** females **feed on the blood** of other animals using sucking mouth parts.

WATER STRIDER

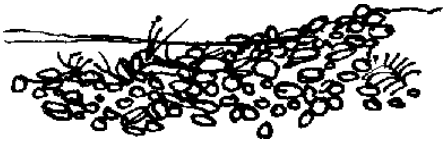
These slim **insects** live on the **surface film** of quiet waters, drifting aimlessly or running rapidly about. They **prey** on other smaller insects, catching them either on the surface or by diving below.

NORTHERN PIKE



The pike is a **fish** that waits in ambush for unsuspecting **prey** to swim by. Found only in larger wetlands that are deep enough to allow it to live through the winter, the pike has few natural predators. It feeds on other fish, frogs, small birds, crayfish and insects. People, loons, otters and ospreys eat pike.

Lesson three continued

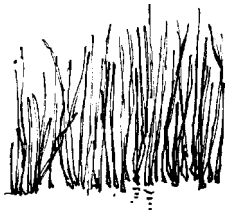


Shallow Water Zone
The shallow water or **littoral** zone is where light penetrates to the bottom.

SEDGES

Sedges are **emergent** plants found in shallow water or moist soil around a wetland. They are an important plant for **nesting** and feeding waterfowl and provide valuable **cover** and **food** for many species.

WHITETOP GRASS



An **emergent** plant of shallow, temporary wetlands, whitetop can grow to nearly one metre. It provides excellent **cover** for marsh nesting birds as well as being a valuable **hay crop** for farmers after the birds' eggs hatch.

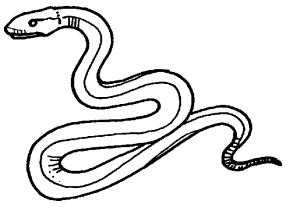
SPRINGTAIL

These small, wingless insects are found in vegetation along a **wetland's edge**. The name comes from their ability to spring into the air by using their tail when disturbed by **predators**.

WATER SPIDER

Water spiders live among the vegetation in shallow water. They **hunt** for other small invertebrates and can dive under water for several minutes in pursuit of **prey**. Waterbirds and large insects prey on them.

GARTER SNAKE



These nonpoisonous snakes live along the **wetland's edge**. They **feed** on frogs, minnows, toads, mice and insects. While solitary during the summer, they spend the winter hibernating **underground** with other snakes.

MALLARD DUCK

The mallard is the most common duck, easily recognized by the dark green head of the male. They **nest** in fields or along the shore of marshes, feeding on vegetation and insects. Mallards eat a variety of foods and are **omnivorous**. When the marshes freeze, mallards **migrate** south to warmer areas.

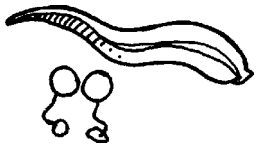
Lesson three continued

Organism life cycles

Metamorphosis is a series of changes that allows an organism to have different forms and different habits as it grows. In **insects**, those with **four** life stages are **complete**, those with three stages are **incomplete**. In complete metamorphosis the stages are **egg, larva, pupa** and **adult**. In an incomplete metamorphosis the stages are **egg, nymph** and **adult**. **Amphibians** also have a three stage metamorphosis – egg, larva and adult. **Fish** and **birds** usually have a two stage cycle – egg and adult, with an intermediate **juvenile** phase. Most **mammals** do not lay eggs (the platypus is an exception) and are born resembling the adult. They are not mature and are unable to reproduce for some time after. In fact, the offspring of mammals are often born blind and helpless.

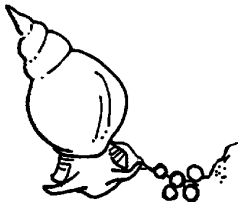
Let's look at some wetland creatures and examine their life cycles.

LEECHES



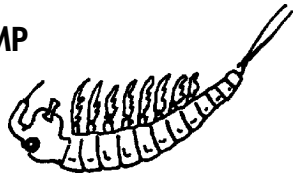
Leeches lay **eggs** in a cocoon which they fasten to a plant or bury in the mud. They hatch looking just like adults.

SNAIL



Most snails have male and female organs. Snails lay **eggs** which hatch into young resembling the adults.

FAIRY SHRIMP



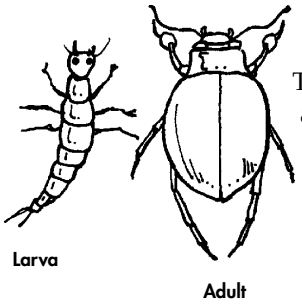
These tiny **crustaceans** lay **eggs** which are dropped to the bottom of the wetland by the adult. They hatch into an immature stage which must **moult** before becoming an adult.

DAPHNIA (water fleas)

Females carry a number of **eggs** in their body. They hatch and remain there for several days before being released. The young must **moult** before becoming adults.

Lesson three continued

PREDACEOUS DIVING BEETLE



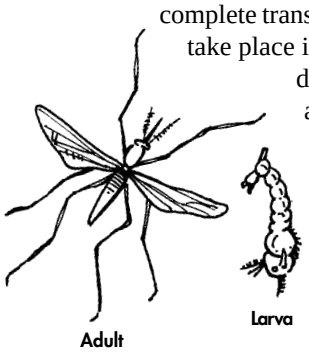
These common wetland insects have a complete **metamorphosis**, meaning they have **four stages**. The **eggs** are laid on shoreline plants, hatching into aggressive aquatic **larvae**. The larvae eventually crawl to shore where they become **pupas**, hiding under logs or stones. They emerge weeks later as full grown **adults**.

