

Teacher's Guide to the Wetland Forest Trail



Contributors to this Guide

include:

Josh Silverstein

Becky Haag

Sara Focht

Mary Terra-Berns

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WELCOME TO THE WATERLIFE DISCOVERY CENTER!

This manual has been developed to help you create a meaningful and fun experience at the WaterLife Discovery Center for you and your students.

Although the activities in this manual target 5th – 7th grade students, teachers may want to modify them for younger or older students. As well, the activities may be modified to teach other disciplines, like math and writing.

This manual is meant to be used in conjunction with the interpretive signs along the Wetland Forest Trail. Each section of the manual (as well as the student's field journal) is linked to the corresponding trail sign. Reviewing the manual before your field visit will familiarize you, and your students, with the interpretive signs and what the WaterLife Center has to offer.

This Teacher's Guide is meant to be a resource for *you!* Therefore, we hope you find it useful and informative. If you have any suggestions for how we can improve this manual or for what other types of materials would be useful, please don't hesitate to contact us.

Thank you, and enjoy your visit!



CONSERVATION

Conservation is a state of harmony between men and land. By land is meant all of the things on, over, or in the earth. Harmony with land is like harmony with a friend; you cannot cherish his right hand and chop off his left. That is to say, you cannot love game and hate predators; you cannot conserve the waters and waste the ranges; you cannot build the forest and mine the farm. The land is one organism. – Aldo Leopold

Aldo Leopold, the father of modern wildlife management, realized that wildlife conservation and wetland conservation are tied closely together. One cannot be separated from the other. Because of that, hunters and anglers have stood at the forefront of wetland conservation in America for over 100 years. Sportsmen and sportswomen have paid billions of dollars to conserve millions of acres of habitat for resident wildlife through license fees and excise taxes on sporting equipment.

These revenues remain the primary funding source for State Conservation agencies, such as Idaho Department of Fish and Game. Critical national and state conservation legislation has also been driven primarily by sportsmen. Additionally, sportsmen are responsible for founding and generously contributing to nonprofit conservation organizations which may directly own, lease, and manage land for wildlife.

The land upon which the WaterLife Discovery Center is built was purchased and donated to Idaho Fish and Game by a group of Bonner County sportsmen. Much of the funding for construction of the WaterLife Center came from hunting and fishing organizations. One only needs to look at the donor list to realize that hunters and fishermen are not only interested in wetland habitat conservation, but also in providing a place for the public to learn about the importance of wetlands in our daily lives.

If you are enjoying your visit here at the WaterLife Center, please thank a sportsman or sportswoman; they made it possible.

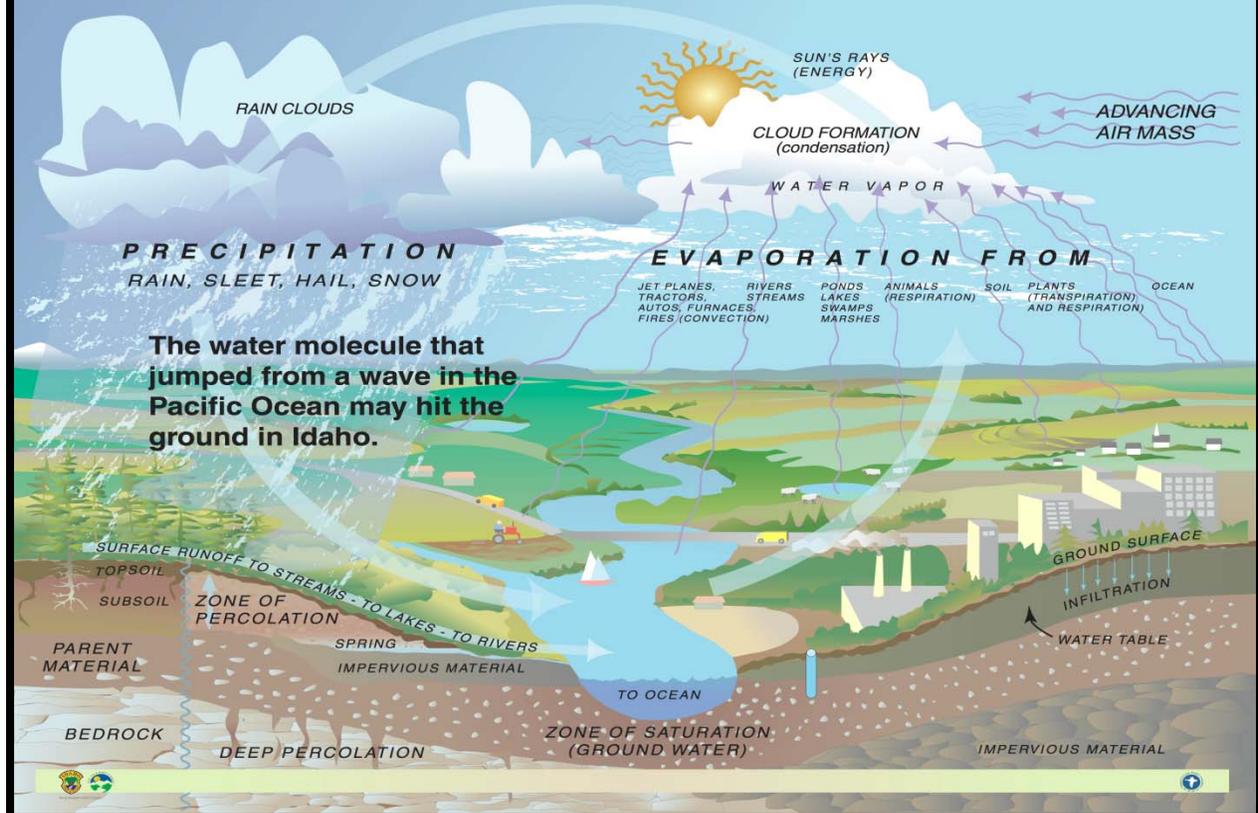
Suggested Activity

Have students come up with a local (Idaho) project they think would benefit wildlife conservation and how that project would be funded. This needs to include, how, where, who, and what species will likely benefit.

Water Cycle

Each molecule of water on earth has been processed through the water cycle countless times.

Then, one year or one hundred years later, that molecule may work its way back to the ocean to start the cycle again!



Learning Objectives-after this lesson, students will be able to:

- Describe the different stages in the water cycle
- Explain the source of local precipitation
- List the three forms of water

Vocabulary Words

- | | |
|--------------|-------------------|
| Dew Point | Hydrology |
| Evaporation | Precipitation |
| Condensation | Relative Humidity |

THE WATER CYCLE

Earth's water is always in a state of motion, and the **Water Cycle**, also known as the **Hydrologic Cycle**, describes the continuous movement of water on, above, and below the surface of the Earth. The Water Cycle is truly a "cycle" because it has no beginning or end. Water can change form between solid (ice), liquid (water), and vapor (steam) at various places within cycle. These processes can happen in the blink of an eye or over millions of years.

The Water Cycle has no particular starting point. Oceans are a convenient starting point that many scientists use because most of the Earth's water is stored there.

Terminology

Evaporation

Evaporation is part of the hydrologic cycle in which liquid water is converted to a gas (vapor) and enters the atmosphere. Ninety percent of atmospheric water comes from evaporation. The vapor on the surface of oceans, lakes and rivers rises with air currents that travel upwards.

Condensation

Condensation is the opposite of evaporation and occurs when water changes from a gas to a liquid. As rising air cools, it cannot hold as much water vapor as it could when it was warmer. The cool condensed air collects as liquid on tiny particles, such as dust and pollen, in the sky and forms clouds. Morning dew is an example of condensation. Without condensation, water would not collect in clouds. Clouds are crucial to the water cycle because they move water around the globe.

You can see condensation happening not just in the formation of clouds, but at home as well. When you pour glass of cold water on a hot day, water forms on the outside of the glass. That water didn't somehow leak through the glass; it actually came from the air. Water vapor in the warmer air outside the glass turns back into liquid when it touches the cold glass.

Precipitation

As clouds move around the atmosphere, growing and colliding, they may accumulate so much water that they can no longer hold it all. When this happens, water falls from the sky as precipitation, and may be in the form of rain, snow, hail or sleet. Precipitation on the land near Sandpoint flows into lakes and streams where it is eventually is carried back to the Pacific Ocean.

Run-off/collection

Most precipitation falls back into the oceans or onto land. When it falls on land, the precipitation flows over the ground as surface runoff or soaks into the ground. Runoff flows to freshwater streams, rivers and lakes; and a substantial amount soaks into the ground and is stored in underground aquifers. Eventually, sometimes a few days, sometimes hundreds of years later, this water finds its way back to the oceans where the water cycle begins all over again.

At the WaterLife Center

Lake Pend Oreille, and on a lesser scale, this low lying Wetland Forest Trail, act as collection areas for the water that is precipitated here. Most of the precipitation in northern Idaho comes from the evaporation and condensation of water from the Pacific Ocean.

Suggested Activities

Have the students draw a simplified version of the water cycle in their journal including evaporation, condensation, and precipitation.

Lead The Incredible Journey lesson in Project WET.



Wonderful Wetlands!

Wetlands provide the vital link between land and water.

Wetlands provide us many benefits.

- They act as filters to trap excess sediments, nutrients and pollutants.
- They reduce the effects of drought by acting as sponges that trap and slowly release surface water, rainfall and snowmelt.
- They reduce erosion by slowing down the speed of flood waters.

