



WAVE on Wheels Outreach

Turtle Time Presentation

Grades 9-12

Time requirement

1 Hour

Group size and grade

Up to 50 students maximum

Materials

3 species of turtle & tortoise

Turtle Artifacts Bin

WAVE Tablecloth

Goal

Through live turtle and tortoise encounters, students will be excited, engaged, and educated about the wonders of turtle life and the importance of conservation.

Objectives

1. Students will be able to list 5 adaptations a turtle has including a combination of internal and external body parts as well as behaviors.
2. Students will be able to define natural selection and discuss its effects on shark adaptations.
3. Students will be able to list at least 5 species of turtle and tortoise and identify a unique characteristic to that species.
4. Students will be able to discuss biological factors relating to turtle population numbers, individual growth rates, and reproduction success.
5. Students will be able to discuss social behavior strategies among turtles.

6. Students will be able to discuss turtle conservation efforts as well as how they can help save turtles and other aquatic animals.
7. Students will be able to design and describe a method for monitoring and minimizing human impacts on turtle environments.

Theme

Turtles and tortoises have similar but distinct adaptations to survive in their environment.

Kentucky Core Academic Standards – Science

High School. *Interdependent Relationships in Ecosystems*

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce

High School. *Natural Selection and Evolution*

HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

LS4.C: Adaptation

High School. *Human Sustainability*

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

ESS3.C: Human Impacts on Earth Systems

Background

Turtles are Reptiles

Turtles and tortoises are reptiles. Reptiles are cold-blooded or ectothermic animals, which means they depend on external sources to maintain their body temperatures. Scales or scutes protect reptiles from abrasions and loss of body moisture. Reptiles breathe air through lungs. Most reptiles hatch from eggs which are typically covered in soft, leathery shells. Reptiles include crocodilians, snakes, turtles, and lizards.

A Turtle or a Tortoise

All tortoises are turtles, but not all turtles are tortoises. Tortoises are a specific group within the larger turtle classification. Tortoises and turtles are similar; however, a turtle lives mainly in water and a tortoise lives on land. Since turtles spend most of the time in water they have webbed feet for swimming. Turtles can live in the ocean or in freshwater, like ponds and lakes. Tortoises do not have webbed feet since they walk on land. Another difference is their shells. A tortoise shell is large and dome-shaped while most turtle shells are flat and hydrodynamic.

Turtle (including Tortoises unless Specifically Stated) Adaptations

Turtles have a shell that is made up of 59-61 bones covered by plates called scutes which are made of keratin, like human fingernails and hair. They cannot crawl out of the shell because the spine and rib cage are connected to the shell. They also feel pain and pressure through the shell as nerves run throughout the shell. The upper shell of a turtle shell is called the carapace, and the bottom portion is called the plastron. These sections are connected on the side by bony structures called bridges. A species's shell shape is an adaptation to environmental factors. Dome-shaped shells are more difficult for predators to crush. Flat, streamlined shells aid in swimming and diving. Small, cross-shaped plastrons give more efficient leg movement for walking along the bottom of ponds and streams. In addition to the protection of their shell, various types of turtles have a variety of defensive adaptations. Box turtles have a hinged shell capable of encapsulating their entire body, while many tortoises have bulky, tough, and sometimes spurred front legs that will protect their head once pulled into the shell. Snapping turtles have a smaller plastron but are more aggressive, and some turtles, like musk turtles, can emit a foul smelling odor.

Turtles also have a built-in navigation system in the form of tiny magnetic particles in their brain that help the turtle process unique magnetic signatures. The planet's core contains iron and is surrounded by a layer of molten metal which moves slightly causing fluctuations in the magnetic field. This creates unique signatures which allow female sea turtles to relocate their birth beach in order to lay eggs at their place of birth.

Growth rates of turtles can be effected by many environmental and genetic factors. Turtles may possess indeterminate growth meaning they have the potential to grow their entire lives. However, as they reach adult size more energy is used for reproduction, defending territory, and body maintenance than on new growth. It is well documented that growth rates in ectotherms are significantly affected by the amount of food intake. More recent studies are also showing that water temperature and carbon dioxide levels may affect the growth rate and potential as these factors can effect metabolic rates. Additional studies suggest influences such as differentiating diets play a major role in embryonic development, which may lead to growth abnormalities. Over time, these issues could lead to genetic variations influencing inherited abnormalities.

Turtles are typically thought of as being solitary animals; however, this is an understudied area of animal behavior. One study trained Florida Red-bellied Cooters (*Pseudemys nelsoni*) to

dislodge clear plastic bottles to obtain food pellets. These turtles not only showed rapid learning, but required minimal retraining. Additionally, they investigated whether turtles could vicariously learn by observing other experienced turtles that had learned the task. All turtles showed evidence they learned not only to follow others to the bottles but also to approach the correct bottle that contained food reinforcement. This study of social behavior, learning, and cognition of turtles will hopefully spark interest in turtle behavior and cognition. Pancake tortoises are surprisingly social and stay in larger groups as long as there is adequate food. As many as ten tortoises have been found sharing the same crevice. Turtles also show symbiotic relationships with other species including mutualistic relationships with cleaning species including remoras and tangs.

