salamanders can be found in wetland vernal ponds formed from melted snow and heavy spring rains. Spotted salamanders eat insects, worms, snails, and small fish. Their skin is bluish-black or dark gray, and they have two rows of round yellow or orange spots down their backs. Their bellies are slate gray.

Red-spotted newts are amphibians that live near fens, marshes and emergent wetlands. Newts have long and slender bodies and a flattened tail. In its larval stage, this newt is called a red eft because of its bright reddish-orange color. After reaching maturity, this newt's skin will turn olive, and its sides will acquire red spots that are surrounded by black.

Spring peepers are small tree frogs that live near marshes, ponds, streams, or vernal pools (water that forms in large pools in the spring, but dries up in the summer.) Like all amphibians, spring peepers must lay their eggs in water. Like many salamanders, spring peepers are nocturnal – highly active at night. They grow less than an inch and a half in length and can be tan, gray or dark brown with a dark "X" on their backs. Spring peepers also have large toe pads to grip plants when they climb.

Muskrats are large rodents that live in aquatic environments throughout New Jersey watersheds, swamps, lakes and marshes. They prefer to make their home in aquatic habitats where the water level remains fairly stable, preferably at a depth of four to six feet. The muskrat's thick, glossy pelt (skin with fur) is dense and waterproof. It has a rudder-like, scaly tail to help it easily move backwards and forward in water. Muskrats have partially webbed hind feet that make them strong swimmers and divers. Muskrats are generally herbivores, eating plants such as cattails, water lilies, sedges and rushes; but they may also feed on fish, crayfish, frogs and freshwater clams. Muskrats have strong lungs and can swim underwater for up to 17 minutes before surfacing to take a breath.

Fiddler crabs live near water on the mud or sand. They dig burrows during high tides that can reach a foot deep. These burrows are often linked to other tunnels and have more than one entrance to provide fiddler crabs with an escape route from predators like fish, raccoons and aquatic birds. Male fiddler crabs have one large front claw and one small one, while females and young fiddlers have two small claws. The male fiddler crab uses the large claw to wrestle other males, to mark his territory and to attract a mate. The small claw is used to gather food. Fiddlers roll a ball of mud and use it to plug the hole of their burrow during high tides. The ball of mud traps a tiny pocket of air inside for them to breathe. All crabs have gills, which they must keep moist in order to breathe, so they stay near water at all times. Fiddler crabs grow between one and two inches and may be tan, blue-green, turquoise, black, yellow, or orange in color. Fiddler crabs eat algae, microbes, fungus and other decaying detritus. Some scientists believe that fiddler crabs help preserve wetland habitats because they aerate the soil and prevent anaerobic conditions as they forage for food and burrow in the sand.

Banded sunfish live in heavily vegetated areas of bogs, lakes and streams with sandy or muddy bottoms. Its body is lined by six or seven dark vertical stripes. The banded sunfish has rounded pectoral (front side) fins, a gill cover spot that is larger than its eye, and an arched line on the side of its body that ends just before its tail. It has an olive-colored body sprinkled with iridescent gold, green and purple markings. Banded sunfish feed mostly on aquatic insect larvae, scuds and other small crustaceans. They grow two to four inches in length and live up to four years. Spawning can occur from early spring into summer. The female lays eggs in a small, round nest built by the male.

River otters are expert swimmers and divers. They can stay underwater for up to two minutes. They have specially built ears and diamond-shaped noses with a valve-like skin that closes when the otter swims underwater. Otters have webbed and clawed feet that are useful for running on land and swimming. They can run up to 15 - 18 mph. River otters are three to four feet long and weigh 15 to 25 pounds. Their colorful coats range from nearly black to reddish or grayish brown on their backs. Their belly is silvery or grayish brown. The throat and cheeks are silvery to yellowish gray. Otters eat fish, crustaceans, and other aquatic invertebrates and they have few natural enemies, especially in water. On land, young otters are vulnerable to a variety of predators such as the fox, wolf and raptors.