Freshwater wetlands are found in low-lying areas often along rivers, lakes, and streams. Water is provided by snowmelt, rainfall, flooding, and ground seepage. Wetlands can be dry sometimes (seasonal) or continually wet (permanent).

There are several types of wetlands found in Idaho. They are defined by the plant types found:

- shrub
- forested
- cattail marshes
- sedge/grass
- peat bogs



Learning Objectives-after this lesson, students will be able to:

- List three things that define a wetland
- Describe three ways wetlands are important
- Describe why the Wetland Forest Trail is a wetland

Vocabulary Words

Protozoa
Wetland
Estuarine

Bacteria
Detritus
Nutrients

Fungi
Lacustrine
Riparian

Marine
Palustrine
Aquatic Life

WONDERFUL WETLANDS

Due to the large variety of wetlands worldwide, the definition of what a wetland is can vary. According to the official definition used by the U.S. Government, wetlands must contain the following three specific features:

1. Hydrology (amount of and period of time that water is present);
2. Hydrophytic vegetation (plants adapted to wet soil);
3. Hydric soils (soils low or absent in oxygen due to their saturation in water).

The U.S. Fish and Wildlife Service accepts as wetlands areas that meet one of these three criteria, while the U.S. Army Corps of Engineers only classifies areas as wetlands that meet all three criteria.

Why Wetlands are Important

Wetlands are exceptionally productive because of the amount of vegetation they contain. Abundant plants constantly photosynthesize, converting carbon dioxide to oxygen and producing energy and food. Nutrients produced by the plants are distributed widely through floods, storms, and tides. The nutrients from detritus also fuel more plant growth which in turn feeds herbivores, such as deer and moose.

Dead and dying plants (detritus) form the base of food webs. Protozoa, bacteria, fungi, and larvae consume the detritus. Fish, worms, birds, and insects consume the detritus-consumers. These animals in turn are eaten by other animals further up the food chain, such as hawks, eagles, mink, and coyotes.

The dense vegetation in wetlands creates a natural water treatment system that surpasses anything that humans have created. As water enters a wetland it slows down. Sediment settles out and is trapped by the wetland plants and their roots. Plants also absorb almost two-thirds of the nitrate and phosphorous, commonly carried in storm water runoff and floods, especially runoff from agricultural areas with their heavy loads of fertilizer.

Bacteria in the water and soil also can neutralize wastes, including the body wastes of animals and humans. The slowed, cleansed water of a wetland may pass into another waterway, but much of it percolates into the ground and recharges groundwater supplies.

There are many types of wetlands in the world (e.g., marine, estuarine, riverine,

lacustrine, and palustrine). In Idaho, we have the following three types riverine, lacustrine, and palustrine.

At the WaterLife Center

A wetland dominated by woody plants, which is what we have here at the WaterLife Center, is typically called a swamp or wooded wetland. The soils are saturated during the growing season and at certain times of the year standing water is common. Waterlines are visible on the trunks of trees and rocks.

Woody plant species common to wooded wetlands of the Pacific Northwest include tree species such as western red cedar, black cottonwood, and paper birch, and woody shrubs such as common snowberry, red-osier dogwood, Sitka alder, and Wood's rose.

Wildlife

Wetlands support an abundant and diverse array of wildlife including:

- Mammals such as moose, deer, beaver, mink, raccoons.
- Birds like waterfowl, songbirds, woodpeckers, wading and shore birds, raptors.
- Reptiles and Amphibians such as frogs, toads, salamanders, snakes.
- Insects such as butterflies, spiders, beetles, dragonflies.



Suggested Activities

Make Your Own Wetland

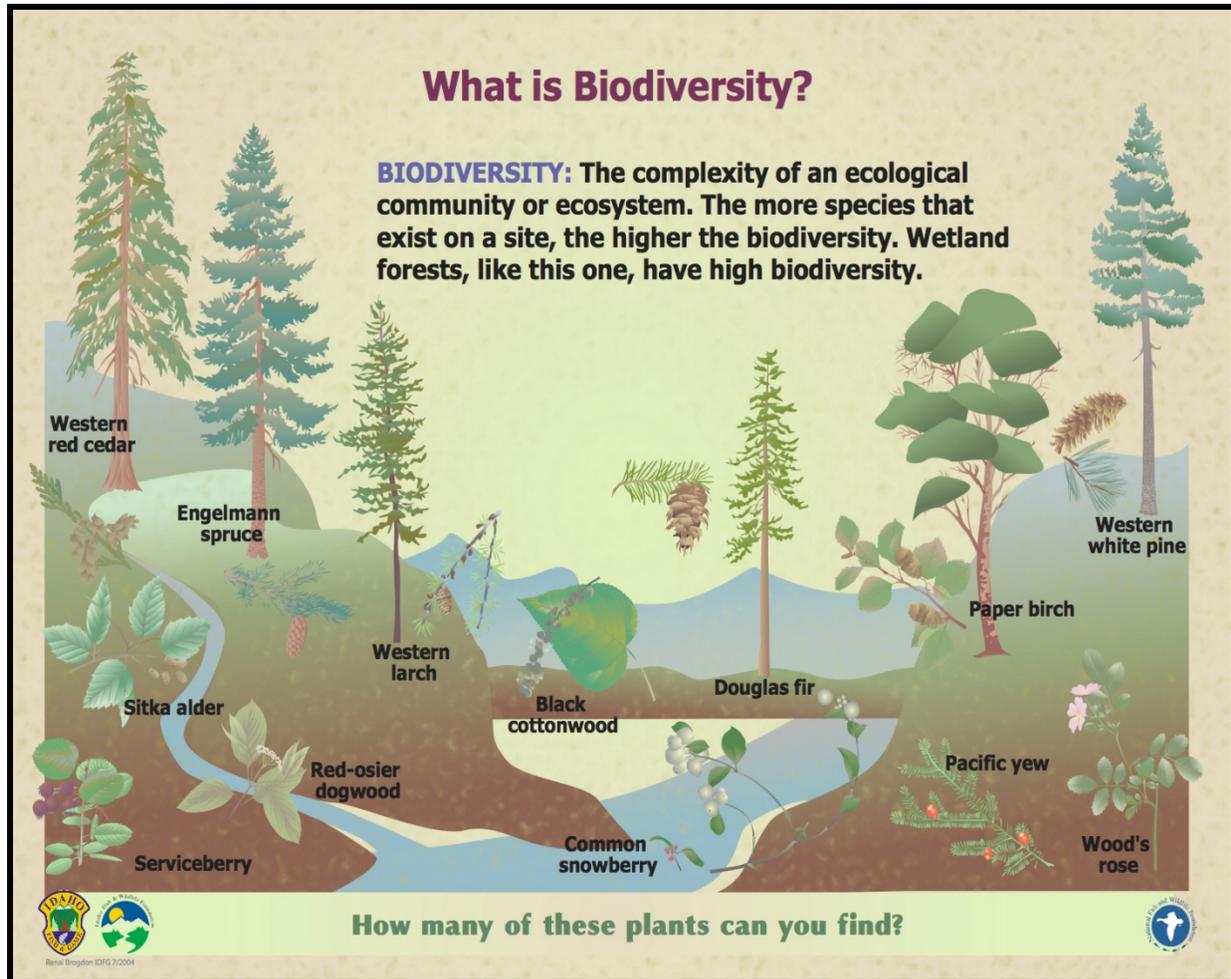
(Materials: four jars per student group, gravel, four types of soil, organic material, and water.)

Break students into groups of 4 (+/-). Demonstrate some of the properties of wetlands and how they are formed, using four jars and varying amounts of soil and organic material. Put an inch of gravel in the bottom of each jar. Add a different kind of soil to each jar. Fill half full, with one inch of organic material on top.

Add water to the jars in 50 ml increments, waiting at least two minutes in between in addition of water. When there is standing water on the surface of the soil, stop adding water.

Which type of soil drains most quickly? Why? Which soil type absorbs the most water before showing puddles? All containers now satisfy one of the conditions for being a wetland. Discuss what other conditioners should be met for these containers to become “real” wetlands.

Think about a simple wetland food web that includes, 1) organisms you can see, and 2) organisms you can't see (whether cryptic or small).



Learning Objectives-after this lesson, students will be able to:

Explain why places with high biodiversity are more stable than places with low biodiversity

Vocabulary Words

Biodiversity
Species Richness
Species Abundance

Ecological Stability
Monoculture

BIODIVERSITY

The word “biodiversity” is a contraction of the phrase “biological diversity.” Biodiversity is the complexity of an ecological community or ecosystem, which includes genetic variation within species, the variety of species in an area, and the variety of habitat types within a landscape. Wetland forests, like this one, have high biodiversity.

Globally, biodiversity is greatest in the tropics. Estimates of the number of species living on Earth falls between 5 million and 30 million, largely because most living species are microorganisms and tiny invertebrates. However, roughly 1.75 million species have been formally described and given official names. Over half of the described species are insects, which comprise almost 75% of the known animal species.

A significant proportion of drugs are derived, directly or indirectly, from biological sources. In most cases these medicines cannot presently be synthesized in a laboratory setting. Additionally, a wide range of industrial materials are derived directly from biological resources. There is enormous potential for further research into sustainably utilizing materials from a wider diversity of organisms.

Healthy ecosystems support abundant wildlife, which the people of Idaho enjoy through recreational activities such as hunting, fishing, and wildlife viewing. Hunting and fishing fees pay for much of the conservation of fish and wildlife species in Idaho.

At the WaterLife Center

Notice the biodiversity of trees on this site, including cottonwood, fir, and cedar. The different species of trees and bushes present provide various nesting and feeding opportunities for wildlife and contribute unique chemical and physical variation to the area.

