The Art of Science: 
*Animals & Their Habitats*

Teacher’s Guide 
2012-2013
The Art of Science:
Visual Arts & Drama Workshops
2012-2013 Season

The Art of Science school program at arts pace invites students to examine Life Sciences topics through visual arts and creative drama activities. This unique full-day arts and science exploration program offers a 1.5 hour visual arts workshop AND a 1.5 hour drama workshop led by professional artists.

In the visual arts workshop, students create a work of art using drawing and painting techniques. In the drama workshop, students explore through theatrical games, improvisation activities, and tableaux work (available in French).

Program topics include:

**BC Marine Life**
Explore the diversity and interconnectedness of marine life forms of BC’s west coast.

**Animals & Their Habitats**
Investigate North American animals and their environments, and how the food web works.

**The Human Body**
Discover the wonders of the human body and how the different body systems are interconnected.

**Resources**

**Web:**
- Canadian Museum of Nature - [http://nature.ca/notebooks/english/namerica.htm](http://nature.ca/notebooks/english/namerica.htm)
- Smithsonian National Museum of Natural History - [http://www.mnh.si.edu/mna/](http://www.mnh.si.edu/mna/)
- Animals/Wildlife Habitat Facts by Laura Klappenbach - [http://animals.about.com/od/habitat-facts/u/habitat-facts.htm](http://animals.about.com/od/habitat-facts/u/habitat-facts.htm)
- Marine Life of British Columbia – [www.marinelifephotography.com](http://www.marinelifephotography.com)
- National Geographic - [http://animals.nationalgeographic.com/animals/?source=NavAniHome](http://animals.nationalgeographic.com/animals/?source=NavAniHome)
- The Nature Conservancy: Protecting Nature Preserving Life – [www.nature.org](http://www.nature.org)
- Defenders of Wildlife: Protecting Native Animals and Their Habitats – [www.defenders.org](http://www.defenders.org)
- David Suzuki Foundation: Solutions Are In Our Nature – [www.davidsuzuki.org](http://www.davidsuzuki.org)

**Books:**
Our planet is an extraordinary mosaic of land, sea, weather, and life forms. No two places are identical in time or space—we live in a complex and dynamic tapestry of habitats. Each species depends on its physical surroundings. Any place that provides a home for a particular species is called a habitat.

Some species have adapted to an extremely specific area – whether it’s the cold, rocky slopes of an underwater mountain or a shallow, muddy wetland. Others travel thousands of kilometers through many different kinds of conditions. Anything that changes a habitat will affect all the species that live there.

Despite the differences that may exist from one place to the next, there are some general habitat types that can be described based on shared climate characteristics, vegetation, or animal species. These habitat types help us to understand the wildlife that inhabits them and better protect both the land and the species that depends on it.

Habitats form an unbroken tapestry of life across the Earth’s surface and are as varied as the animals that inhabit them. Habitats can be classified into many genres—grasslands, deserts, tundra, woodlands, mountains, ponds, streams, marshlands, coastal wetlands, shores, oceans—but there are general characteristics that apply to all habitats regardless of its location.

**Habitat Characteristics:**

A first step to understanding individual animals, and in turn populations of animals, is to understand the relationship they have with their environment. The environment in which an animal lives is referred to as its habitat. A habitat includes both biotic (living) and abiotic (non-living) components of the animals’ environment. Abiotic components of an animal’s environment include a huge range of characteristics, examples of which are:

- temperature
- humidity
- oxygen
- wind
- soil composition
- day length
- elevation

Biotic components of an animal’s environment include such things as:

- plant matter
- predators
- parasites
- competitors
- individuals of the same species

The Complex Web of Life – Food Chains and Food Webs:

To make things even more complex, each species may need different habitats and different sources of food at different stages in their life. And at different stages, they are food for different species.

For example, salmon start their life as eggs in the gravel nests of freshwater streams and rivers, making them a tasty snack for ducks. After they hatch and grow, bigger fish and seabirds eat young salmon. When they become adults, salmon live in the salty water of the ocean where they are eaten by orcas, seals and sea lions. As salmon return to the rivers and streams to spawn, bears and bald eagles gobble them up.

When you consider all the different species and habitats that make up this region, and all the different ways they connect to one another, it adds up to an incredibly intricate, ever-changing web of life.

Interactions between the abiotic and biotic components are easily identified by examining food chains and food webs. A food chain is defined as the transfer of energy from plants to animals through the process of animals eating plants and animals eating other animals. For example, the sun transfers energy in the form of light to green plants. Green plants convert the sunlight into energy, which is stored in the plant matter. The energy within plants is transferred to plant-eating animals when the plants are consumed. Energy is also passed from animal to animal as predators, (organisms that hunt and kill other organisms for food); consume prey, (organisms that are hunted and caught for food). For example, a simple food chain can consist of a green plant being consumed by an insect and the insect being consumed by a bird. Generally, any one species is represented in more than one food chain.

In forest communities, food chains become more complicated as many animals eat many different foods (energy sources) depending on the availability and abundance of the food. When many different species of plants and animals are interdependent, that is, depending on one another for survival, the process is called a food web.

All living organisms that function together in a given area interacting with all the non-living and living factors result in a flow of energy. Such interactions lead to clearly defined biotic structures and cycling of materials between living and non-living parts. Ecology is the study of interactions between living things and their environments. The word ecosystem refers to the system of interactions between living and non-living things.

From WWF Northeast Pacific Marine Region Fact Sheet #2, Habitat Facts, and Parks Canada (Forest Food Web Activity)
The Rocky Mountains are a mountain habitat that stretches through western North America from Alaska to New Mexico, forming the middle section of the Western Cordillera, an extensive belt of mountains that reaches from the Arctic Circle to Mexico. The Rocky Mountains straddle the continental divide, a natural barrier to the west of which water flows toward the Pacific Ocean and to the east of which water flows in the direction of the Arctic and Atlantic Oceans.

Animals & Their Habitats:

Alpine/Mountain Habitats and the Bighorn Sheep:

Alpine, or mountain, habitats occur in highlands and mountain ranges around the world. Mountains provide habitat for a wide range of terrestrial animals including mammals, birds, reptiles, invertebrates and amphibians.