SPRINGTAIL

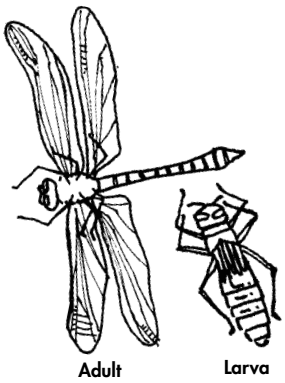
Eggs are laid in the vegetation along the shore. The young are different from adults only in colour.

MOSQUITO

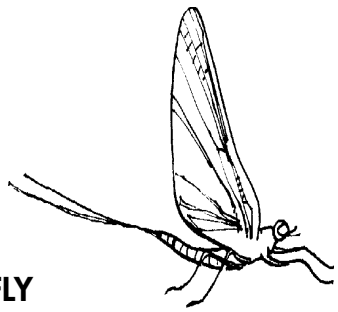
Like all true flies, mosquitoes have a **four-stage life cycle**. Their metamorphosis is complete – from **egg** to **larva** to **pupa** to **adult**. This complete transformation may take place in as little as 10 days or as long as two years.



DRAGONFLY



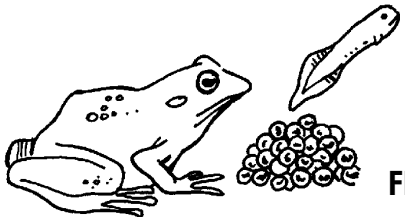
These large insects have a **three-stage life cycle** much like that of the mayfly. The **eggs** are laid in water, where they hatch into **nymphs**. The nymphs eventually crawl up on shore where they moult into winged **adults**.



MAYFLY

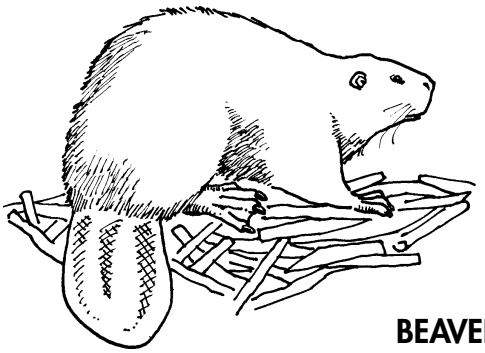
Mayflies show **incomplete metamorphosis**. They lay **eggs** in the water which hatch into **nymphs**. The nymphs live and feed in the water. After some time the nymphs crawl up on shore where they moult, emerging as flying **adults**.

Lesson three continued



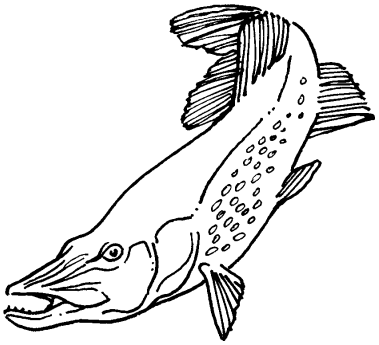
FROG

Frogs lay their **eggs** in jelly-like strings or masses in the water. The legless **larvae** which hatch have gills and are known as **tadpoles**. The development of legs and lungs takes several weeks, at which time they become **adults** and can move out of the water. Why do frogs have large hind legs?



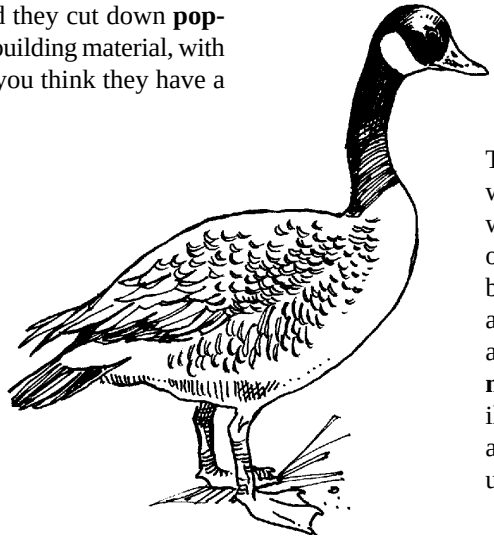
BEAVER

These Canadian symbols are born blind and helpless in the beaver lodge in late spring, but look very much like their parents. They grow slowly over the next two years. After their second winter they will find a mate, build their own lodge and have their own young. Beavers create small wetlands with their stick and mud dams and provide important **habitat** for many other species. Beaver are **herbivores** and they cut down **poplar**, their favorite food and building material, with their sharp teeth. Why do you think they have a large, flat tail?



NORTHERN PIKE

Like most freshwater fish, the female pike lays **eggs** which are then **fertilized** by the male. These eggs will hatch in a few weeks, with the young looking like the adult. Pike are **carnivorous** and often eat other fish or small waterbirds.



CANADA GOOSE

These large geese lay an average of five **eggs** which are incubated by the female for about four weeks before hatching. Vegetation nests may be on shore, on top of muskrat lodges or in man made basket structures. The goslings are unable to fly and spend several months growing their muscles and feathers. By fall they are strong enough to **migrate** south to their wintering grounds as a family unit. Some females return the following spring as adults, ready to nest, though most don't lay eggs until two years old. Do geese mate for life?