Some birds, such as flickers and brown creepers, nest in tree cavities while others such as wrens and song sparrows nest low in bushes. Still others, like crows and western tanagers prefer high tree tops. This forested wetland generally provides greater opportunities for a greater variety of inhabitants than the surrounding upland areas.

Wildlife

Wetlands support a diverse array of wildlife species. Forested wetlands generally support a greater variety of wildlife than nearby upland forests. Wetland ecosystems are second only to the rain forests in the number of wildlife and plant species that depend on them for feeding and habitat. One third of all U.S. bird species, about 230 out of 686 species, depend on wetlands for one or more of their life requirements.

Wetlands are important to mammals as a source of food and cover. Many of our local game and non-game species are dependent on the biodiversity in wetlands. For example, bears are omnivorous consumers and feed on fish, frogs, eggs, and berries found in wetlands.

Approximately 190 species of amphibians, including frogs, salamanders and toads, require wetlands for reproduction activities further illustrating the high level of biodiversity found in wetlands.

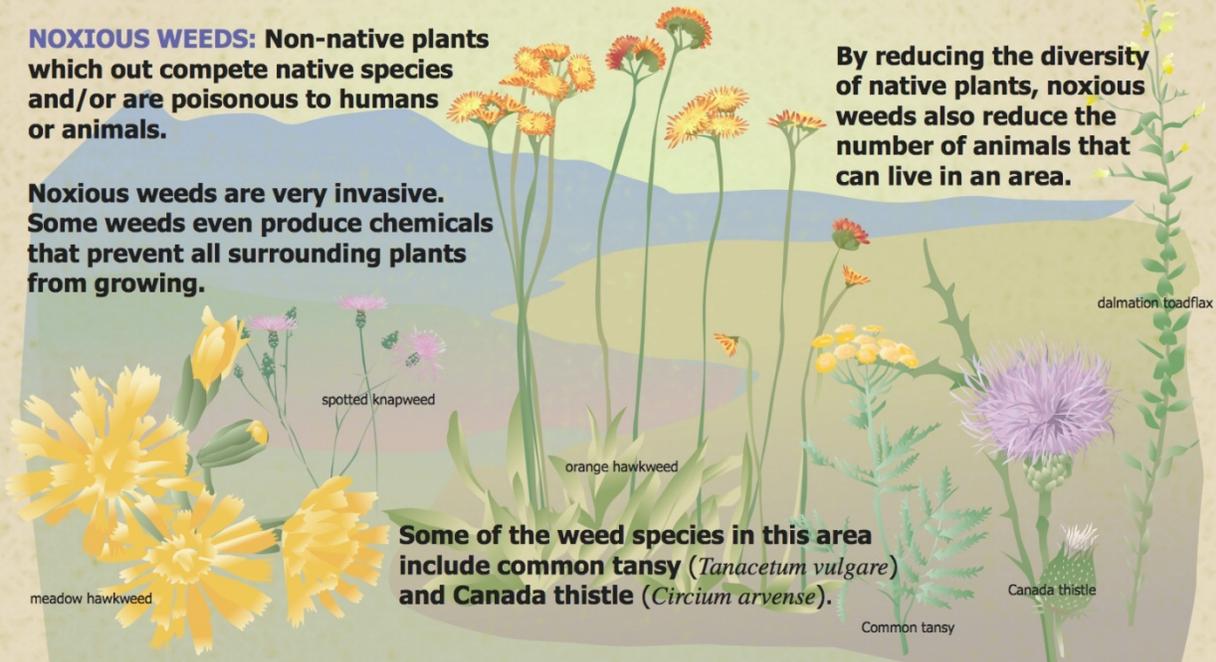


Why Should We be Concerned About Noxious Weeds?

NOXIOUS WEEDS: Non-native plants which out compete native species and/or are poisonous to humans or animals.

Noxious weeds are very invasive. Some weeds even produce chemicals that prevent all surrounding plants from growing.

By reducing the diversity of native plants, noxious weeds also reduce the number of animals that can live in an area.



Some of the weed species in this area include common tansy (*Tanacetum vulgare*) and Canada thistle (*Cirsium arvense*).



How Can Humans Control the Spread of Noxious Weeds?



Learning Objectives-after this lesson, students will be able to:

- Explain what a native plant is/Explain what a non-native plant is
- List the attributes of a noxious weed
- Describe the competitive process between native plants and noxious weeds
- Describe the effect noxious weeds have on wildlife, human recreation, agriculture.

Vocabulary Words

- | | |
|--------------------|------------------|
| Competition | Invasive Species |
| Native Species | Noxious Weed |
| Non-native Species | Habitat |

NOXIOUS WEEDS

Native plants in Idaho are those which evolved here. Native plants have developed adaptations to survive in Idaho under certain climate conditions, weather patterns, fire patterns, and wildlife that feed on them. Native plants in Idaho have natural limits to their growth.

Non-native plants in Idaho are plants that evolved somewhere else and were transported to Idaho. These plants could be from elsewhere in this country, or from other countries. Not all non-native plants are “bad” (e.g. apple tree). However, some non-native plants are considered “bad.” These plants are called **noxious weeds** (invasives) and spread rapidly out-competing native plants. Invasive plants can cause economic, aesthetic, recreational, and ecosystem damage.

Invasive plants out-compete natives because they often:

1. Produce larger numbers of seeds than natives
2. Germinate quicker and grow faster than natives
3. Monopolize nutrients and water through extensive root systems or by releasing toxins that kill surrounding plants
4. Avoid predation from herbivores through spines, thorns, hairy leaves, and/or toxins that have a foul taste
5. Tolerate a broader range of environmental conditions (extreme heat or cold, low nutrient availability)

Remember that just because a plant is not native to Idaho, doesn't make it a noxious weed! It must be an invasive plant. The state of Idaho has an official noxious weed list. These plants have been identified by the state as problem plants; time, money and labor are dedicated to eradicating them!

The Idaho Weed Awareness Campaign website can help you learn more about noxious weeds, learn what plants are on Idaho's noxious weed list, and help you identify weeds. <http://www.idahoweedawareness.org/>

Terrestrial and Aquatic Invasive Plants

Some invasive plants, such as spotted knapweed, are considered terrestrial plants. The word terrestrial refers to plants that live and grow on land. Aquatic invasive plants, those that live and grow in the water, include Eurasian water milfoil and curly leaf pond weed. Once an invasive species has established itself in an area, it

is very difficult to remove. The most common reasons non-native species thrive in a new environment is because abundant food sources are available and they have few, if any, natural predators or parasites to moderate their growth.

How to Control Invasive Species

There are over 4500 non-native species in North America. Many are pests to agriculture, businesses, industries, and humans. A few of the methods used to control non-native species are:

- **Prevention** – Once an invasive species has established itself in an area, it can be *very* difficult to eradicate. Preventing the introduction of non-natives is the best control. Preventative measures include inspecting vehicles that transport them, and educating the public.
- **Physical control for plants** - Cutting or harvesting plants, crop rotation, and burning to keep their numbers from growing, spreading and reduce their reproductive rates.
- **Chemical control for plants** - Chemicals can be sprayed directly on plants to kill them or introduced in the soil to inhibit plants from germinating.
- **Biological control for plants and animals** - This method generally consists of identifying a natural enemy or predator for the known pest and introducing it into an area to control the population of the pest.

At the WaterLife Center

The WaterLife Discovery Center and the Wetland Forest Trail have invasive weeds! Common tansy and Canada thistle are two weeds you are likely to see here. Check your noxious weed manual or the kiosk on the trail for photos helpful in identifying these plants.

Wildlife

Noxious weeds destroy wildlife habitat, food, water, shelter and space each animal needs to survive. Noxious weeds often do not have the nutritional content of native vegetation, which may directly affect herbivores both large (e.g., deer and moose) and small (insects). Indirect impacts may include a decline in species that depend on insects for food. Humans can be affected when invasive species compete with cultivated crops and forage for domestic livestock.

Eurasian water milfoil (EWM) can be found in Lake Pend Oreille and in the Pend Oreille River. Although waterfowl will eat EWM, it has less value as a food source for waterfowl than the native plants it replaces. This may compromise an animal's health when compared to those whose diet consists of primarily native species. Dense beds of EWM can obstruct predation, alter feeding success and behavior, and cover spawning areas as well. Fish abundance in a native plant community can be as much as 3 to 4 times greater than that of an area over taken with EWM. Beds of EWM support fewer invertebrate species and significantly lower population density of invertebrates than beds of mixed native vegetation.

Spotted Knapweed is one of the most aggressive and damaging invasive species in the United States. In Glacier National Park it has put wildlife at risk, infesting over four million acres and reducing six native plant species to "rare" status and bunchgrass, which is important forage for elk, has been reduced by 97.8 percent.

Some songbirds exhibit delayed breeding, diminished productivity, and reduced site fidelity in knapweed-invaded habitats compared to native habitats.