Mountains are masses of rock that have been pushed upward, high above the surrounding land. Most mountains form at the boundaries of the Earth's tectonic plates, where landmasses converge, diverge, or shift side-by-side. These movements cause uplifting, splitting, and folding of the earth's crust that sculpt mountain ranges of varying sizes and elevations. Once formed, mountains are further shaped by erosion, earthquakes, and continued movement of tectonic plates.

Mountains are found throughout the world and the habitats they support are home to an extraordinary diversity of wildlife. The plants and animals that characterize a mountain habitat reflect the local climate conditions, which can vary greatly based on the orientation of the mountain (with respect to the sun and weather patterns) as well as elevation, (the height it is above sea level or ground level). A sequence of changes can be observed as you follow the profile of the mountain upward. These changes are referred to as altitudinal vegetation zones and they influence the animal species that can be found at different locations within a mountain range. As you move to higher elevations, temperature decreases and winds may be stronger. Depending on the orientation of the mountain range as well, one face may receive more precipitation than the other.

Mountains provide habitat for a wide range of terrestrial animals including mammals, birds, reptiles, invertebrates and amphibians, one of which is the bighorn sheep.

Range: The bighorn sheep is one animal found in mountain habitats. The Canadian population of this stocky muscular animal is restricted to western Alberta and southern British Columbia, where there are high elevations with low precipitation levels in winter and spring. Bighorn sheep also live in the U.S.A. and Mexico.
**Characteristics:** They range in colour from light brown to grayish or dark brown, and have a white rump and lining on the backs of all four legs. Bighorn sheep get their name from the large, curved horns on the males, or rams. During the mating season, the adult males engage in fierce matches, crashing head-on into each other with an impact that can be heard 2 km away. The bony structures in the head are adapted to protect the brain by absorbing the tremendous impact of such clashes. They are legendary for their ability to climb high, steep, rocky mountain areas.

Adult males range in weight from 165 to 302 lb. The ewes (female sheep), lambs, yearlings and young rams band together in groups led by an old ewe. They are joined in autumn by the mature rams, in time for the mating season.

**Diet:** Bighorn sheep eat different foods depending on the season. During the summer, they eat grasses or sedges, (grass-like plants). During the winter they eat more woody plants such as willow, sage and rabbit brush.

**Threats:** Their chief predator is the cougar, but unattended kids (young sheep) are often taken by the Golden Eagle. Their heads, with their magnificent horns, are prized by hunters. Loss of food from livestock grazing, loss of habitat from development and changes in climate are also threats that have decreased the Bighorn sheep population from 1.5 million at the beginning of the nineteenth century to less than 70,000 today.

From Animals/Wildlife Habitat Facts and Defenders of Wildlife

**Beaches/Coasts and the Sea Turtle:**

Beaches and coast lie at the threshold between land and sea where wildlife adapts to a constantly changing coastline and sways to the rhythms of the tides. Where water meets land, a diverse array of animals and wildlife gather to feed, reproduce, and seek out shelter—birds, crustaceans, mollusks, fish, echinoderms, and many other organisms inhabit these ever-changing habitats.

The intertidal zone (or littoral zone) is the area of the sea floor that lies between the high and low tide marks, bridging the gap between land and sea. At high tide, the intertidal zone is submerged beneath seawater and at low tide it is exposed to air. For this reason, the intertidal zone presents a harsh set of challenges to inhabiting organisms, who must adapt to constantly changing conditions.

Sea turtles are one of the Earth’s most ancient creatures that inhabit beach and coastal habitats. Sea turtles nest on beaches where they lay their eggs. When the young hatch out of their eggs, they make their way to the ocean. The seven species that can be found today have been around for 110 million years, since the time of the dinosaurs. The sea turtle’s shell, or carapace is streamlined for swimming
through the water. Unlike other turtles, sea turtles cannot retract their legs and head into their shells. Their color varies between yellow, greenish and black depending on the species.

Did you know?
Green sea turtles can stay under water for as long as five hours even though the length of a feeding dive is usually five minutes or less. Their heart rate slows to conserve oxygen. Nine minutes may elapse between heartbeats!

**Diet:** What sea turtles eat depends on the subspecies, but some common items include jellyfish, seaweed, crabs, shrimp, sponges, snails, algae and **mollusks**, (animals with no skeleton; many, like clams, have a shell for protection).

**Population:** It is difficult to find population numbers for sea turtles because male and juvenile sea turtles do not return to shore once they hatch and reach the ocean, which makes it hard to keep track of them. Sea turtles are found in all warm and temperate waters throughout the world and migrate hundreds of miles between nesting and feeding grounds. Most sea turtles undergo long **migrations**, (moving from one place to another), some as far as 1400 miles, between their feeding grounds and the beaches where they nest.

**Size:** Kemp’s Ridley is the smallest sea turtle at 30 inches long (.762m). The largest sea turtle is the leatherback - an adult can reach over six and a half feet long (over 1.8m). Adult female and male sea turtles are the same size.

**Weight:** Kemp’s Ridley weighs between 80-100lbs (36-45 kg). Leatherback can weigh over 2,000 pounds (over 907 kg)

**Lifespan:** Up to 80 years.

**Behavior:** Sea turtles spend most of their lives in the water, where not much information can be gathered on their behavior. Most of what is known about sea turtle behavior is obtained by observing hatchlings and females that leave the water to lay eggs. Sea turtles, like salmon, will return to the same nesting grounds at which they were born. When females come to the shore they dig out a nest in the ground with their back flippers, bury their **clutch**, (the number of eggs produced at one time), of eggs and return to the ocean. After hatching, the young may take as long as a week to dig themselves out of the nest. They emerge at night, move toward the ocean and remain there, by themselves, until it is time to mate.

**Threats:** About 1 in 1,000 baby sea turtles will make it to adulthood. They are a source of food for crabs, birds, and other marine animals. However, the biggest threats to sea turtles by far are human related. Oil spills, habitat loss due to development, and entanglement in marine debris such as plastic bags are threats that face many marine animals, but others specifically affect turtles.
For example, when sea turtle eggs are incubating, the surrounding temperature affects the sex of the hatchlings, with higher temperatures producing more females. As sand becomes warmer due to climate change, the ratio of females to males becomes out of balance, affecting breeding activities when they reach adulthood. Also, the artificial lighting coming from beachside communities confuses turtles which normally follow the moon and stars’ reflection off the waves to make it back to water, making them more vulnerable to predators, dehydration and road kill. In some countries, turtle shells are traded on the black market and turtles and their eggs are harvested for food.