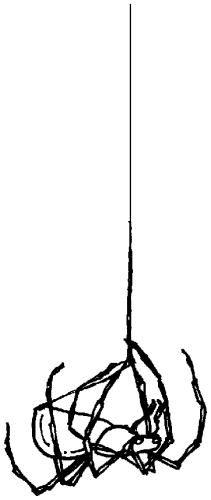
Lesson four

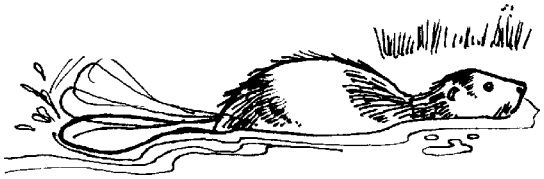
Adaptations

All animals have **adapted** physically and behaviourally to allow them to use their environment and to help them find a **niche** within an ecosystem. Let's examine some common wetland organisms and some of the adaptations they've made.

SPIDERS

Spiders have developed the ability to spin silk. This allows them to build elaborate **webs** that trap food while protecting them from other predators.

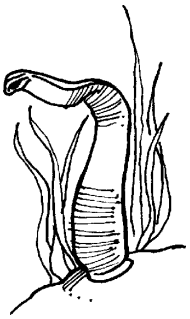




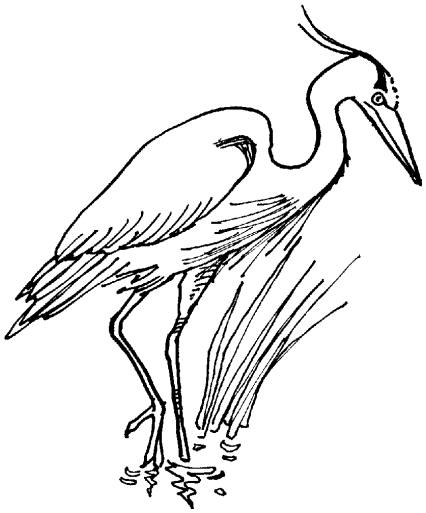
BEAVERS AND MUSKRATS

Both of these **mammals** have **weblike** feet which make them strong swimmers. Their **tails** are different, however. Although a muskrat's tail is long and thin and a beaver's tail is broad and flat, both act as rudders for steering. The beaver slaps its tail on the water to warn other beavers of approaching danger. Beavers have long, sharp front **teeth** to help them cut vegetation for food and building material. The beaver also has **clear eyelids** to provide protection while swimming underwater. Special **oil glands** and **thick fur** keep these animals warm and dry. Why do you think these animals were important in Canada's history?

LEECHES



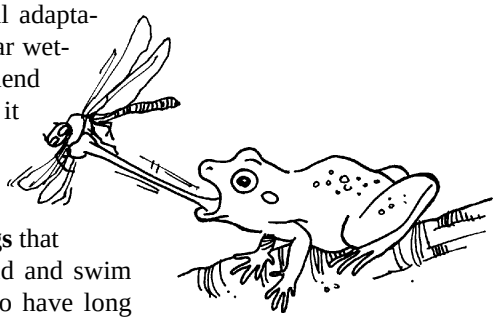
These **wormlike** creatures have **suckers** on either end that help them cling to plants so they are not swept away by wind or waves. The suckers allow them to hang on to larger, stronger prey while they are taking their blood meal. Leeches swim by moving their long bodies in undulations.



HERON

These and many other **wetland birds** have **long legs** that make it easy for them to wade in water in their search for food. They also have long **bills** for catching fish, frogs and other food. They **nest** in colonies high up in trees and **migrate** south in the winter to find open water.

FROGS AND TOADS

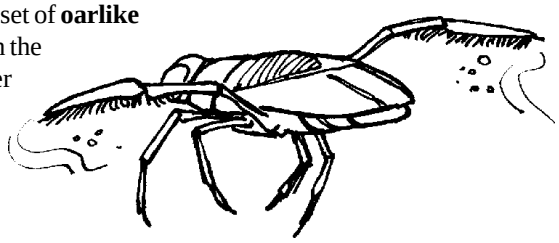


These **amphibians** have several adaptations to assist them in living near wetlands. Their **colours** help them blend in to their surroundings, making it difficult for predators to see them. Many toads also produce a **poison** that makes them taste bad to predators. Frogs have **long legs** that help them jump quickly on land and swim strongly in the water. They also have long **sticky tongues** that allow them to catch insects for food.

Lesson four continued

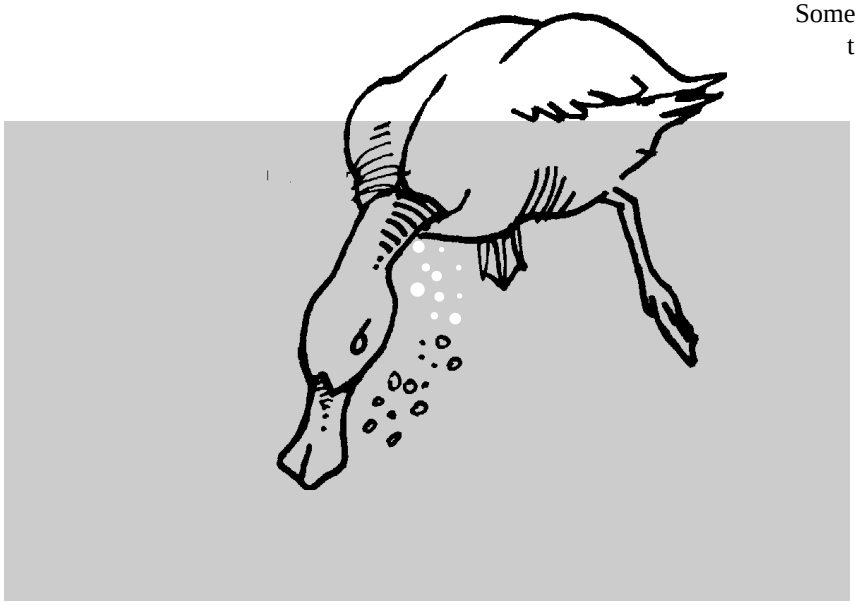
WATER BOATMAN

These marsh **insects** have a set of **oarlike legs** that move them through the water much faster than other insects. This helps them catch their prey while escaping animals who would like to eat them.