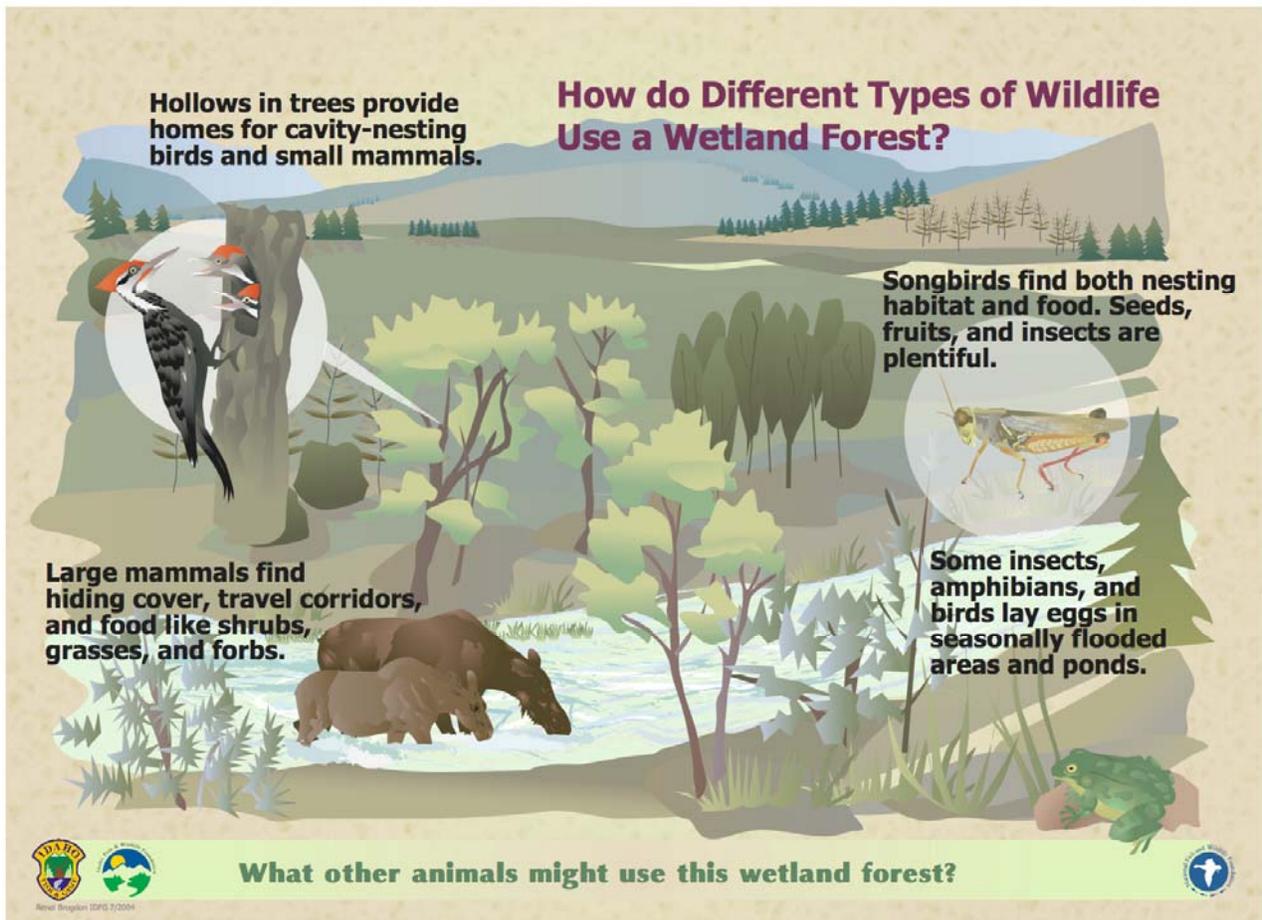
Grasshoppers and other insects significantly decline with knapweed invasions, supporting the contention that waning food resources are driving impacts of knapweed on songbirds and other insectivorous wildlife species.

Suggested Activities

The WaterLife Center should have a classroom set of "Noxious Weeds of Bonner County" to carry with them while at the Waterlife center. Have each student find as many different invasive species as they can and write and illustrate each in their journal.

What methods might be effective in controlling these? Name some positive and negative aspects of each control measure?

Look at the forest succession section, can you predict in what habitats you would expect to find more or less noxious weeds.



Learning Objectives-after this lesson, students will be able to:

- Define the four components of habitat (food, water, shelter and space)
- Give examples of animals that use wetland habitat

Vocabulary Words

Snags

Habitat

Forbs

WETLANDS AND WILDLIFE

Animals need food, water, shelter, and space to survive; therefore, they search out habitats that will fulfill these basic needs. A suitable habitat will provide the physical (shelter, space) and biological (food, water) requirements for continued existence. In a forested wetland such as the one at the WaterLife Center, wildlife populations are dynamic because the forest is always changing through succession (discussed in the next section), and other natural and manmade occurrences. Loss of habitat is one of the primary threats to animal survival. If habitat is destroyed or degraded, animals cannot continue to get what they need to survive.

Wetlands Plants

Wet soil has less oxygen, so plants living in it must have special adaptations. Some, like reeds and sedges, are hollow so oxygen travels more quickly through the plant, and others, such as lilies, dangle their roots into water to absorb oxygen directly from the water. Similar adaptations allow plants to get the proper nutrients and sunlight.

Wetlands Animals

Wetlands provide important habitat for a wide variety of wildlife – mammals (e.g., muskrat, otter, and raccoon), birds (e.g., herons, blackbirds, geese, and ducks), reptiles (e.g., garter snakes), amphibians (e.g., frogs and salamanders), fish (e.g., sunfish, bluegills, bass) and invertebrates (e.g., dragonflies, mosquitoes, and many, many, others). Some animals live their whole lives in wetlands while others may use wetland habitats specifically for breeding or other essential parts of their life cycle.

Wildlife Habitat

Many game species such as bear, deer, and elk use wetlands as travel corridors, hiding and resting cover, and forage on the wide variety of plants. Predatory species take advantage of the abundant prey species foraging in the wetlands.

The plentiful supply of algae and small invertebrates provide forage for birds and reptiles that make nests in the downed logs and branches. Many wetland plant species provides food (seeds, fruits) for a variety of primary consumers such as deer, muskrat, mice and voles. Cavity nesters like woodpeckers, chickadees, owls

and flying squirrels, utilize dead trees (snags) for nesting. Woodpeckers use snags as well as stumps and downed logs to forage for insects. Dead and dying trees with loose bark and fissured trunks provide excellent roosting places for bats. Bats can eat up to 420 insects, such as mosquitoes, in one hour, making wetlands a premier habitat for them.

At the WaterLife Center

A forested wetland is home to and frequented by a variety of wildlife species. Listen and you may hear varied thrushes and hermit thrushes. Great horned owls can be found sitting on large branches in trees watchful for an unsuspecting shrew or vole to scurry along the ground.

Owls will often use the same perch and owl pellets can be found on the ground under these trees. Breaking apart these pellets will reveal what the owl has been eating.

Bats use the loose bark on trees for roosting at night. Larger animals such as deer frequent the trail for a travel corridor and to get a drink of water. They also use the dense vegetation for security cover.



Suggested Activities

Sound Map

Making a sound map is one way to record different sounds you hear over a period of time. If sound maps are created in a variety of different habitats, you can determine relative species abundance. Sound maps are a quiet, individual listening activity. Children who have a hard time concentrating or are restless will have a difficult time with this activity. A reward for the most sounds heard may help some children focus on the activity.

For children, 5-10 minutes is an appropriate time span for a sound map. Before the children disperse to find their listening area, give them all the directions. Tell them:

1. They will need to find a place to comfortably sit in sight of you, but not with other kids.
2. They will need their journal and pencil.
3. They must be as quiet as possible
4. It does not matter which way they face when they sit.
5. They need to draw a dot in the center of their paper. That dot represents them. Space at the top of their paper represents space in front of them. Space at the bottom of the paper represents space behind them. The right side of the dot represents space to their right and so on.
6. They are to record everything they hear with a symbol. Students can use letters or shapes to represent sounds. Each time they hear a repeated sound, they record it again using the same symbol.

Some students might do better if they close their eyes and wait for a sound, then open their eyes and record the sound on their paper. This activity does not use sight at all.

1. They should continue the activity until you tell them the time is over.
2. They should make a legend after the time is up. It does not matter if they don't know what the sound was.

5-01-04 Picnic Meadow



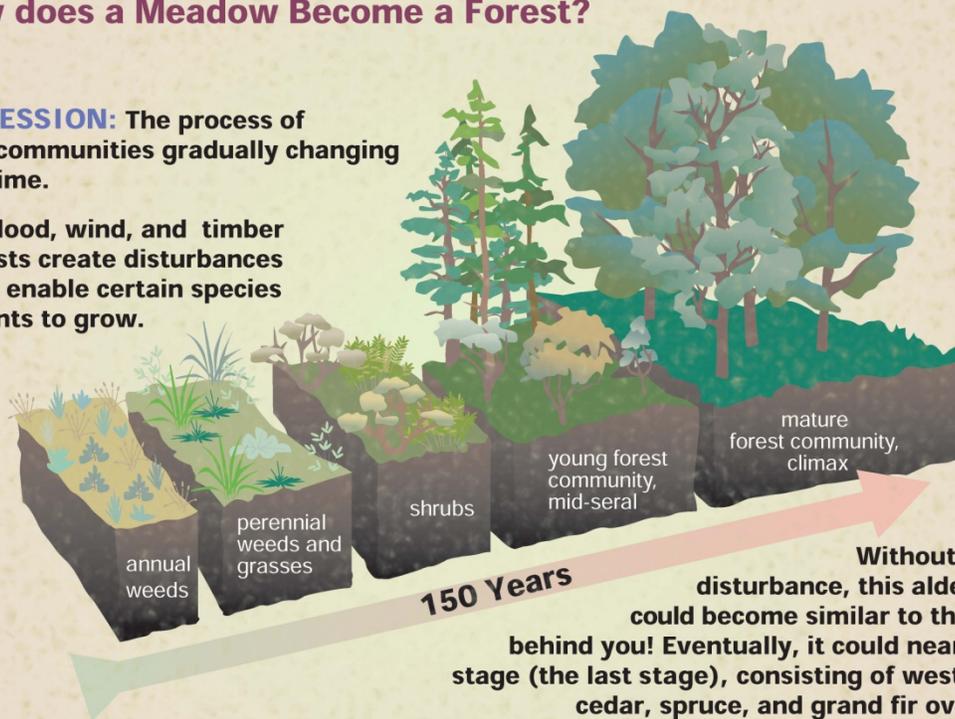
- ~ Clark's Nutcracker
- ~ pine squirrel chatter
- ~ Kinglet
- o flicker
- o fly buzzing
- ~ bird wings flapping
- Δ raven call
- () grouse drums
- ~ unknown bird
- o unknown bird
- o wind in conifers
- o chickadee
- o woodpecker
- ~ tree trunk creaking
- o Sandhill cranes
- Me



How does a Meadow Become a Forest?