From Animals/Wildlife Habitat Facts and Defenders of Wildlife

**Deserts/Scrublands and the Roadrunner:**

Deserts and scrublands are landscapes that have very little precipitation, or rain. Deserts are diverse habitats—some are sun-baked lands that experience high daytime temperatures while others are cool and go through chilly winter seasons. Deserts are arid, or dry regions, and receive less than 10 inches of rain per year. Deserts are large areas with a lot of bare soil and low vegetation cover. The world’s deserts occupy almost one-quarter of the earth’s land surface. Scrublands are semi-arid habitats that are dominated by scrub vegetation such as grasses, shrubs, and herbs.

Biologically, deserts and scrublands contain plants and animals adapted for survival in arid environments. Woody-stemmed shrubs and plants characterize vegetation in these regions. Above all, these plants have evolved to minimize water loss. Animal biodiversity is equally well adapted and quite diverse. Although deserts receive little rainfall, when rain does fall, the desert experiences a short period of great abundance. Plants and animals have developed very specific adaptations to make use of these infrequent short periods of great abundance.

The legendary roadrunner is famous for its distinctive appearance, its ability to eat rattlesnakes and its preference for scooting across the American deserts, as popularized in Warner Bros. cartoons. The roadrunner is a large, black-and-white, ground bird with a distinctive head crest. It has strong feet, a long, white-tipped tail and an oversized bill. It ranges in length from 20 to 24 inches from the tip of its tail to the end of its beak. It is a member of the Cuckoo family, characterized by feet with 2 forward toes and 2 behind.

When the roadrunner senses danger or is traveling downhill, it flies, revealing short, rounded wings with a white crescent. But it cannot keep its large body airborne for more than a few seconds, and so prefers...
Roadrunner Facts:
Roadrunners are quick enough to catch and eat rattlesnakes.
Roadrunners prefer walking or running and attain speeds up to 17 mph. hour

Weight: 8-24 oz.
Length: 20-24 inches
Height: 10-12”
Lifespan: 7 to 8 years

Walking or running (up to 17 miles per hour).

**Tail:** The roadrunner has a long, graduated tail carried at an upward angle.

**Legs:** The roadrunner has long stout legs.

**Behavior:** The roadrunner is uniquely suited to a desert environment by a number of physiological and behavioral adaptations. Its carnivorous, (meat-eating) habits offer it a large supply of very moist food. It reabsorbs water from its feces before excretion. A nasal gland eliminates excess salt, instead of using the urinary tract like most birds. It reduces its activity 50% during the heat of midday. It’s extreme quickness allows it to snatch a humming bird or dragonfly from midair.

**Habitat:** The roadrunner inhabits open, flat or rolling terrain with scattered cover of dry brush or other desert scrub.

**Food & Hunting:** The roadrunner feeds almost exclusively on other animals, including insects, scorpions, lizards, snakes, rodents and other birds. Up to 10% of its winter diet may consist of plant material due to the scarcity of desert animals at that time of the year. Because of its lightening quickness, the roadrunner is one of the few animals that prey upon rattlesnakes. Using its wings like a matador’s cape, it snaps up a coiled rattlesnake by the tail, cracks it like a whip and repeatedly slams its head against the ground till dead. It then swallows its prey whole, but is often unable to swallow the entire length at one time. This does not stop the roadrunner from its normal routine. It will continue to walk about with the snake dangling from its mouth, consuming another inch or two as the snake slowly digests.

**Threats:** A roadrunner life does have its dangers. Roadrunners are occasionally preyed upon by hawks, house cats, raccoons, rat snakes, bullsnakes, skunks and coyotes eat nestlings and eggs. During the winter months, many succumb to freezing, icy weather.

From Animals/Wildlife Habitat Facts, Defenders of Wildlife and Desert USA

**Forests/Woodlands and the Grizzly Bear:**

Forests occupy one third of the Earth’s land area and are found on all corners of the globe. There are many different types of forests and each have different climate characteristics, species compositions, and wildlife communities.

Forests are habitats in which the trees are the dominant form of vegetation. They occur in many regions and climates around the globe—the tropical
rainforests of the Amazon basin, the temperate forests of eastern North America, and the boreal forests of northern Europe are just a few examples.

The species composition of a forest is often unique to that forest, with some forests consisting of many hundreds of species of trees while others consist of just a handful of species. Forests are constantly changing and progress through a series of stages during which species composition changes within the forest.

Despite the variability of our planet’s forests, there are some basic structural characteristics that many forests share—characteristics that can help us to better understand both forests and the animals and wildlife that inhabit them.

Mature forests often have several distinct vertical layers. These include:

- forest floor
- herb layer
- shrub layer
- understory
- canopy
- emergents

These different layers provide many different habitats and enable animals and wildlife to settle into various pockets of habitat within the overall structure of a forest.

The forest floor is often blanketed with decaying leaves, twigs, fallen trees, animal scat, moss, and other detritus, (particles/materials worn or broken away from a larger mass). The forest floor is where recycling occurs, fungi, insects, bacteria, and earthworms are among the many organisms that break down waste materials and ready them for reuse and recycling throughout the forest system.

The herb layer of the forest is dominated by herbaceous (or soft-stemmed) plants such as grasses, ferns, wildflowers, and other ground cover. Vegetation in the herb layer often gets little light and in forests with thick canopies, shade tolerant species are predominant in the herb layer.

The shrub layer is characterized by woody vegetation that grows relatively close to the ground. Bushes and brambles grown where enough light passes through the canopy to support shrub growth.

The understory of a forest consists of immature trees and small trees that are shorter than the main canopy level of the tree. Understory trees provide shelter for a wide range of animals. When gaps form in the canopy, often times understory trees take advantage of the opening and grow to fill in the canopy.
The **canopy** is the layer where the **crowns**, or tops, of most of the forest’s trees meet and form a thick layer.

**Emergents** are trees whose crowns emerge above the rest of the canopy.

**Canada’s Boreal Forest:**

Canada’s boreal region stretches 10,000 continuous kilometers across the country — its size rivals even that of the Amazon rain forest! As one of the world’s greatest remaining forests, the boreal provides an important haven for the many creatures that inhabit its vast canopy, lakes and wetlands.