An **osprey** is a raptor (bird of prey.) Raptors are at the top of their food chain and prey on smaller animals. The osprey has special adaptations to hunt fish but will occasionally eat rodents, birds, small vertebrates and crustaceans. The adult is blackish-brown above and white below; the breast is white or sometimes shows a brown band. The head is mostly white with a broad black stripe extending from the eye to the back. Bill and talons are black and eyes are yellow to orange. Ospreys range in size from 21 to 25 inches long with a wingspan of 59 to 67 inches. They are the only raptor that will plunge into the water for prey. Ospreys will hover 30 - 100 feet above the water looking for fish. When a fish is spotted, the osprey dives feet first into the water. The osprey's method of catching prey calls for some adaptations not found in more terrestrial hawks. The osprey's feathers are slightly oily to limit water absorption. The shank of the leg is scaled, not feathered, with short, dense feathering on the thighs. The pads of the toes are covered with spicules (small spikes) for grasping slippery fish. The osprey also has a reversible outer toe that can either be at the front of the foot or moved to the back for a two toe forward, two toe back formation for carrying fish. They build nests close to water near the tops of trees. The nest is built of sticks and lined with grasses, seaweed, moss, lichens, bark and mud.

This lesson was funded in (whole or part) with federal funds from Title IV, Part B, 21st Century Community Learning Centers program of the No Child Left Behind Act of 2001 awarded to the New Jersey Department of Education.

Wetlands Addendum

Types of Wetlands Found in New Jersey

The Great Swamp Refuge is located in Morris County, New Jersey. The refuge holds 7,600 acres of varied wetland habitats, serving as a breeding, nesting and feeding ground for birds, foxes, deer, muskrats, turtles, fish, frogs, wildflowers and plants.

Aquatic beds are found near the edges of lakes or streams, and are dominated by plants that generally grow on or below the surface of the water. Water lily, duckweed and pondweed grow in aquatic beds three to six feet deep. Waterfowl such as ducks and herons feed and rest in aquatic beds because they offer food and protection. Fish spawn (deposit their eggs) and feed in aquatic beds.

Emerging wetlands are found next to lakes and streams. They are home to green plants that produce flowers and fruit. Plants in emerging wetlands have soft stems, roots that are submerged in the water or wet soil, and leaves that are above the water or wet soil.

Bogs are covered by thick carpets of moss, lichen and peat (dead plant material.) The water in bogs is low in oxygen, highly acidic and usually cold. Almost all of the water found in bogs comes from precipitation (rain and snow.) Plants and animals that live in bogs have adapted to the low nutrient levels and acidic waters. Carnivorous (meat-eating) plants such as Venus flytraps eat insects because the water and soil in bogs lack the minerals and other nutrients needed for survival. Cranberries are harvested from bogs in New Jersey.

Fens have slow moving water that rinses acid from the soil. Minerals and nutrients drain into fens from surrounding soils and from groundwater. Fens are covered by grasses, rushes, sedges and wildflowers – mostly vascular plants with specialized tissues that transport water and minerals. These plants provide food and shelter for other aquatic organisms. Fens provide shelter to insects such as mosquitoes; amphibians such as the Eastern tiger salamander; birds, and mammals such as shrews, voles and muskrats.

Marsh wetlands usually have shallow, standing water throughout the year. Marshes are often "riparian," meaning they form a transition or buffer zone between water and land. Marshes contain lots of nutrients for plants and animals, but the water and soil found in marshes are "anaerobic" or lacking oxygen. Marsh plants adapt to the low levels of oxygen by drawing air through hollow spaces from their leaves to their roots and to the soil around their roots. There are several types of marshes, including freshwater and saltwater. Saltwater marshes can be found at the edges of estuaries (where freshwater flows into the ocean.) Saltwater marsh plants have adjusted to growing in salty, waterlogged soil and can excrete excess salt from specialized cells in their stems, roots and leaves. Cattails, rice, crabs, shrimp, tadpoles and insect larvae can all be found in marshlands.

Forested wetlands or swamps are covered by large trees and woody plants more than twenty feet tall. Swamps have water-saturated soils during the growing season and standing water during other times of the year. Both evergreen trees (having foliage that stays green throughout the year, such as the Eastern white pine), and deciduous trees (having leaves that fall off or shed seasonally, such as the Willow oak), grow in swamps. Few green plants grow in forested wetlands because of the acidic soil and lack of oxygen. Swamps also contain a layer of rotting plants called "peat."

Scrub/shrub wetlands are densely populated by small trees and bushes that are less than 20 feet in height. These wetlands are flooded with shallow, standing water for extended periods during the growing season. Their thick vegetation protects small birds and amphibians from larger prey. Scrub/shrub wetlands are important breeding areas for amphibians because of the absence of predator fish. Pussy willow, dogwood and elderberry are typical shrubs found in this type of wetland. Wood ducks, song birds, herons, muskrats and deer can also be found in scrub/shrub wetlands.