DUCKS

Different species of ducks have different adaptations to help them survive in the wetland. The females are very **drab coloured** so that predators find it difficult to locate them on the nest. All have **webbed feet** to make them better swimmers.



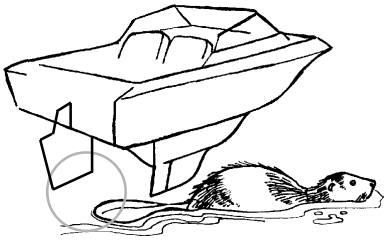
Some ducks, like **wigeons**, have bills that allow them to graze on grass, while **mergansers** have sharp, teethlike **lamellae** to help them catch fish. **Shovelers** use their lamellae to strain for small invertebrates. **Wood ducks** and other species nest up in trees in old woodpecker holes and natural cavities. This provides them safety from predators like foxes, skunks and raccoons. People and conservation groups like Ducks Unlimited put up wooden nest boxes to help these and other cavity nesters find homes.

Some ducks, like the **blue-winged teal**, nest in grassy fields while others like the **canvasback** build floating nests out of cattail. Other ducks, such as the **mallard**, use their webbed feet to tip up and dabble at the water surface for food. **Redheads** have their legs farther back on their body and can dive to the bottom of the wetland to feed.

Lesson four continued

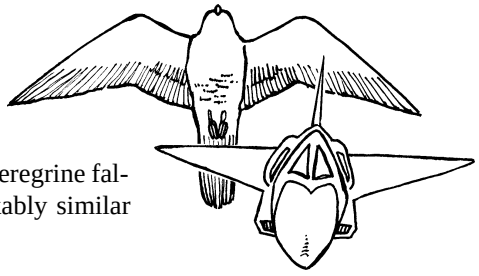
Adaptations and human inventions

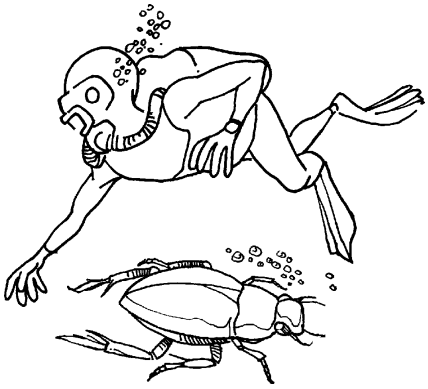
BOAT RUDDER
The boat rudder was designed to imitate the steering effects of the tail of an otter or beaver when it is swimming.



CANOE PADDLES
Like a duck's webbed feet, they are broad to maximize propulsion when pushed through the water.

AIRPLANE WINGS
Like the feathered wings of a bird, they can be altered to allow for more surface area in slower flight or swept back for speed. A peregrine falcon and a jet fighter have remarkably similar wing shapes.





SCUBA TANKS
Scuba tanks allow a person to breathe underwater by storing oxygen, just like a diving beetle stores air for its extended dives in a chamber under its wing covers.

CAMOUFLAGE CLOTHING
Soldiers wear camouflage clothing to avoid being spotted by the enemy, much like the splotchy colours of a frog hide it in vegetation from predators.

Lesson four continued

The *It's Just Like* game

Students play the *It's Just Like* game by comparing an animal or plant adaptation to something used by humans (e.g. a canoe paddle compared to a duck's webbed feet, or a raincoat compared to a duck's feathers).

GAME RULES

All of the playing cards are dealt to up to five players in the group. Each card contains a picture of a human invention on one side of the card. The other side of the card has an adaptation of a living thing that exhibits a similar function, with an explanation of the adaptation.

The person clockwise from the dealer begins by choosing one of their cards and showing only the side with the human invention to the rest of the group. The next player gets the first chance to answer the question by suggesting a species adaptation that fits the invention. If this person is unable to provide an answer, the first person to raise their hand and say "it's just like..." gets a chance to respond.

One *It's Just Like* token is given for a correct match-up. Another token is awarded for a correct explanation of the adaptation and how it relates to the human invention. There may be more than one correct answer for each invention card and the card holder decides whether to award a token for a different answer. If the answer on the card is not given, the card holder reveals the answer to the group.