The bison, North America’s largest land mammal, wanders throughout the northern boreal while the world’s smallest carnivore, the Least Weasel, finds nests in the region’s underground. The world’s largest populations of woodland caribou, bears, and wolves roam this frontier and billions of birds — including warblers, thrushes, ducks, and shorebirds — frequent this region to breed and raise their young. These diverse forests are mostly made up of **coniferous** trees, (trees that bear cones), though **deciduous** trees, (trees where part of the tree falls off in certain seasons), such as poplar and birch are also found within the stands that function as one of the world’s largest carbon reservoirs. The boreal range is also home to hundreds of First Nations communities that rely on the forest’s resources.

From afar, this rugged green swath of vegetation seems **tranquil**, (quiet; undisturbed) and untouched; free from roads, development and human exploitation. Such is not the case. Logging is slowly consuming vast sections of the forest. Hydropower and mining companies continue to exploit the boreal’s southern limits while working towards its northern regions. The effects of oil and gas exploration scar the land with expanding networks of roads. These pressures threaten the existence of this grand forest and have triggered the need for immediate conservation efforts.

The grizzly bear is a large predator that is different from black bears due to a distinctive hump on its shoulders. Grizzly bears have curved faces and long claws about the length of a human finger. They are usually darkish brown in colour but can also be very light cream to black.

The long hairs on their backs and shoulders often have white tips and give the bears a “grizzled” appearance, hence the name “grizzly.” The correct scientific name for the species is “brown bear,” but only coastal bears in Alaska and Canada are referred to as such, while inland bears and those found in the lower 48 states are called grizzly bears.

**Diet:** Grizzly bears are **omnivorous** and will eat both vegetation and animals including grasses, sedges, roots, berries, insects, fish, and small and large mammals. In
some areas grizzly bears eat moose, caribou and elk, in others they eat salmon. The Grizzly bear’s diet varies depending on what foods are available in that particular season.

**Population:** Historically, there were around 50,000 grizzly bears in North America. Today, there are 1,000 - 1,200 grizzly bears remaining in five separate populations in the lower 48 states. In Alaska, there are thought to be over 30,000 grizzly bears.

**Range:** Grizzly bears are found in a variety of habitats, from dense forests, to subalpine meadows and arctic tundra. In North America, grizzly bears are found in western Canada, Alaska, Wyoming, Montana, Idaho, and Washington. Historically, they could be found from Alaska to Mexico, California to Ohio. The grizzly bear was once common on the Great Plains, but human encroachment has forced remaining populations to move to rugged mountains and remote forests.

**Behavior:** Bears live solitary, (lives alone), lives except during breeding, when raising their cubs, and in areas with a super-abundant food supply such as salmon streams. Grizzly bears hibernate during the winter for 5-8 months, and usually dig their dens on north-facing slopes to ensure good snow cover.

Grizzly bears need to eat a lot in the summer and fall in order to build up sufficient fat reserves for surviving the denning period. This is particularly true for pregnant females who give birth to one pound cubs and then nurse them to about 20 pounds before emerging from the den in April-May.

**Threats:** The greatest threat to grizzlies today is conflict with people. Bears are often killed by wildlife officials once they start to frequently show up in residential areas for easy meals of garbage, livestock, pet food and birdseed, or by hunters or hikers who encounter them in the field and shoot out of concern for personal safety rather than use bear spray.

Much of the grizzly’s habitat has been lost or degraded as a result of development, road-building and energy and mineral exploration. And climate change also poses new challenges to the bears; they are denning later, putting them on the landscape longer in the fall when unintended shootings by hunters are most common.

From Animals/Wildlife Habitat Facts, Defenders of Wildlife and Canadian Geographic
Grasslands/Savannas and the Bison:
Grasslands and savannas are habitats characterized by the predominance of grass vegetation and the absence of forests or thick tree stands. Grasslands are located in temperate regions, (places that do not experience extreme temperature changes), while savannas occur in tropical areas. Both habitats receive enough rainfall to support grass growth but they do not receive enough rainfall to support the growth of forests.

Grasslands are amazing, mind-bending places that support an incredible diversity of life. They are a resilient, critically important ecosystem that supports hundreds of specially adapted plant, mammal, bird, and reptile species that can’t be found anywhere else in the world. Fascinating predator-prey relationships, specially-adapted grasses and rare flowering plants, glacial formations that fascinate geologists—these are just a few of the elements that characterize Canada's grasslands, one of our most important, and most threatened, natural spaces.

Temperate Grasslands, which include Canadian grassland ecosystems, are also found around the globe. Plant and animal species in temperate grasslands are shaped by less rainfall (25 to 90 centimetres), and cycle through a greater range of seasonal temperatures. Many temperate grassland animals, which must adapt to dry, windy conditions, are recognizable to Canadians, for example, grazing species like antelope and elk; burrowing animals like prairie dogs and badgers; and predators like snakes and coyotes.

The dramatic contours of Canada’s grasslands are the result of glacial movement and melting ice, which shaped this landscape over the last two hundred million years. Grasslands National Park, for example, has glacial meltwater channels and layers of rock formation that hold fossilized secrets from 80 million years ago.

**Diet:** Bison mainly eat grasses and sedges.

**Population:** Historically, bison numbered an estimated 20-30 million. Unregulated shooting of bison, which culminated in mass slaughters during the 1870s, reduced the population to 1,091 in 1889. Today, approximately 500,000 bison live across North America. Most are not pure bison but rather have been cross-bred with cattle in the past and are raised. Fewer than 30,000 bison are in conservation herds, and fewer than 5,000 are free-ranging and disease-free.

**Range:** Bison once roamed across much of North America. Today bison are ecologically extinct, (when
Did You Know?
The trails carved by animals like bison and deer in their seasonal migrations formed some of the earliest traceable paths into the American wilderness, and were followed by Native Americans, explorers and pioneers.

A bison’s thick fur offers great protection against the harsh elements of the American plains. Their winter coat is so thick and well insulated that snow can cover their backs without melting.

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Bison Facts:

- **Height:** 6-6.5 feet at the shoulder.
- **Length:** 10-12.5 feet.
- **Weight:** 900-2,000 lbs; males are larger than females.
- **Lifespan:** 18-22 years in the wild; over 30 years in captivity.