Wetland Plants and Animals

Plants of Aquatic Wetlands
Duckweed has many rounded leaves that float on the water. Duckweed leaves are small and serve as food for water birds and beavers. Cattails are the most common wetland plants. They grow more than eight feet tall on stiff stems. Cattails have flower spikes shaped like hot dogs. Muskrats, beavers and geese eat cattails. Birds nest among the cattails. Muskrats use this plant to build their homes. Early Americans used cattail stems to weave baskets and bedding. Cattail spikes could be torches when soaked in oil. Cattails were once used to insulate gloves and shoes, and cattail pollen is used to make flour.

Plants of the Bogs
Peat moss has a unique structure that allows it to hold 15 times as much water as the weight of the plant. Because of its ability to hold water, peat moss can survive during long dry periods.

Plants of Forested Wetlands
The forest wetland is full of Venus flytrap plants. This carnivorous plant has pointed hairy leaves that trap insects for food. Venus flytraps are becoming endangered because people dig them up to sell for a profit. Willow trees grow in forested wetland. Their roots trap sand and other sediment, preventing erosion and helping other trees grow in the wetland. Some of the trees that grow in swamps form a set of roots above the soil surface or above the water that allows them to get oxygen to the lower roots.

Plants of Emergent Wetlands
Purple loosestrife grows faster than any other wetland plant. It is a non-native and invasive plant that thrives in freshwater wetlands, crowding out native plants. Yellow iris is another invasive plant. Native Americans used Iris flowers as perfume and Iris leaves to make ropes and snares to trap elk for food. Iris is poisonous to humans, but it can be used to make a paste to stop swelling.

Plants of Shrub/Scrub Wetlands
Blackberry shrubs can grow roots from the branches if the branch is resting in a wet area. Blackberry thorns protect small animals hiding in the branches. Birds and bears eat blackberries. Birds and insects are protected in the cover of willow. Rats, birds and rabbits eat willow twigs. Willow trees also grow in shrub/scrub wetlands. Its branches are flexible and can be used to make baskets, twine, dye and furniture. Native Americans chewed willow bark for pain relief since it contains a chemical similar to aspirin.

Plants of Saltwater Marshes
Saltwater marsh plants include salt marsh grass and spartina. These plants have special glands that allow them to eliminate excess salt that they take in from the water and soil.

Insects of the Wetlands
Wetland insects include mosquitoes, water striders, dragonflies and mayflies. Mayfly larvae and adults serve as a food source for fish and amphibians. Water striders use a property of water called surface tension to walk on water. The surface of water acts likes a skin to help water striders and pond skaters. Pond skaters have specialized, paddle like legs that enable the insect to "skate" on the surface of the water.

Cranberries are red berries used in foods and in herbal products. Cranberries are a unique fruit. They can grow and survive only in acid peat soil, an adequate fresh water supply, and a growing season that extends from April to November. Cranberries grow on low-lying vines in bogs or marshes layered with sand, peat, gravel and clay.
Cape Cod Cranberry Growers' Association

Blackberry grows in relatively open, disturbed, and moist sites such as shrub/scrub wetlands. Blackberry shrubs grow quickly and tolerate poor soil. Blackberry bushes are often called brambles, from a word that means prickly. The plants have stiff, sharp prickles along the stems and midrib of leaves. White-tailed Deer, Eastern Cottontail, and Beaver eat the leaves and stems of the blackberry shrub. The shrub also provides great cover and protection for birds and small animals. Many plants often grow closely together to form a thicket. Several species of birds nest in blackberry shrubs. Birds and other animals eat blackberries and spread the seeds through their droppings.
Community Mapping Network

Cattails or bulrushes are wetland plants, typically 1 to 3 meters tall, with spongy, strap-like leaves and starchy, creeping stems. Cattails grow along lake margins and in marshes, often in dense colonies, and are sometimes considered a weed in managed wetlands. The plant's root systems help prevent erosion, and the plants themselves are often home to many insects, birds and amphibians. The disintegrating heads are used by some birds to line their nests. The downy material was also used by Native Americans as tinder for starting fires.