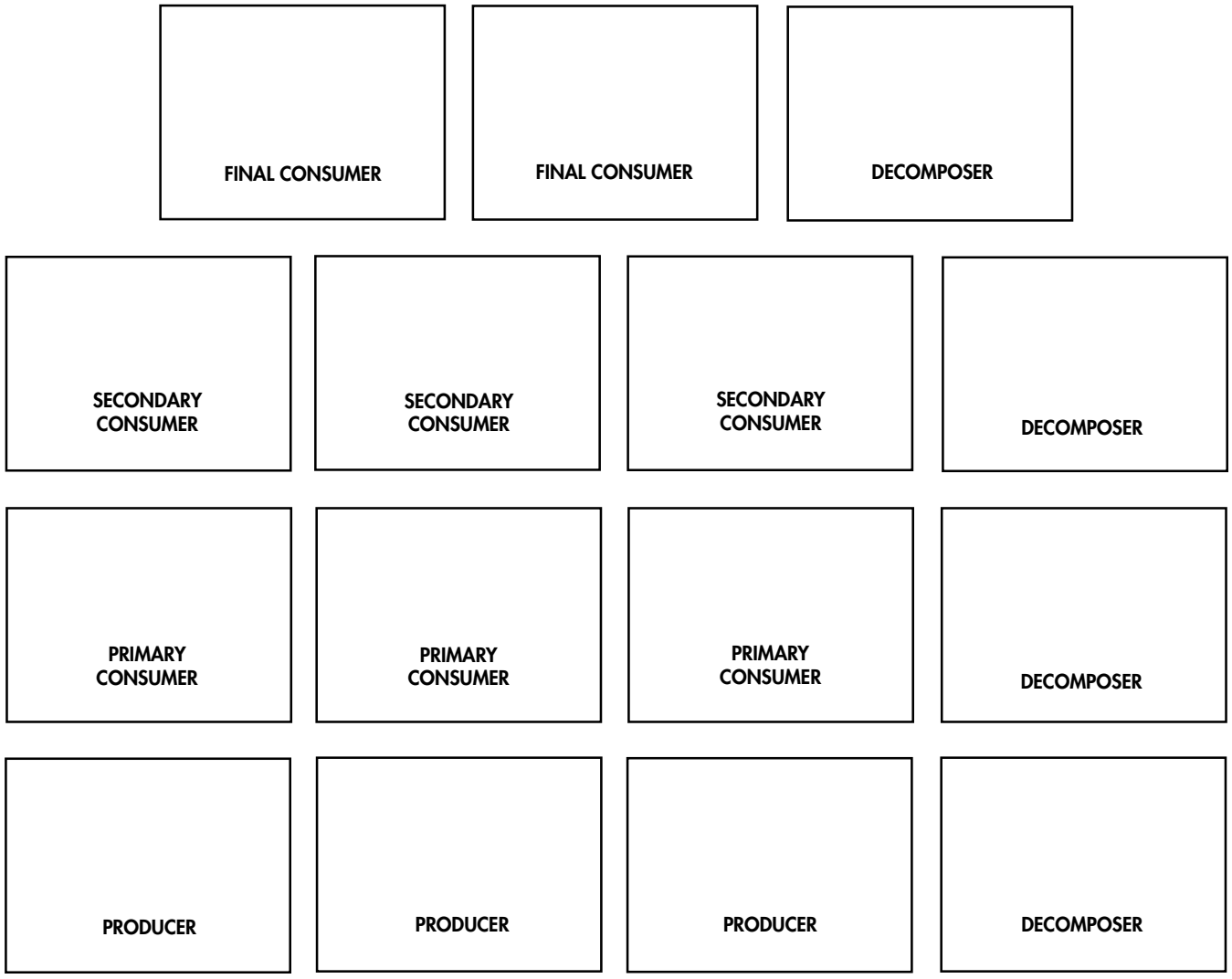
The game continues until all cards have been shown and all students have had the opportunity to answer.

The winner of the game is the student who gathers the greatest number of *It's Just Like* tokens.

Lesson five

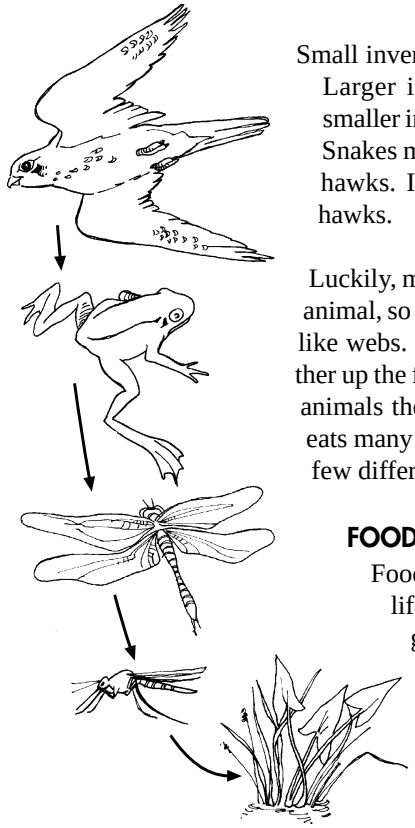
Produce, consume or decompose

Discuss the terms **producers**, **consumers** and **decomposers** with your teacher. Determine the difference between **primary**, **secondary** and **final** consumers. Decide which of these groups are **herbivores** and which are **carnivores**. Place the name of a wetland organism in one of the appropriate boxes below. Place the source of its energy (food) in the box below it and the organism that uses it for food above it. Note that decomposers operate at each level. When you have finished filling all of the boxes, draw lines with arrows showing the direction of the energy flow. You may join boxes to more than one other box. See lesson six on page 18 for more ideas.



Lesson six

Chains and webs...where does the food go?