**Behavior:** Bison move continuously as they eat so that they rarely overgraze an area. They historically roamed great distances. The females, or cows, lead family groups. Bulls, or males, remain solitary or in small groups for most of the year, but rejoin the group during mating season. Bison often rub, roll, and wallow. Wallowing creates a saucer-like depression called a wallow. This wallow was once a common feature of the plains; usually these wallows are dust bowls without any vegetation. In winter, bison can dig through deep snow with their heads to reach the vegetation below.

**Threats:** Intolerance is the greatest threat to bison. Though bison are no longer threatened with extinction, there are currently very few places where wild bison are allowed to live as wildlife. Almost all of their historic stomping grounds are off limits, due primarily to opposition from livestock interests. Yellowstone – the one place where wild bison were not completely wiped out – is home to the largest free-roaming bison herd in the United States. But even here bison are not allowed to roam much beyond the park boundary and are kept to fewer than about 3,500 in number. When the herd grows above this level, the “surplus”, or extra bison are often shipped to slaughter.

**Size:** Bison are definitely the biggest land mammal in the Western Hemisphere. They can be over 6 feet and weigh over 750 pounds. Although they are so large, they are not slow. American bison can attain speeds of up to 37 mph.

Bison have poor eyesight, but have good hearing and an excellent sense of smell. Bison can reach speeds of up to 35 mph.

From Animals/Wildlife Habitat Facts, Defenders of Wildlife and Animal Wildlife
Lakes, Rivers, Wetlands and the Otter:

Aquatic habitats come in many forms: lakes, rivers, wetlands, marshes, lagoons, streams, rivers, and swamps. Where freshwater mixes with saltwater you’ll find mangroves, salt marshes, and mud flats. All of these habitats are home to a diverse assortment of wildlife including virtually every group of animals—amphibians, mammals, reptiles, invertebrates, and birds.

Wetlands are habitats that are the link between land and water. To be called a wetland, an area must be filled or soaked with water at least part of the year. Since wetlands lie at the junction between terrestrial and aquatic habitats, they possess a unique mixture of species, conditions, and interactions. As a result, wetlands are among our planet’s most diverse and varied habitats.

Wetlands are defined by the soils, hydrology, and species that occur within them. Wetland soils, also known as hydric soils, are shaped by water. These soils are saturated or even submerged all or part of the year. Hydric soils vary depending on the composition of the soil and water in the area and therefore, wetlands vary greatly throughout the world.

Wetlands are highly productive communities and provide habitat and food resources for a wide range of species. Wetlands have a high level of nutrients and along with the availability of water they provide ideal habitat for fish, amphibians, shellfish, and insects. Additionally, many birds and mammals rely on wetlands for food, water, breeding grounds, and shelter.

Sea Otter Facts:

**Height:** Length - California sea otters: 4 feet; northern sea otters are slightly larger.

**Weight:** 45 lbs (females); 65 lbs (males). Northern sea otters can reach up to 100 pounds.

**Lifespan:** 10-15 years (males); 15-20 years (females)

The heaviest member of the weasel family, the sea otter is also the second smallest marine mammal. Sea otters have the densest or thickest fur in the animal kingdom, which insulates them and keeps them warm. Unlike other marine mammals, the sea otter does not have a layer of blubber (fat) to help keep it warm.
Diet: Sea otters mainly eat urchins, abalone, mussels, clams, crabs, snails and about 40 other marine species. Sea otters eat approximately 25% of their weight in food each day!

Population: Historically, sea otters numbered between several hundred thousand to more than a million. But due to the fur trade, worldwide numbers dropped down to a total of 1000-2000 in the early 1900s. As of 2009, the three-year running average is approximately 2,800 southern sea otters off the coast of California. There are between 64,600 and 77,300 northern sea otters residing in Alaska, Canada and Washington. There are approximately 15,000 in Russia and less than a dozen in Japan.

Range: The sea otter’s historic range stretched from Japan, along the coast of Siberia and the Aleutian Chain and down the Alaska, British Columbia, Washington, Oregon and California coast to Baja California. Currently sea otters can be found in California, Washington, Alaska, Canada, Russia, and Japan.

Behavior: Sea otters live in shallow coastal waters off the northern Pacific. They are the only mammals other than primates, birds and a few other animals known to use tools. They use small rocks or other objects to pry shellfish from rocks and to hammer them open.

Threats: Currently the largest human threats to sea otter populations are entrapment in fishing traps and nets, shootings, and oil spills. The latter causes their fur to mat preventing it from insulating their bodies in the frigid water, resulting in death.

Indirect threats include pollution from runoff into the marine environment and habitat degradation. The pollution of our coasts has resulted in sea otters being the most diseased wildlife populations in the world.

From Animals/Wildlife Habitat Facts, Defenders of Wildlife and the Invasive Species Council of BC

Did You Know?

Sea otters spend much of their lives in the water and can dive up to 330 feet when looking for food. They sometimes rest in coastal kelp forests, often draping the kelp over their bodies to keep from drifting away.

Seas, Oceans and the Orca:

Seas and oceans stretch from pole to pole and reach around the globe covering more than 70 percent of the Earth’s surface. The world’s oceans hide a vast underwater landscape of underwater mountain ranges, continental shelves, and sprawling trenches. The features of the sea floor include mid-ocean ridges, hydrothermal vents, trenches and island chains, continental margin, abyssal plains, and submarine canyons. Mid-ocean ridges are the most extensive mountain chains on earth, spanning some
40,000 miles across the sea floor and running along divergent plate boundaries (where tectonic plate are moving away from one another as new sea floor is being brought up from the Earth’s mantle).

**Did you know?**

British Columbia has a rich diversity of water bodies such as small salt lakes, large freshwater lakes, rivers, streams and wetlands. These different water bodies have some similarities but many differences. **Lakes** can be large or small, fresh water or salt, but all have still water and are surrounded by land. **Rivers** and streams are flowing bodies of water. They usually start from lakes, springs or wetlands. **Wetlands** are smaller bodies of water that have unique vegetation, are not very deep and may not stay wet all of the year.

**Hydrothermal vents** are places in the sea floor that release geothermally heated water at temperatures as high as 750°F. They are often located near mid-ocean ridges where volcanic activity is common and the water they release is rich in minerals.