The **bog turtle** is found in the eastern United States in colonies from New York and Massachusetts south to southern Tennessee and Georgia. This is a semi-aquatic species, preferring habitats with cool, shallow, slow-moving water, deep soft mucky soils, and herbaceous vegetation. Bog turtles live in shallow, spring-fed fen, sphagnum bogs and swamps, marshy meadows and pastures generally dominated by sedges or sphagnum moss with soft, muddy bottoms, slow-flowing water and open canopies. Like other cold-blooded or ectothermic species, they require habitats with regular solar penetration

for basking and nesting. The bog turtle is one of the smallest North American turtles with the adult shell measuring 3 to 4 ½ inches in length. It has a large, bright orange, yellow or red blotch on each side of its head. When danger threatens, the turtle burrows rapidly into the mucky bottom. They eat beetles, insect larvae, snails, seeds and millipedes.
U.S. Fish and Wildlife Service

The **pitcher plant** is a carnivorous, or meat-eating plant. Carnivorous plants have adapted to living in low-nutrient environments by developing features to attract, trap, kill, digest prey and absorb nutrients. They eat invertebrates and occasionally small frogs and mammals. The most common habitat for pitcher plants is in bogs and fens, where nutrient concentrations are low but water and sunshine are seasonally abundant. Most plants absorb nitrogen from the soil through their roots; but carnivorous plants absorb nitrogen from their animal prey through their leaves that are specially modified as traps. Pitcher plants use "pitfall" traps with leaves folded into deep, slippery pools filled with digestive enzymes.
The Botanical Society of America

Mosses are small, low-lying, soft plants that grow 1 - 10 cm tall. They usually grow close together in clumps or mats in moist, shady areas. They do not have flowers or seeds, and their simple leaves cover thin wiry stems. Mosses are non-vascular plants. Unlike flowering plants, they do not have special channels to transfer nutrients up the stalk. Moss plants do not possess true roots. Instead, mosses get their nutrients and moisture from the air. Because of this they prefer damp places and have adapted to dealing with long dry periods. Mosses use spores to reproduce. Sphagnum peat-mosses are large mosses that form extensive acidic bogs in peat swamps. The leaves of peat-mosses have large dead cells alternating with living photosynthetic cells. These dead cells help to store water. Because of its water-holding capacity, peat moss is added to soil to improve its water-holding capacity and has been used as an absorbing material for oil spills. The Eskimo used peat moss to curb diaper rash.
College of Natural Sciences & Mathematics, University of Massachusetts Amherst

Herbaceous angiosperms (flowering plants) are the dominant and most familiar group of land plants. They have true roots, stems, leaves and flowers. They also have seeds. Angiosperms are more highly evolved than algae, mosses, fungi and ferns. Their advanced structures allow angiosperms to thrive on land. They have roots that hold the plant in place and take in needed minerals and water. They have leaves. They have stems that hold the plants up and move nutrients and water through the plant. Angiosperms are the primary food source for animals and provide oxygen to breathe.
Monroe County Women's Disability Network

Mosquitoes are two-winged insects. Female mosquitoes have mouth parts that form a long proboscis for piercing the skin of mammals, birds and sometimes reptiles and amphibians to suck their blood. The mosquito proboscis is serrated. The females need protein to produce and lay their eggs, while male mosquito diets consist of nectar and fruit juice. The females lay their eggs in water and the larvae and pupae live entirely in water. When the pupae change into adults, they leave the water and become flying land insects. Mosquitoes lay their eggs on the surface of woodland pools, tidal floodwaters, freshwater swamps, standing water or containers of collecting water.

Eastern garter snakes live in moist fields, forests, meadows and marshes. They are non-venomous and feed on small fish, frogs, toads, salamanders, earthworms, tadpoles, mice, bird eggs, slugs, crayfish, leeches, insects and other small snakes. They grow between 14 and 48 inches in length and have narrow heads and bodies. They range in color from light brown to black with two alternating rows of black spots. Eastern garter snakes have black lines on their lip scales. They also have three long stripes, usually with a yellow dorsal stripe. The lateral stripes are cream to yellow and are located on the second and third scale rows. There can also be a row of black spots below the lateral stripes.

American black ducks are large ducks found in wooded ponds, salt marshes and estuaries. The American black duck is chocolate brown with bright white feathers on its underwings. They have a lighter brown neck and head, red legs and feet. Males have a flat, broad yellow bill, while females have a darker olive bill. The American black duck feeds mainly on aquatic plants, but will also forage near the shore for seeds and insects. They float high in the water and are strong fliers. Their legs are placed towards the center of their bodies. Nests are built close to the water, often on the ground and lined with soft plant material.

Spotted salamanders are amphibians -- vertebrates that begin the first part of their lives under water (breathing with gills) and the rest of their lives on land (breathing with lungs.) Amphibians are ectothermic – they warm themselves by obtaining heat from the environment. Salamanders have soft, moist skin covering their long bodies and tails. They have no scales, claws or external ear openings. Most have four short legs, but some species only have front legs. Salamanders must return to the water to mate and lay their eggs. Females lay a milky egg mass about four inches long and attach the eggs to sticks or plant stems submerged in water. During the rainy season and early summer, spotted