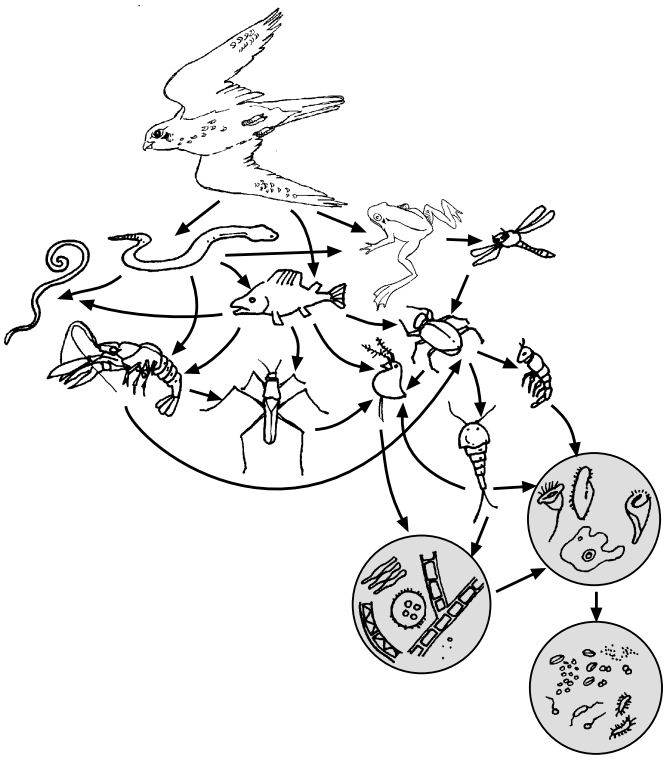


Small invertebrates eat little bits of plant life called algae. Larger invertebrates, like water beetles, feed on the smaller invertebrates. Frogs, in turn, eat the water beetles. Snakes may eat the frogs and the snakes may be food for hawks. If there was no algae, we might not have any hawks.

Luckily, most animals feed on more than one other type of animal, so food chains aren't just one straight line but more like webs. Food webs are shaped like pyramids – the further up the food chain you go, the fewer the number of food animals there are for any individual animal. Thus, a frog eats many different kinds of food, but the hawk only has a few different food animals available to it.

FOOD CHAIN

Food chains are a good illustration of how marsh life is interconnected. Food chains are lines of progression where one animal depends upon those beneath it in the chain for food.



FOOD WEB

Food webs are complex relationships which may include many organisms at each level of food gathering. An organism may eat several different organisms and in turn may be eaten by several more. Are all levels of organisms interdependent or independent?

Lesson six continued

We're all in it together

From your reading or field trip to the wetland, develop three different **food chains** from **producers** (plants) to **consumers** (herbivores, carnivores) to **decomposers**. Include the source of **energy** in the ecosystem and the direction that the energy flows. If there is linking across the food chains, indicate this **web** by drawing arrows between linked organisms and show the direction of energy flow (who eats whom?). You may use either words or words and diagrams to describe the food chain.

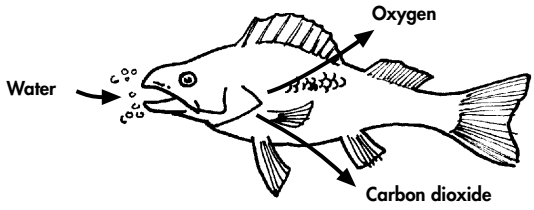
Energy Source: _____		
Food Chain One	**Food Chain Two**	**Food Chain Three**

Lesson seven

Water, water everywhere.... but where, oh where, is air?

All wetland animals need to breathe oxygen to survive. Unlike plants they cannot produce their own oxygen, so they have developed ways to take it from the water or from the air. Oxygen enters the water by **diffusion** from the atmosphere and as a by-product of **photosynthesis** by green plants in the water. Healthy ecosystems have a balance between the oxygen producers and the oxygen users. Let's look at different wetland organisms and see some of the ways they obtain oxygen.

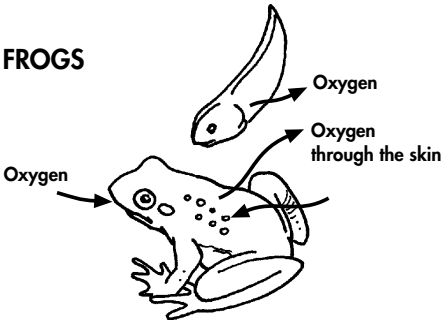
FISH



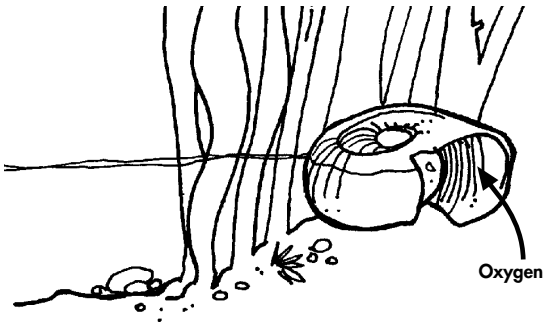
Fish take water into their mouths and expel it out past their **gills**. These gills have many blood vessels and it is here that a rapid exchange of gases takes place. Oxygen enters the bloodstream, while waste **carbon dioxide** diffuses into the water.

FROGS

In the larval or tadpole stage, frogs breathe through **gills**. As they change into adults they develop **lungs**, much like mammals have. However, frogs are unique in that they can also breathe through their **skin**.



SNAILS

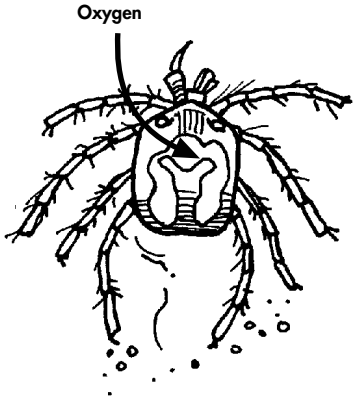


Snails have a **lung** in the form of a cavity between the mantle and body wall. To replenish their air supply they may come to the surface. They can, however, obtain some oxygen by **diffusion** from the water. When **dissolved** oxygen levels in the water are high, a snail makes fewer trips to the surface for air.