**Trenches** form on the sea floor where tectonic plates converge and one plate sinks beneath another forming deep-sea trenches. The plate that rises above the other at the convergence point is pushed upward and can form a series of volcanic islands.

**Continental margins** frame continents and stretch outward from dry land to abyssal plains. Continental margins consist of three regions, the continental shelf, slope, and rise.

An abyssal plain is an expanse of sea floor that begins where the continental rise ends and extends outward in a flat, often featureless plain.

**Submarine canyons** form on continental shelves where large rivers run out to sea. The water flow causes erosion of the continental shelf and digs out deep canyons.

Seas and oceans are diverse and dynamic—the water they hold transmits vast amounts of energy and drives the world’s climate. The water they hold sways to the rhythms of waves and tides and moves in currents that circle the globe.

**Subhabitats:**

Since the ocean habitat is so extensive, it may be broken down into several smaller subhabitats:

- *Inshore waters* - the shallowest areas of the oceans that line coastal areas, formed by continental shelves.
- *Open sea* - the vast deep waters of the oceans

The open sea is a stratified subhabitat, with light filtering down a mere 250 meters, creating a rich habitat where algae and planktonic animals thrive. This region of the open sea is referred to as the surface layer. The lower layers, the *midwater*, the abyssal zone, and the seabed, are covered in darkness.
Orca Facts:

**Size:** Male orcas can grow up to 23 feet long, while females top out around 21 feet.

**Weight:** Males weigh seven to ten tons, and females weigh 4 to 6.

**Lifespan:** Orcas live 30 to 50 years in the wild.

Life on earth first evolved in the oceans and developed there for most of evolutionary history. It is only recently, geologically speaking, that life has emerged from the sea and flourished on land. The animal inhabitants of seas and oceans range in size from microscopic plankton to massive whales, including the orca.

The orca, or “killer whale” is a toothed whale and is the largest member of the dolphin family and is highly social. Orcas have long, rounded bodies with large dorsal fins at the middle of their backs. Their black bodies are marked with white patches on the underside and near the eyes.

**Diet:** Orcas feed on fish, squid, birds, and marine mammals. Like dolphins, orcas use *echolocation* - bouncing sound off of objects to determine their location - to hunt and use a series of high-pitched clicks to stun prey. Members of orca pods very often work together to catch a meal. Pod members sometimes will force many fish into one area and then take turns feeding or will *beach* (slide out of the water onto the shore) themselves to scare seals or penguins into the water, where other killer whales are waiting to feed.

**Population:** Official worldwide populations of orcas are currently unknown, but likely not to be less than 50,000 individuals.

**Range:** Found in all oceans of the world, orcas are most common in the Arctic and Antarctic and are often spotted off the west coast of the United States and Canada. Orcas are found in both coastal waters and open ocean.

**Behavior:** Orcas are highly social animals that travel in groups called *pods*. Pods usually consist of 5 - 30 whales, although some pods may combine to form a group of 100 or more. Orcas establish social hierarchies, and pods are lead by females. The animals are thought to have a complex form of communication with different *dialects* (slightly different

**Did You Know?**

The orca’s large size and strength make it among the fastest marine mammals, able to reach speeds in excess of 35mph!

Many orcas live with their mothers for their entire lives!
language) from one pod to another.

**Threats:** Recent studies have found that orcas are amongst the most contaminated marine mammals in the world. Pollution and chemical contamination make orcas more vulnerable to disease and likely cause reproductive difficulties.

*From Animals/Wildlife Habitat Facts and Defenders of Wildlife*

**Tundra and Polar Regions and the Arctic Fox:**

**Tundra** is a cold habitat characterized by low temperatures, short vegetation, long winters, brief growing seasons, and limited drainage. Arctic tundra is located near the North Pole and extends southward to the point where coniferous forests grow. Alpine tundra is located on mountains around the world at elevations that are above the tree line.

The tundra environment is characterized by the general presence of **permafrost,** (ground that is permanently frozen), except beneath some lakes and rivers; short summers with almost continuous daylight; long winters and arctic “nights”; low annual precipitation; strong winds and winter blizzards; discontinuous vegetation; unstable, wet soil conditions resulting from permafrost and frost action. Tundra plants have developed many adaptations for survival.

Tundra environments present many challenges to human activities. Buildings, pipelines, roads and airports must be constructed so that they can cope with cold climate and permafrost, and proper advance planning must precede resource development and waste disposal to avoid damage to ecosystems.

The core of the Arctic is a great ocean - the Arctic Ocean - parts of which are covered all year round by ice that drifts about the North Pole. The Arctic Ocean has many thousands of big and small islands and is almost surrounded by land: the northern parts of Europe, Asia and North America.

The Antarctic is an isolated continent surrounding the South Pole. Most of Antarctica’s land lies beneath ice and snow almost 2km thick. It has high mountains and glaciers and is the coldest, driest and windiest continent on Earth.

These regions are very cold: the coldest temperature ever known on earth (-89°C or -129°F) was recorded in Antarctica. The average winter temperature in the Arctic is about -30°C. The short Arctic summer can be relatively warm, however. It gets warm enough for people living within some parts of the Arctic circle to grow vegetables. The lands surrounding the Arctic Ocean support a greater variety of plants, as the summers are warmer than in the Antarctic.
Because water cannot drain away through the permafrost, there is plenty of surface water. Large trees do not grow here; instead there are huge areas of swampy plains with low-lying bushes and grasses called ‘tundra’ or ‘muskeg’. Flowering plants such as the Arctic poppy bring a surge of yellow to the tundra in the summer. Reindeer moss also grows in abundance. Many birds and some animals, like the arctic fox, live in the tundra in summer, migrating in autumn.

To live in such cold places, Arctic foxes have several adaptations that allow them to survive. Their round, compact bodies minimize surface area that is exposed to the cold air. Its muzzle, ears, and legs are short, which also conserves heat.

Of course, the defining feature of the Arctic fox is their deep, thick fur which allows them to maintain a consistent body temperature. Arctic foxes also have thick fur on their paws, which allows them to walk on both snow and ice.

**Diet:** Lemmings are the staple food for Arctic foxes. However, they will eat whatever is available out on the frozen tundra, even if it means scavenging leftovers from other predators, such as polar bears!

**Population:** Arctic fox populations range in the hundred thousands, but fluctuate with the available lemming population.