SUCCESSION: The process of plant communities gradually changing over time.

Fire, flood, wind, and timber harvests create disturbances which enable certain species of plants to grow.



What disturbances might occur here?
How might they affect this plant community?



Learning Objectives-after this lesson, students will be able to:

Explain the progressive stages a forest goes through by describing the composition of different species and densities prior to reaching a climax community.

Describe the function of corridors.

Vocabulary Words

Succession
Seral Stages
Climax Community
Disturbance

Shade Tolerant
Shade Intolerant
Edge

SUCCESSION

Forest openings are critical for many plant communities. Many plants like western larch and ponderosa pine need lots of light to germinate and grow. Without openings, these species cannot thrive. Openings can be natural (fire, disease, windthrow, fungal or insect outbreaks, etc.) or man-made (logging, fire breaks, utility cuts).

Openings in the forest also affect wildlife, such as deer, birds, and other creatures. In the winter, more sunlight means warmer temperatures in openings, and often better foraging in the spring and summer. Deer and other species may live near the edge of an opening, taking advantage of both the forage available in the opening and the shelter offered by the forest itself.

Stages of succession

Succession is the more or less predictable progression of the vegetative composition and structure of an ecological community. In each stage, the plants present prepares the area for the next stage in succession until a final equilibrium state, the climax is achieved.

Initial – pioneer species colonize an area in which life is not present, often following an ecological *disturbance*. Pioneer species must be hardy and must grow quickly to survive the often harsh conditions of a bare landscape. Such species include lichens, algae, mosses, and grass-like plants.

Intermediate – species in the area are more demanding in relation to environmental factors. Generally larger plants and shrubs.

Sub-climax – more complex than intermediate, precedes final stage. Larger shrubs and small trees are often indicative of this stage.

Climax - is the assemblage of plants that grow in an area when the final stage of succession has been reached.

Trees in the Forest

Plants such as western larch and ponderosa pine that need a lot of sunlight are called *shade-intolerant species*. Shade-intolerant trees do not thrive under a canopy of shade. The *shade-tolerant species* such as cedar and fir will out-compete the shade intolerant species in shady conditions. Shade tolerant species are more adapted to growing with less available sunlight. Therefore, forests will change in species composition through time. A young forest is more likely to be composed of shade intolerant species slowly becoming shade tolerant dominated over time. This is *succession*.

Forest openings

Corridors are lineal features whose primary wildlife function is to connect two significant and otherwise isolated habitat areas. The purpose of wildlife corridors is to reduce or moderate adverse effects of habitat fragmentation. For example, a band of trees may be left uncut during a timber harvest to connect two forested pieces that the harvest would otherwise leave isolated from one another. Animals needing hiding cover will use these corridors to move from one section of habitat to another.

Edge, also called **Ecotone**, is a term used in habitat ecology referring to the area between two habitat types. For example where a meadow and forest meet, this is the edge. Where habitat is fragmented by roads, timber harvest, or development, more edge is created. Some species, primarily habitat generalists (e.g., raccoons), will proliferate with increased amount of edge in a landscape. However other, more specific “core-dwelling” species (e.g., pine marten) do not fare as well as edge increases.

Wildlife

Different species of wildlife will use the different types of habitat throughout a landscape. Some species, such as woodland caribou and some owls, prefer the old growth climax forests to provide them with the food they have evolved to eat. Other species, such as snowshoe hare, prefer young forests. Still other animals,

such as lynx, will frequent both young and old forests to meet their food (snowshoe hare) and denning (older forests) requirements.

Many species of animals use different habitat types for different life requirements. For example, deer may rest in a forested area that provides good hiding cover, but will venture out into a meadow to eat. Thus, a mosaic of habitat types across the broad landscape will benefit the greatest variety of animals.

At the WaterLife Center

The Wetland Forest Trail is surrounded by different types of habitat on all sides. For example, the yard is across the road to the north. If the yard were left untended by humans, do you think it would become a forest look like the timber patch to the east? Would it eventually become an area similar to the Wetland Trail? For this to happen, trees and shrubs would first start to extend the forested area along the *edge*. What do you think will be the first plants to grow there?

Conversely, if a tree falls in the forested wetland, it will create an opening. This will allow more sunlight into that area, making it a drier micro-site, and vegetation would progressively grow until the opening was closed again.

What else might affect succession? How about soil types?



Suggested Activities

The Succession Game

This is a modified rock-paper-scissors activity, so to speak. All students start out as “bare ground,” for which they are squatting close to the ground with their arms stretched out horizontally. They must hop around and find someone else at the same stage of succession that they are (which will not be difficult starting out, since everyone is bare ground!).

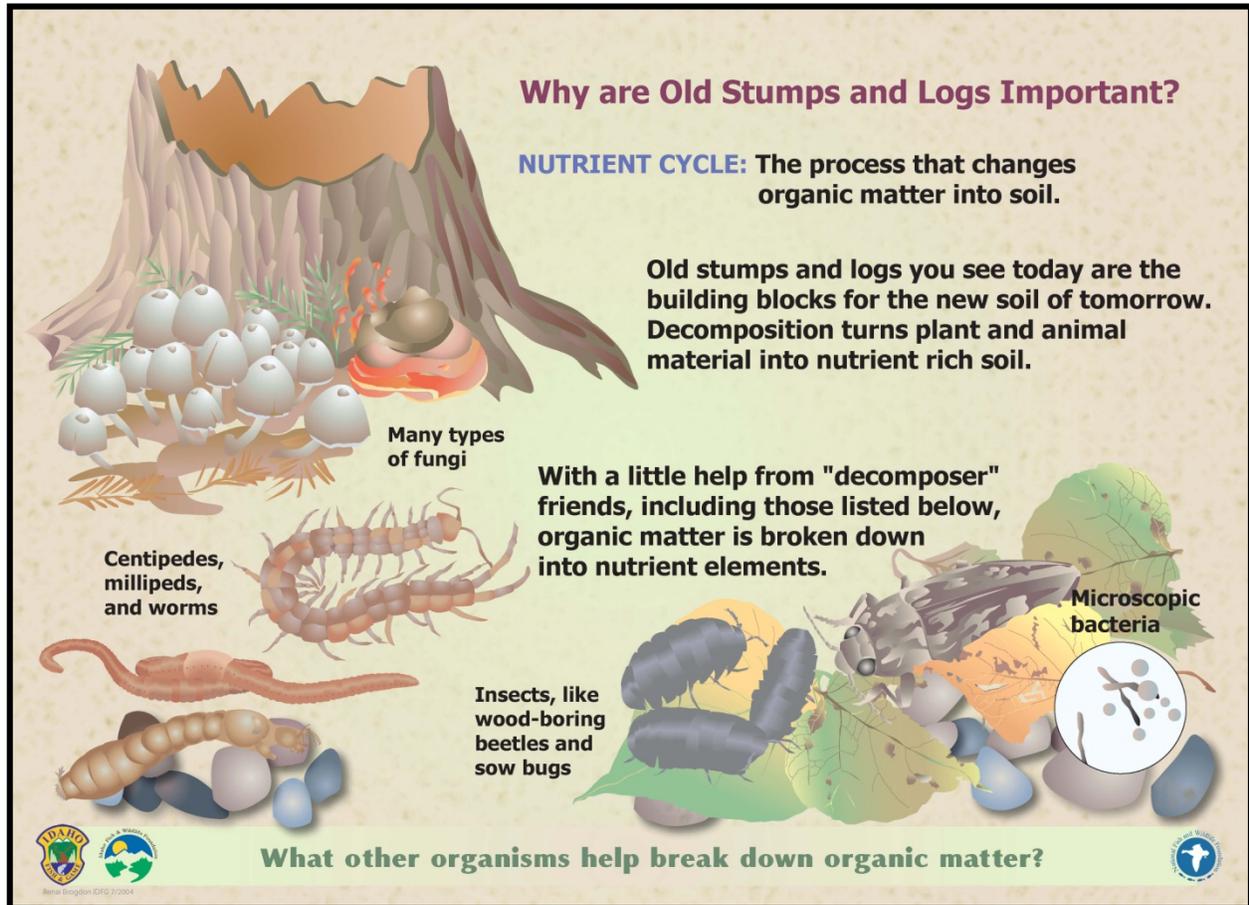
Once they meet someone, they play rock-paper-scissors (explain this to make sure everyone is on the same page) and the “winner” gets to move further along in succession to become grass. Grasses are still squatting, but wave their hands above their head like grass swaying in the wind. “Losers” must find another bare ground, and play again. Grasses may now play other grasses.