Lesson seven continued

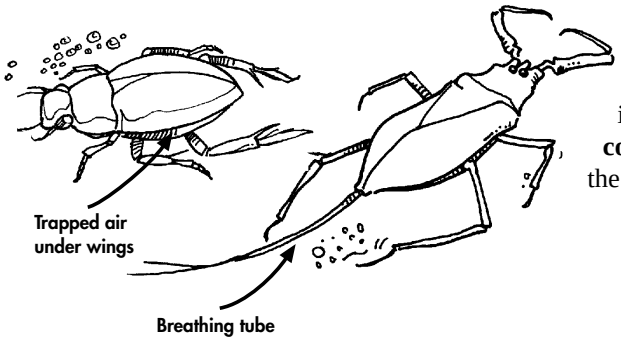
WATER MITES

These **arachnids** breathe by **absorbing** oxygen through their body wall. This is the most common method of breathing in the simpler wetland organisms.



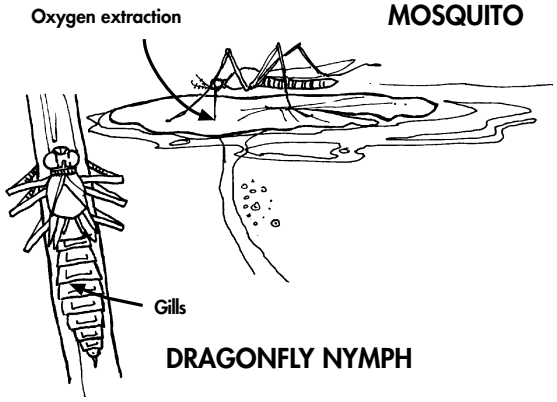
PREDACEOUS DIVING BEETLE

WATER SCORPION



Many **insects** have developed methods for trapping air in their body for use while underwater. The **predaceous diving beetle** rises to the water's surface where it takes in atmospheric air and stores it beneath its **wing covers**. The **water scorpion** takes in air through **tubes** at the end of its body, much like a **snorkel**.

The **nymphs** of **mayflies** and **dragonflies** have **gills** at the rear of their bodies. Other insects, including some **beetles** and **flies**, pierce plants with their sharp mouth parts and take oxygen directly from them. The larger animals including **mammals** and **birds**, store oxygen in their **lungs**, just like **people**.



Lesson eight

Wetland stress

A biologist found that the number and type of organisms living in the Old Muddy River changed from place to place down the river.

Beginning at the bridge, the water was sampled every kilometre for six kilometres downstream. Below are the numbers of the organisms that she found in the samples collected.

LOCATION	Number of Organism A	Number of Organism B	Number of Organism C	Number of Organism D	Number of Organism E
Bridge	7	**25**	**121**	3	**54**
1 km	9	**26**	**115**	4	**48**
2 km	**87**	2	7	**33**	**45**
3 km	**115**	1	4	**38**	**46**
4 km	**95**	4	11	**28**	**50**
5 km	20	**20**	**54**	13	**51**
6 km	11	**27**	**125**	9	**58**

Task one

Use a line graph to chart the data found in the above table. Use a different colour line for each of the organisms and provide a legend indicating which coloured line belongs to which organism.

After looking at the graph, the biologist went to look for possible causes for the differences. She recorded the kinds of human activities taking place at the sites where she had taken her samples. This is the page from her notes. →

Observations of human development along the Old Muddy River

June 16

Bridge: Heavy car traffic and a ski slope slightly upstream. City parks on both sides of river.
One kilometre downstream: Parks continue along river banks, houses next to park.
Two kilometres downstream: City sewage treatment plant outlet into river one side, houses along other side.
Three kilometres downstream: Dairy farms along east side of river, golf course on west side.
Four kilometres downstream: Grain farms on both sides of river.
Five kilometres downstream: Grain farm on east side of river, lightly forested area on west side.
Six kilometres downstream: The stream flows into a small marsh which is surrounded by cattails and willows.

Lesson eight continued

Task two

For each river location decide if you think the water is clean, somewhat polluted or very polluted. Remember that rivers flow downstream and receive their run-off from surrounding land. Identify and explain possible causes for the changes in the number of organisms in the river at three different locations.

Transfer the information that you have proposed into the following chart, listing causes as either harmful or beneficial. Remember, some species might actually thrive in polluted water.