**Range:** The Arctic fox is found throughout the entire Arctic tundra, through Alaska, Canada, Greenland, Russia, Norway, Scandinavia, and even Iceland, where it is the only native land mammal.

**Behavior:** The tundra is not an easy place to live. It is barren, rocky, and without much vegetation. Arctic foxes are extremely well adapted to their frigid homes, and have secured a place where they make the best out of almost any situation.

One of the most unique and interesting behaviors of Arctic foxes is how they hunt. They have incredible hearing, aided by their wide, front-facing ears, which allow them to locate the precise position of their prey beneath the snow.

When the Arctic fox hears its next meal under the snow-pack, it leaps into the air and pounces, breaking through the layer of snow right onto the prey beneath.
Arctic Fox Facts:

Size: Arctic foxes can range from 2.3 to 3.5 feet (.76 - 1.1m) in length, in addition to their 12-inch (.3m) tail. At the shoulder, they stand around 9 inches to 12 inches (.2 - .3m) tall.

Weight: Arctic foxes range from 6.5 to 21 lbs (2.9 - 95kg). Female Arctic foxes tend to be smaller than males.

Lifespan: Usually around 3 to 6 years.

Threats: In addition to being prime targets of the fur trade, some Arctic fox populations have also fallen victim to diseases spread from domestic dogs.

Also, the Arctic fox is losing ground to the larger red fox. As their name suggests, Arctic foxes are specially adapted to thrive in the cold winters and thick snows of the far north. Where conditions are less extreme, however, this highly specialized species is generally out-competed by its cousin, the more adaptable red fox.

As global warming takes its toll and the snow-line continues to recede further and further north, the range of the Arctic fox shrinks, too, giving way to the northward advance of the red fox.

From Animals/Wildlife Habitat Facts, Defenders of Wildlife, the Canadian Encyclopaedia and WWF Global
Extension Activity 1

The Food Web

This activity is from Nature: Canadian Museum of Nature – Ukaliq, the Arctic Hare

General Description: Although it is a key actor in the polar food web, the Arctic hare is not widely known, especially in comparison to the Arctic fox or polar bear. In this activity, students will be prompted to ask themselves about the role it plays in the Canadian Arctic food web.

Links with the Common Framework of Science Learning Outcomes:
- Classify organisms according to their role in a food chain.
- Describe interactions between biotic and abiotic factors in an ecosystem.

Links with Other Subjects:
- Language
- Social Studies (Geography)

Duration:
- 10 minutes for the game only
- 40-50 minutes for the entire lesson, not counting student work time.

Preparation:
Before conducting this activity in the classroom, you will need to:
- visit the Web site Ukaliq: The Arctic Hare (http://nature.ca/ukaliq) and read the sections relating to the organisms mentioned in the game: Characteristics, Habitat, Eat and Be Eaten.
- draw up a list of the eight actors in the game Build a Food Web on the site and cut out the words so they can be put up on the board: Inuk hunter, Arctic wolf, Arctic fox, Snowy Owl, Arctic hare, Arctic willow, purple saxifrage, flea
- do the activity on the site yourself so that you fully grasp the 'click and drag' concept and see all the possible food chains. These are listed below.
**Food Chains in Build a Food Web:**

Chains are expressed vertically in the columns below.

<table>
<thead>
<tr>
<th>Inuk hunter (hunter)</th>
<th>Arctic wolf (wolf)</th>
<th>Arctic fox (fox)</th>
<th>Snowy Owl (owl)</th>
<th>Arctic hare (hare)</th>
<th>Arctic willow (Aw)</th>
<th>purple saxifrage (Ps)</th>
</tr>
</thead>
<tbody>
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<td>Snowy Owl</td>
<td>Arctic hare</td>
<td>purple saxifrage</td>
<td></td>
</tr>
</tbody>
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**Required Materials:**
- computer with Internet access
- coloured pencils.

**Objectives:** Students will:
- discuss the interrelations among the different Arctic-dwelling organisms
- draw Arctic-dwelling animals
- ask themselves about the interrelations among the animals of the Arctic
- use an interactive Web-based game to discover a few food chains, as well as part of the Arctic food web.

**Introduction:**

Ask students to tell you about animals that live in the cold regions of Canada. If they name animals on the list of words you have cut out, put the words on the board. Ask them to tell you what these animals need to live: water, food, shelter and territory.

**Development:**

Discuss these animals and the constraints of their habitat (extreme cold, wind, etc.) in detail. Put up the names of the other animals that have not been mentioned and touch on them before moving on.

Then ask students if they are familiar with the ‘predator-prey’ concept. If yes, move on. If not, take the time to explain that a predator is an organism that attacks and eats another organism. Accordingly, the prey is the organism that is attacked and eaten. It would be a good idea to ask the students to give a few examples, or you could provide some: the cat and mouse are a classic example. Before going any further, students also need to grasp the concepts of the food chain and food web. Of course, they will be better understood during the Web-based activity, but it is important for students to get the basic idea before they go to the site.

Again, if you have already gone over these concepts with your students, then you can simply skip this step. In short, a food chain is a way of looking at ‘who eats whom’. Actors of the chain are usually linked by arrows to indicate the direction of energy transfer. Combining several food chains that share actors creates a food web.

Once these concepts are well understood, you can present the food web game **Build a Food Web.** Guide students to the game’s Web page. Tell them to click on the images to find five chains with two actors, five chains with three actors, two chains with four actors, one chain with five actors, and a final chain with six actors. They need to remember to write them down. And, it will be all the better if they can find more!

**Note:** The Arctic hare must be included in each of the food chains.

**Conclusion:** Ask students to study a few pictures on the site in order to get a good idea of the Arctic landscape and the activity of the Arctic hare.

**Suggestions for Student Work:**

- Students draw two of the food chains that they found (four or more actors) and describe in writing how the different actors interact.
- Students draw two of the food chains that they found (four or more actors) and describe in writing how the different actors interact. The teacher challenges them to add another member (one that was not part of the activity) to each of the chains.
Expanding the Lesson:

- Students draw a food chain with actors from your region and compare it to one of the Arctic food chains.

- Students include abiotic factors in their work.
Extension Activity 2

Parks Canada – Forest Food Web Activity

(This activity is from Parks Canada and is Adapted from Focus on Forests)

Written By: Staff at Pukaskwa National Park

TOPIC: Ecological interactions in the boreal forest.