The game continues as grasses become shrubs (standing halfway with their hands out in an upside-down “V”) and eventually trees (standing tall with their hands together above their head). Since, in this simple version of succession, trees are the climax – the top rung of the ladder – once you become a tree your feet are rooted in the ground and you stand in the same spot and get to watch the other plants try to move along the successional path.

As facilitator, watch how the ratios start to change. When there are a few trees, and several shrubs and grasses, with maybe a few bare grounders left, have everyone stop, freeze, and look around to see the community that has been created. Briefly discuss how even with trees around there is still bare ground, grass and shrub-life.

You may wish to freeze the game many times and have the students notice how the structure of the community looks. When nearly all the students are trees, holler out some kind of natural or human made disturbance (wildfire, wind storm, logging operation) and tell them the disturbance cleared the area down to bare soil.....have them start again.





Learning Objectives-after this lesson, students will be able to:

Explain why dead and dying plants and animals are beneficial to ecosystems
 Describe how organic matter is broken down

Vocabulary Words

Decomposer
 Nutrient
 Organic Matter

THE NUTRIENT CYCLE

Just like water cycling through different stages, forms, and locations, nutrients follow a cycle of their own. Generally, nutrients found in plants are eaten and processed by animals, which then pass along the nutrients either in their feces or to animals higher on the food chain when eaten. Feces, fallen trees, and the bodies of dead plants and animals decompose into the ground. This process is aided by bacteria, insects, and fungi that break down the natural material. As the organic material decomposes, nutrients are returned to the soil, and taken up by new plants through their root systems: the cycle continues.

Each plant needs specific soil conditions to grow and thrive. Plants native to a geographical location are better suited to grow in the type of soil indigenous to that area. Thus, the natural processes that take place in an area are critical to perpetuating the plants and animals of that area.

To illustrate this point, consider a typical yard and garden at home. When growing a garden, it is best to test the soil to ensure that it can support the plants the gardener wants to grow. Often people will add commercial fertilizer, manure, or compost to their gardens and lawns to optimize the plants' growth. This is because gardens and lawns are typically kept clean and free of debris, decaying matter (detritus), and feces that would otherwise add the necessary nutrients to the soil for plants to grow.

But, too much of a good thing can be as harmful as too little. Adding too much decaying matter to an area can overload the soil and make it too nutrient rich to grow plants as well. Each ecosystem and habitat type has developed its own typical nutrient load from the plants and animals that inhabit it, leading to its own soil type.

Wildlife

The anadromous salmon (Steelhead and Chinook) that travel up the Clearwater River and its tributaries to breed will naturally die after spawning. The bodies of these fish provide vital nutrients along the banks of the streams and rivers. Sometimes, fish hatcheries that catch adult fish in their native streams and bring them to the hatchery to spawn will return the spawned out carcasses to the river to continue the cycling of nutrients.

In northern Idaho, some nutrient recycling is accomplished by ospreys and eagles. These raptors catch fish, take them to their terrestrial perches and eat them. The waste from this meal often times ends up fertilizing the perching tree.

Stumps, snags and old logs are vital ecosystem components for a variety of reasons. Many insect species live in and feed on the decaying matter. In turn, amphibians, bird, and mammals rely on these insects for their own diet.

Snags are an important component of the forest structure that provide den sites, nesting, roosting and foraging sites for many wildlife species (approximately 44 bird species and 14 species of mammals), as well as nutrients for the soil as they breakdown and decay. Several species of amphibians and reptiles are dependent on snags and downed logs for dens and food. In addition to providing excellent nesting and foraging sights for cavity nesters such as nuthatches and woodpeckers; many small mammal species also use snags. Bats, which roost under the loose bark of snags, can help control forest pests by consuming large numbers of insects during their nightly feeding. Flying squirrels use cavities and witches' brooms for nesting, especially when adjacent to riparian areas.

Small mammals such as the least weasel, squirrels, skunks, mice and wood rats use old logs for hiding cover and dens. Reptiles, such as snakes and lizards and amphibians including salamanders and frogs also use old logs for resting, hiding, and nesting.

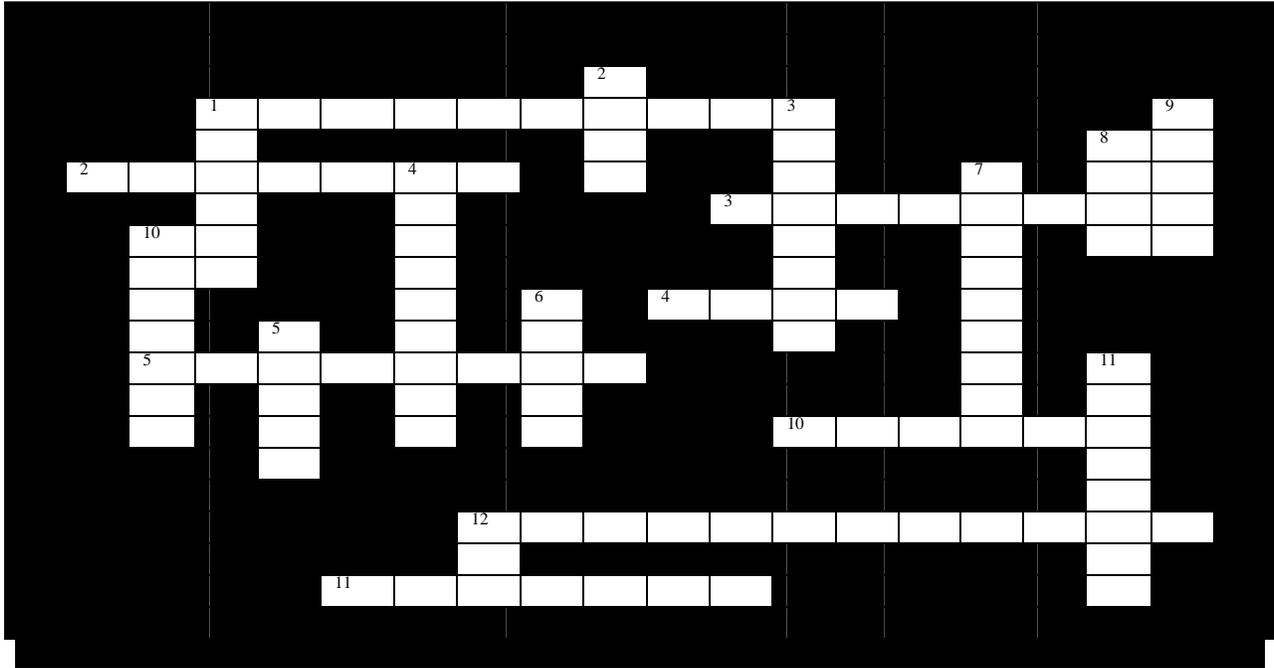
Thus, dead, dying and decaying organic matter in the forest provides habitat for resident wildlife from the smallest shrew to a big grizzly bear, as well as forage opportunities necessary for their survival.

At the WaterLife Center

Just looking around the kiosk along the trail we can find lots of old stumps and logs. Fallen logs rot and the bark loosens up, providing cover for small animals. Also, directly adjacent to the trail is a standing dead tree, called a snag. Why are snags important habitat features? Look closely at the snags, stumps and downed logs for bug holes and larger holes and cavities that have been excavated by pileated woodpeckers and yellow bellied sapsuckers.

Suggested Activities

Crossword Puzzle - Complete the following puzzle using the clues below.
 (Answers on page 50)