HARMFUL	BENEFICIAL

Lesson eight continued

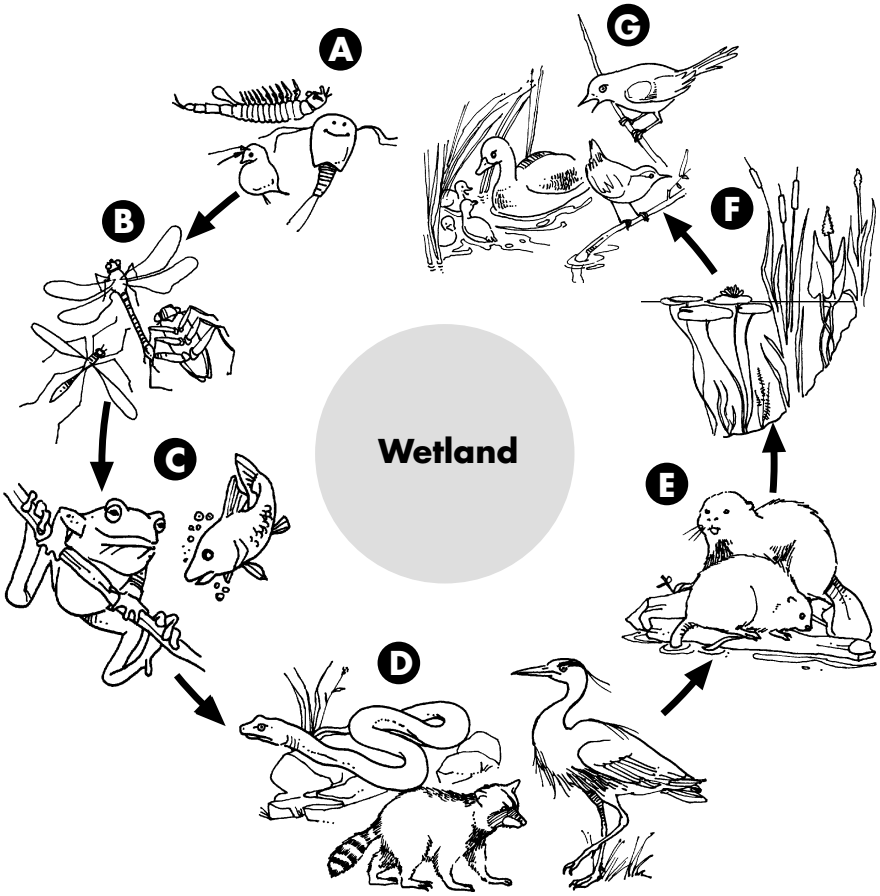
Impacts of wetland destruction

Do you remember when we talked about food chains and food webs? When we showed how many plants and animals depend upon one another for survival? This is an important thing to remember when we talk about wetland destruction. Even if the wetland isn't lost, but becomes polluted, the loss of even one kind of plant or animal can affect the lives of many others.

Wetlands are ever changing. Many will disappear, either naturally or through impacts caused by people. In fact, it is estimated that more than 70 per cent of the marshes on the Canadian prairies have disappeared and many of those remaining have been damaged. In the St. Lawrence River and Great Lakes regions, up to 90 per cent of the wetlands are gone. Most of these were drained for agriculture, industry or buildings. Others were filled during times of natural drought, leaving no basin to trap water when wet seasons returned. Wetland organisms are tough, however, and can stand dry periods. In fact, natural wet/dry cycles are important to help keep many of our marshes healthy. But drained, filled or polluted wetlands rarely recover and their loss is usually permanent unless people step in. The effects of these permanent losses are far reaching. Much like the outwardly moving rings caused when you drop a pebble into a puddle, the effects of wetland destruction are felt far beyond the body of water itself and affect many different organisms.

Wetlands are important because they catch the water that runs across our land when the snow melts or after a heavy rain. Without wetlands to slow and trap this water, it runs quickly across much more land. This can cause downstream flooding and erosion of rich topsoil. Without topsoil, farmers need to spend more money on fertilizers to produce a crop. Marshes are nature's best tool for storing floodwaters, recharging clean water for wells and cleaning up pollution. If marshes are drained, pollutants collect further downstream and wells may dry up. Pollutants can cause problems in the wetlands we use for recreation and drinking water. Do you think people are an important part of wetland ecosystems?

Lesson eight continued



Let's look at a recently drained marsh. It is easy to see that we would quickly lose some of the plants, fish and tiny invertebrates (**A**) that depend entirely on the wetland to survive. But other, larger invertebrates (**B**), like dragonflies, crane flies and diving beetles, would disappear if there were no smaller animals for them to eat and no water for them to hide in or lay their eggs in.

Next to go would likely be the amphibians (**C**) like frogs. They need the wetland for feeding, for laying their eggs in, and for refuge in the soft mud bottoms during winter. Frogs are not very mobile on land and if the closest wetland was far away, all the frogs would die.

Once the frogs disappeared, so would the snakes that rely on them for food. Other animals, like great-blue herons and raccoons (**D**), that rely on frogs and fish for food would also have to find another place to live if the marsh was drained.

The drained wetland would also be an unsuitable place for muskrats and beavers (**E**) to live. Both require water for survival. Once the wetland was drained, the marsh vegetation (**F**) would change. All the plants that need temporary or permanent water to survive would slowly die. Without these plants, many birds and mammals (**G**) that use this vegetation for food, to build their nests in or to hide their young in, would have to move away. Ducks and many other birds, including red-winged blackbirds and marsh wrens, would be without a home.

Lesson nine

Wetland protection and restoration

1. In the box below generate as many ideas as you can think of to respond to the question.

What factors can cause permanent changes to the living (biotic) and nonliving (abiotic) parts of wetlands?

2. With a coloured marker, circle one thing in the box you think is a beneficial change. Explain why you think so: _____
_____
_____
_____
_____
_____
_____
_____
_____

3. List three things you and other people could do to prevent negative changes in wetlands: _____
_____
_____
_____
_____

Also available from Ducks Unlimited

Wetland Ecosystems 1
Habitats, communities and the diversity of life

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GRADES 4-6

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Wetland Ecosystems 2
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GRADES 7-8

TEACHER'S GUIDE
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Wetland Ecosystems 3
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STUDENT JOURNAL
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PROJECT Webfoot™
www.ducks.ca

Because many people are unaware of the tremendous value wetlands provide for our environment, economy and well being, these amazing places continue to be destroyed at an alarming rate. The goal of Project Webfoot is to reverse this trend by raising awareness and appreciation of wetlands among students, teachers, parents and communities.

Project Webfoot is an international, interdisciplinary education outreach program and curriculum created by Ducks Unlimited to bring wetland education to students of all ages. Your support of this program in your community will help create a public that is committed to wetland conservation now and in the future.
To receive more information about Project Webfoot, contact Project Webfoot, c/o Ducks Unlimited Canada, P.O. Box 1160, Stonewall, Manitoba, R0C 2Z0.

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