SYNOPSIS: By watching a video and doing an interactive activity, students will be introduced to food webs and ecological interconnections in the forest.

LENGTH: 45-60 minutes

CURRICULUM CONNECTIONS: For a complete list of curriculum connections, please go to the Teacher Resource Centre website at www.pc.gc.ca/education.

GOAL: To be introduced to the interconnections of forest ecosystems, using food webs as an example.

MATERIALS:
- Food Webs video by Bill Nye "The Science Guy" (optional)
- diagram of food chain and food web
- roll of string
- food chain and web worksheets
- writing materials
- open area

BACKGROUND INFORMATION: Pukaskwa National Park protects a representative portion of the Central Boreal Uplands. This is a section of the boreal forest; the largest ecosystem in the world (see map). The boreal forest was created by and has adapted to the massive forces of ice, fire, insect infestation, and disease. As a result, patchwork stands of trees, large and small, old and young, and at different stages supports a wide diversity of bird and mammal species.

Forests are complex, constantly changing systems made up of living and non-living things. All of the components of a forest community are vital to the health of the ecosystem. The non-living or abiotic components of a forest include water, nutrients, rocks, sunlight, and air. The living or biotic components include wildlife (from the smallest insect to the largest mammal), trees, shrubs, wildflowers, ferns, mosses, lichens, fungi, and microscopic organisms.

Interactions between the abiotic and biotic components are easily identified by examining food chains and food webs. A food chain is defined as the transfer of energy from plants to animals through the process of animals eating plants and animals eating other animals. For example, the sun transfers energy in the form of light to green plants. Green plants convert the sunlight into energy, which is stored
in the plant matter. The energy within plants is transferred to plant-eating animals when the plants are consumed. Energy is also passed from animal to animal as predators consume prey. For example, a simple food chain can consist of a green plant being consumed by an insect and the insect being consumed by a bird. Generally, any one species is represented in more than one food chain.

In forest communities, food chains become more complicated as many animals eat many different foods (energy sources) depending on the availability and abundance of the food. When many different species of plants and animals are interdependent, that is, depending on one another for survival, the process is called a food web. (See diagram.)

All living organisms that function together in a given area interacting with all the non-living and living factors result in a flow of energy. Such interactions lead to clearly defined biotic structures and cycling of materials between living and non-living parts. Ecology is the study of interactions between living things and their environments. The word ecosystem refers to the system of interactions between living and non-living things.

PROCEDURE:

1. Review the concept of a forest by asking students what they think of when they hear the word “forest.” List their responses as a flow chart. Ask students how the listed items (e.g. trees, birds, bears, chipmunks, etc.) interact. As students respond (e.g. the birds live in the trees, the bear eats the blueberries, the mouse eats the blueberries, the bear eats the mouse, etc.), draw connecting lines between the listed items.

2. Ask students what they think the diagram looks like (a spider web). Introduce the concept of food chains and food webs. Introduce and show the Bill Nye video. Following the Bill Nye video on food webs, ask for comments from students. What was most memorable about the film?

3. Move the students to an open area. Without in-depth explanation, have students stand in a large circle in an open area (preferable outdoors). The teacher should stand in the centre of the circle. Explain that students will be transformed into a forest.

4. Ask students what the first thing is needed for a forest. (Answer: trees - name a specific species e.g. jack pine, white pine, birch, etc.). The student answering correctly becomes a tree and holds on to the end of the string (the teacher remains holding onto the ball of string).

5. Ask the students what lives in a tree. The student with an answer (e.g. bird -name a species) holds onto the string. Continue to ask questions such as what does that animal eat? What else eats that? Where does it live? What eats it? For each answer, each student holds onto the string. Note: make sure at least 4-6 trees are part of the circle. Note: the teacher may wish to have the students lower the string when moving within the circle to each student).

6. When all students are holding onto the string, ask them what it looks like. The result is a web-like construction. Discuss the concepts of food webs and ecosystems. Include ideas on different kinds of ecosystems for example aquatic, desert, arctic, etc.

7. As the students continue to hand onto the string, present the situation where a developer decides to
build a cabin in the middle of this forest. But, in order to do so, trees will have to be cut down. On the count of three, have all of the trees gently tug on the string. Ask who felt the tug. Discuss why they felt the tug (e.g. no trees = no food, home, etc.).

8. Proceed to have everyone who felt the tug to gently tug again. Ask who felt the tug. After two or three rounds, everyone should feel the tug. Discuss why. Talk about how humans are part of ecosystems, such as the forest ecosystem. Discuss how humans negatively effect the ecosystem. Does this mean that people shouldn't cut down trees? How can humans prevent mismanagement and destruction of forests?

9. After students complete this discussion, have them drop the string. As the teacher winds up the string, ask how national parks fit into this situation. How do they effect ecosystems? Recap the ideas of interactions between organisms both living and non-living.

10. Upon returning to the classroom, have students complete the food chain and food web worksheets or draw a food web. Remind them of the different interactions between plants and animals, shared food sources, etc. For example, students may wish to colour the arrows different colours i.e. the transfer of energy from plants, to the rabbit, to the owl and wolf is red, the transfer of energy from plants, to the beaver, to the wolf is blue, etc. The images can be used for evaluation and posted throughout the classroom.

**ASSESSMENT:** Select a tool to assess the students' work (e.g. video feedback, group dynamics, class contributions, worksheets, food web diagram, etc).

**EXTENSIONS:**

**Upgrades:**

Research different ecosystems and food webs. How do humans part of those systems? How do they impact them? Compare a forest food web and ecosystem to that of another natural region e.g. wetlands, aquatic, desert, arctic, etc.

Make a list of the plant and animal life found in your area. Make a food web using these. Don’t forget to include humans.

**Downgrades:**

Transfer student food webs to thicker cardboard or plywood. Create food webs with string art.

Make a food web of your own diet for the day, e.g. milk from a cow that ate grass, etc. Compare your food web to that of the forest web. Is it more complicated? Why? Why not?
Boreal Forest Food Chain

Colour and fill in the blanks of this food chain. The arrows represent the pattern of energy exchange between the living things of the boreal forest.

Boreal Forest Food Web

Colour and label this food web. Connect the plants and animals to make a food web!