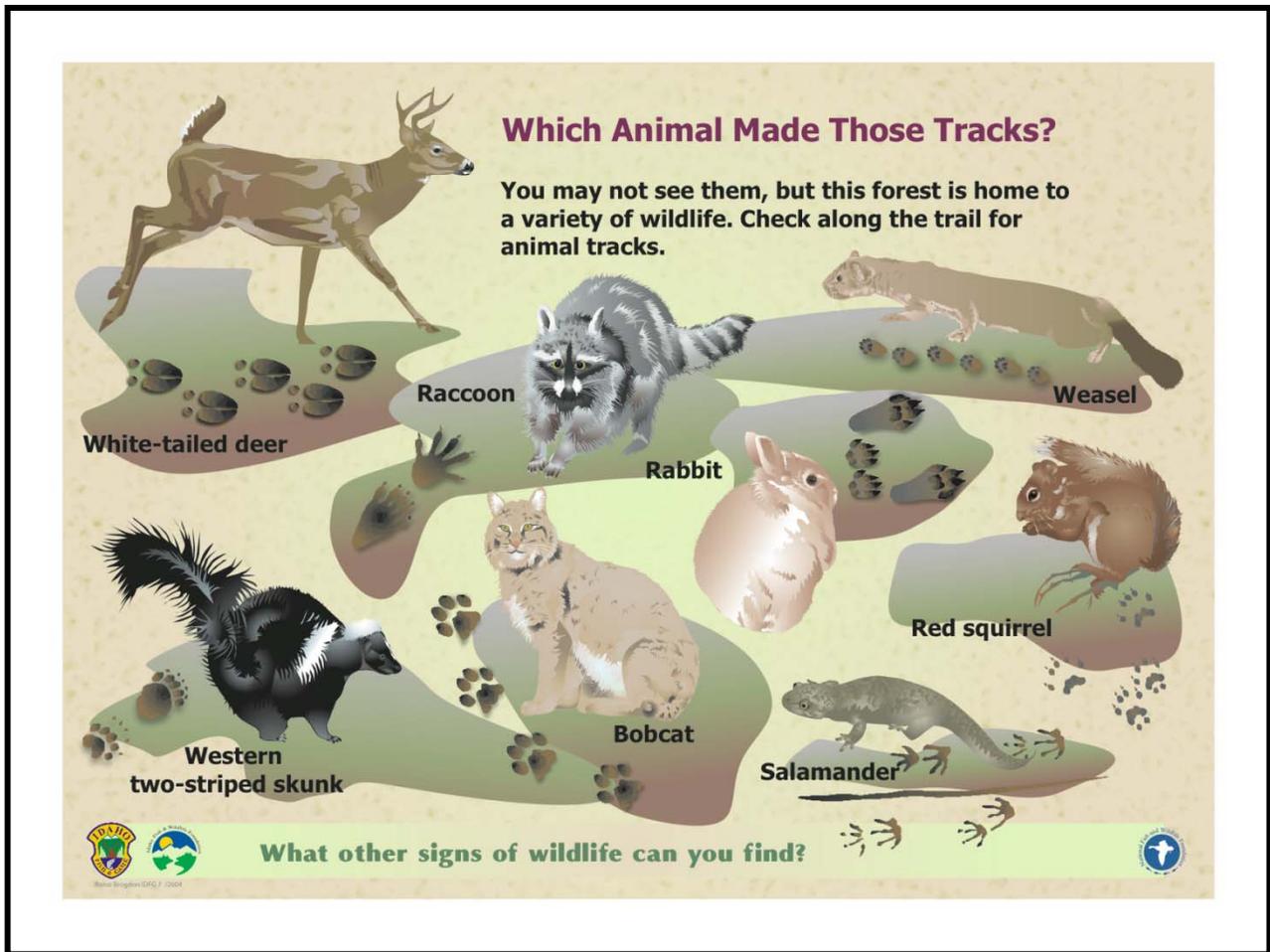


Across

- 1 An organism that breaks down dead plant or animal matter
- 2 The area where an organism normally lives
- 3 A large group of microorganisms
- 4 A dead standing tree
- 5 This matter is a source of nourishment for soil
- 10 A dense growth of trees
11. A lowland area saturated with moisture
- 12 The variability of living organisms on earth

Down

- 1 The remains of something that has broken up
- 2 An invertebrate with a long flexible body and no obvious appendages
- 3 Areas associated with a natural water course
- 4 A cold blooded smooth skinned vertebrate
- 5 The part of a tree left protruding from the ground after it has fallen
- 6 Taxonomic Kingdom including mold, mushrooms and toadstools
- 7 Chiefly nocturnal venomous segmented arthropod with a set of legs per segment
- 8 Collection of dirt and organic matter that vegetation grows in
- 9 Rot
- 10 Matter made up of materials produced by plants or animals
- 11 Decaying matter
- 12 A winged mammal



Learning Objectives-after this lesson, students will be able to:

Describe three categories of tracks and associate animals with those categories

List several different kinds of animal sign

Vocabulary Words

Track

Sign

Trail

Plantigrade

Unguligrade

Scat

Tracker

Gait

Digitigrade

ANIMAL EVIDENCE

Animal footprints or tracks can help you learn about animals and their behavior. However, tracks are just one type of animal sign. There are many others. Any evidence of an animal is considered “sign.”

Animal Track Types

Plantigrade– Plantigrades put their full foot on the ground (humans, bears)

Digitigrade–These animals walk on their digits, or toes. (dogs, cats)

Unguligrades–These animals basically walk on their toe nails! (deer, elk, moose)

Animal Gaits

There are multiple types of gaits, all dependent on the anatomy of each type of animal. (Please refer to the attached diagrams of prints and gaits)

- **Walkers** are “perfect steppers” with *direct registry*—their tracks look like they only have two feet because each hind foot steps exactly where the front foot, on the same side, had stepped previously. Walkers include deer and moose (ungulates), the cat family, and the dog family (though many dogs, especially domesticated, are “imperfect steppers,” and may show slight variation from the typical walker gait).
- **Waddlers**, well, waddle. Because of how their hips are formed, they waddle back and forth as they walk. Waddlers include bears, skunks, raccoons, beavers, muskrats and porcupines.
- **Hoppers** hop from place to place, which is evident in their tracks. Typical tracks show a set of two smaller prints inside (and slightly behind) a set of two larger prints. Hoppers include rabbits and hares, and rodents (e.g. squirrels, chipmunks, mice, voles, shrews, etc.).
- **Bounders** can be identified by tracks that show two front legs bounding forward, followed by two hind legs. Members of the weasel family are bounders, and picturing them enables one to visualize bounding better than a simple description. Members found in this category include weasels, minks, martens, fishers, otters and badgers.

Making Tracks

When attempting to identify an animal by its track you must not only look at the shape of the track and pattern of the gait, but also the how, when, where, and on what substrate a track is made. Time can change the size and shape of a track making it difficult to accurately identify. For example, as snow melts and refreezes, tracks can become larger than when the animal actually made them. Tracks in dry dusty conditions can quickly blow away, or parts of the track can blow away. Rain can wash tracks away.

The habitat where a track was found can also offer valuable clues regarding what type of animal made the track. What type of animals likely live in the area where the track was found? For example, you are not likely to find an antelope track at the WaterLife Center because antelope do not live in the Sandpoint area. You are, however, likely to find a white tailed deer track. In another example, a track found miles from water is not likely to be a beaver or river otter. Geography, surrounding vegetation type, and other habitat clues are fundamental in deciphering animal tracks.

To confidently identify an animal track, you must consider a number of factors: Size, shape, likely age of track, substrate track was laid in, weather conditions, pattern of tracks (gait and track type), location of track, and habitat type.

Additional Animal Sign

In addition to tracks, there are many other clues to help determine what species of animals are in an area. **Nests, dens, beds, hair, and scat** can provide additional information. Many animals, including birds, make nests, and many nests are unique. Woodpeckers and chickadees build nests in the cavities of trees, orioles build hanging nests from tree branches, and several species of swallows build nests primarily of mud and saliva. Hair, feathers, and scat can often be found in and around nests, beds, and dens to provide additional clues.

Scat is another word for animal droppings. The size, shape, and contents of the scat can identify the species of animal it came from.

Scent and sound can identify animals present when none are visible. Some animals can leave a heavy scent after moving through an area. Elk and skunks are

two examples. If you listen you will hear a whole wild world all around you that you may not have noticed before. Different bird species can be identified by their unique song or call. Coyotes yip and howl, elk grunt and bugle, bears growl and snort, and squirrels squeak and chirp. Knowing the language of the animals that inhabit an area can help the observer identify what animals are there even if none can be seen!

Other clues that can help determine what species have been frequenting an area include looking for disturbed soil where animals might have tried to dig or move rocks or stumps. For example, bears will often tear apart stumps looking for insects to eat, and ungulates such as deer and elk will rub the bark off trees in early fall using their antlers.

At the WaterLife Center

Look along the sides of the trail and find animal sign. What kind of tracks and scat can you find?

There is other animal sign present, such as owl pellets, feathers and hair lost by passing animals. Can you identify what kind of animals passed through here by the animal sign present?



Suggested Activities

Have a classroom set of track books or check one out from the local library. The WaterLife Center MAY have one you can borrow. Divide students into groups of two to four, give each group a copy of the book to use.

Animal Sign Scavenger Hunt

Advised each student or group of students to take 10 minutes to see how many signs of animals they can see. Describe or draw each animal sign.

Be sure students note what criteria they used to decipher the animal sign they observed.

Spend two to three minutes standing still and listening. How many different animals can you hear? How many bird species? Can you identify any of them?

For a winter time follow-up, have the students measure track sinuosity as a surrogate measure of habitat use. (A more sinuous track pattern means greater habitat use, a less sinuous track pattern means travel, but not habitat use.)

WORK SHEET

Live animal

Track

Scat

Hair

Home (web, nest, hole)

Digging

Browsed plants

Sounds

Other

Related Classroom Activity

Have each student pick a type of bird that they observed while at the WaterLife Center and look it up in a bird guide. What kind of nest does that bird make? What type of habitat does it live in? What is its geographic distribution? Can you identify its call or song?

GLOSSARY

Aerobic	Living or occurring only in the presence of oxygen 1
Anadromous	Species that migrate up rivers from the ocean to spawn in natal fresh water 1
Anaerobic	Living or occurring in the absence of oxygen 1
Annual plants	A plant that lives or grows for only one year or season, during which the life cycle is completed 1
Aquatic Life	Living or growing in or on the water 1
Biodiversity	The variation of life forms within a given ecosystem. Biodiversity is often used as a measure of the health of biological systems. 2
Climax community	A biological community of plants and animals which, through the process of ecological succession — the development of vegetation in an area over time — has reached a steady state. This equilibrium occurs because the climax community is composed of species best adapted to average conditions in that area. 2
Competition	A rivalry between two or more competitors striving for the top position or the same prize 1
Condensation	The physical process by which a liquid is removed from a liquid 1
Corridors	Corridors connect two or more otherwise isolated habitat fragments
Cryptic	Camouflaged
Decomposer	One that causes rot; one that causes putrefaction, decay; one that causes another to break down into its component parts 1
Detritus	Loose fragments, particles, disintegrated matter, debris 1
Dew Point	The temperature at which air becomes saturated and produces dew 1

Digitigrade	Walking so that only the toes touch the ground (such as dogs, and cats) 1
Disturbance	A variation in the normal course or condition 1
Ecological stability	The resilience (returning quickly to a previous state), constancy (lack of change) or persistence (simply not going extinct). The precise definition depends on the ecosystem in question 2
Ecosystem	An ecological community together with its physical environment, considered as a unit 1
Ecotone / Edge	The line of intersection between two habitat types, the boarder or margin of a particular area 1
Erosion	A natural process including weathering, dissolution, abrasion, corrosion, or transportation by which material is removed from the earth's surface 1
Estuarine wetland	Deepwater tidal habitats with a range of fresh-brackish-marine water chemistry and daily tidal cycles. Salt and brackish marshes, intertidal mudflats, mangrove swamps, bays, sounds, and coastal rivers. Drowned coasts, where supply of river sediment is insufficient to infill estuary basin.
Evaporation	To convert or change into a vapor 1
Gait	A particular fashion or way of moving on foot; any of the ways to move by lifting the feet in an different rhythm 1
Grass	Any of numerous plants of the family <i>Gramineae</i> , characteristically having narrow leaves, hollow jointed stems, and spikes or clusters of flowers 1
Habitat	An area or type of environment where an organism or biological population normally lives or occurs 1
Hydric soils	Soils are characterized by frequent, prolonged saturation and low oxygen content, which lead to anaerobic chemical environments where reduced iron is present

Hydrology	The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil, and atmosphere 1
Hydrophytic vegetation	A plant that grows in and is adapted to an aquatic or very wet environment 1
Impervious	Incapable of being penetrated; <i>a material impervious to water</i> 1
Indigenous	Species that evolved and still exist within an original ecosystem 2
Infiltration	The act of causing (a liquid for example) to permeate a substance by passing through its interstitial spaces or its pores 1
Invasive species	Species that tend to spread, especially those invading, outcompeting and replacing existing species 1
Invertebrate	Organisms lacking a backbone or spinal column 1
Lacustrine wetland	Wetlands around, of, or pertaining to lakes 1
Marine wetland	Open ocean, continental shelf, including beaches, rocky shores, lagoons, and shallow coral reefs. Normal marine salinity to hypersaline water chemistry; minimal influence from rivers or estuaries.
Monoculture	Producing or growing one single crop over a wide area 2
Native species	Originally living, growing, or being produced in a certain place; original inhabitants of an area as distinguished from those from elsewhere 1
Non-native species	Species not native, or originally growing in an area
Noxious weed	Plants that are injurious or harmful to existing plants and/ or the environment 1
Nutrients	Compounds found in the environment that plants and animals need to grow and survive. Excess can cause eutrophication and harm to an ecosystem, however.
Organic matter	Of, pertaining to or derived from living organisms 1

Palustrine Wetland	All non-tidal wetlands that are substantially covered with emergent vegetation--trees, shrubs, moss, etc. Most bogs, swamps, floodplains and marshes fall in this system, which also includes small bodies of open water (< 20 acres)
Peat Bog	A bog or swamp where partially carbonized vegetable matter, usually mosses, accumulate 1
Percolation	The act of passing through a porous substance or small holes, filter; the act of draining or seeping through a porous substance or filter 1
Perennial plants	A plant that lives for more than two years, such as trees and shrubs 2
Plantigrade	Walking with the entire surface of the foot on the ground, as humans and bears do 1
Pollutant	Something that pollutes, especially a waste material that contaminates the air, soil or water 1
Precipitation	Water droplets or ice particles condensed from atmospheric water vapor that fall to the earth's surface, such as rain and snow 1
Predatory Species	Animals that prey on other animals to maintain life 1
Primary Consumer	Organisms that feed on autotrophs (plants, algae, and some bacteria); herbivores 2
Relative Humidity	A term used to describe the amount of water vapor that exists in a gaseous mixture of air and water. 2
Riparian	Of, on or pertaining to the bank of a natural course of water 1
Riverine wetland	Freshwater, perennial streams comprised of the deepwater habitat contained within a channel.
Saturation	The act or process of becoming soaked with moisture to capacity and unable to hold more 1
Scat	The excremental droppings of an animal 1

Sedge	Any of numerous plant species of the family Cyperaceae, resembling grasses but having solid rather than hollow stems, whose leaves have edges rather than being round
Sediment	Any particulate matter that can be transported by fluid flow, and which eventually is deposited. Sediments are most often transported by water, wind, and glaciers. 2
Seral stages	The stages of ecological succession of a plant community. eg, from young stage to old stage
Shade tolerant	Shade-tolerant species: are species of trees that are able to thrive in the shade, and in the presence of natural competition by other plants. 2
Shrub	A woody plant of relatively low height, distinguished from a tree by having several stems rather than a single trunk; bush 1
Snags	A standing, partly or completely dead tree, often missing a top or most of the smaller branches. 2
Species abundance	The number of individuals per species within a given area or community
Species richness	The number of different species in a given area, often used as an approach to defining biodiversity
Succession	The process of plant communities gradually changing over time 1
Terrestrial	Living upon the land as opposed to in the water
Transpiration	The act or process of transpiring, especially through the stomata of plant tissue or skin pores 1
Tributary	A stream or river flowing into a larger stream or river 1
Unduligreade	Animals are those that walk on hooves at the tips of their toes 2

Wetland

A lowland area saturated with moisture, especially when thought of as natural habitat for wildlife **1**

Witch's Broom

A disease or deformity in a woody plant, typically a tree, where the natural structure of the plant is changed. A dense mass of shoots grows from a single point, with the resulting structure resembling a broom or a bird's nest. **2**

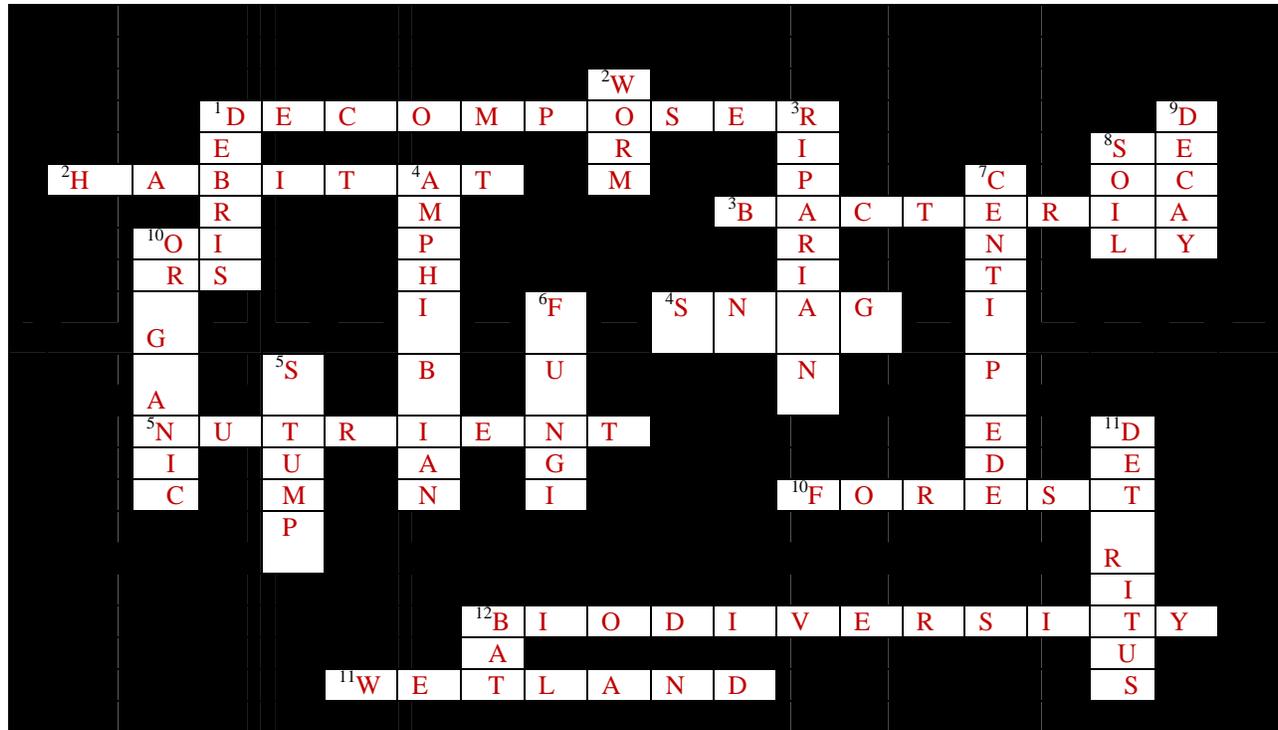
1 [The American Heritage Dictionary](#) The Houghton Mifflin Company 1985

2 Wikipedia the online encyclopedia

We Hope you enjoyed your visit!

Come Back Soon





Across

1. An organism that breaks down dead plant or animal matter **decomposer**
2. The area where an organism normally lives **habitat**
3. A large group of microorganisms **bacteria**
4. A dead standing tree **snag**
5. This matter is a source of nourishment for soil **nutrient**
6. A dense growth of trees **forest**
7. A lowland area saturated with moisture **riparian**
8. The variability of living organisms on earth **biodiversity**

Down

1. The remains of something that has broken up **debris**
2. An invertebrate with a long flexible body and no obvious appendages **worm**
3. Areas associated with a natural water course **riparian**
4. A cold blooded smooth skinned vertebrate **amphibian**
5. The part of a tree left protruding from the ground after it has fallen **stump**
6. Taxonomic Kingdom including mold, mushrooms and toadstools **fungi**
7. Chiefly nocturnal venomous segmented arthropod with a set of legs per segment **centipede**
8. Collection of dirt and organic matter that vegetation grows in **soil**
9. Rot **decay**
10. Matter made up of materials produced by plants or animals **organic**
11. Decaying matter **detritus**
12. A winged mammal **bat**