Female turtles can lay between 2-200 leathery eggs depending on the species and the environmental factors affecting that species. In general, turtles do not exhibit parental care; however, the yellow mud turtle does remain at the nest site for up to 38 days. It appears that predation rates are lower when the female remains with the nest suggesting some degree of parental care. Since turtles lack gender-determining chromosomes, temperature differentiation leads to male or female offspring. Cooler, shaded areas of the nest lead to more males and warmer, sun-lit areas lead to more females.

Turtle Diets

Most turtles are omnivores, which means they eat plants and animals, such as fish, snails, worms, and insects. Most tortoises are herbivores eating grasses, leafy plants, flowers, fruits, and even cacti. Some sea turtles prefer eating jellyfish. Turtles lack teeth but have a large beak specifically shaped to their dietary needs. Carnivorous turtles usually have sharp ridges for slicing through their prey. Herbivorous turtles have serrated ridges to cut through tough plants. Turtles use their tongues to swallow food, but they cannot stick their tongues out to catch food.

Green sea turtles are one of the few animals to eat sea grass which needs to be constantly cut short to remain healthy and grow across the sea floor. Sea turtles act as grazing animals that cut the grass short and help maintain the health of the sea grass beds. Over the past several decades, there has been a decline in sea grass beds which may be linked to lower numbers of green sea turtles. Sea grass beds are important breeding and developmental grounds for many species.

Turtle Predators

Sea turtles are mostly preyed on by large sharks, for example tiger sharks. Some turtles can be eaten by crocodilians, canines, cats, raccoons, and types of birds that will pick up smaller turtles and drop them onto a rock which breaks the shell so they can eat them. One of the biggest predators of all species of turtle is humans. Urbanization has reduced natural turtle habitat and created good environments for turtle predators. The biggest turtle predator is the raccoon, which eats turtle eggs and some adults. Raccoon populations in urban areas have increased because of garbage and artificial feeding and the elimination of raccoon predators. Highway

traffic is responsible for the loss of thousands of turtles, especially box turtles, annually in the United States.

Natural Selection

Turtle ancestry dates as far back as dinosaurs and potentially even beyond. A recent find, named *Pappochelys*, Greek for grandfather turtle, lived some 240 million years ago. It was only about eight inches long, the size of a modern-day box turtle, and though it did not have a shell it did have adapted features. The ribs were broad, sturdy, and extended in line with the spine allowing more volume and improved buoyancy. It also had shell-like bones covering its belly. The largest species of turtle ever documented is unclear amongst *Santanachelys*, *Stupendemys*, or *Archelon*; however, these animals were able to reach lengths of 10 feet and possibly up to 19 feet in length. How they survived the mass extinct of dinosaurs 65 million years ago is unclear; however, there are many theories. These theories of survival include their preferred habitat, their amphibious design allowing for more prey opportunities, their low metabolic rates allowing for long periods without food, as well as a variety of adaptations. Natural selection of adaptations takes time, and if the environmental conditions change too fast, species may not be able to adapt that quickly. For dinosaurs, the environment changed too quickly for natural selection to allow for adaptation to the new climate, food supplies, temperatures, and basic needs. Turtles on the other hand, were able to survive the new environmental conditions, slowly adapting over millions of years to adapt to these new factors.

For a modern day example of natural selection consider a sea turtle nest. When sea turtles hatch they have to climb out of the nest and head to the water in a short period of time. The sea turtles use one another to climb out of the nest, the strong and healthy turtles will make it to the top with the weaker ones near the bottom of the nest, this is an example of survival of the fittest.

Food Web Connections

As with most predators, turtles play a critical role in their ecosystem as a top down control mechanism for the environment's food web. Apex predators consume tertiary and/or secondary consumers, which consume primary consumers, which consume producers, which produce energy from the sun through photosynthesis. The main source of energy for all ecosystems initiates from the sun in the form of solar energy. Through the process of photosynthesis, plants convert this energy into oxygen and glucose. Because of this conversion, green plants, some bacteria, and algae are labeled as producers. An animal, such as an herbivorous fish, who consumes the plant, is known as a primary consumer, because it receives the energy from the plant which converted the energy from the sun. The turtle who eats the fish that feeds on the plant which converted the sunlight is known as a secondary consumer, hence a process that directly related back to the sun as the primary energy source. An apex consumer is the top of the food chain or web with few to no natural predators at adult size such as an alligator, shark, or large cat.

Turtle Conservation

It is important to dispose of trash properly. Recall that turtles have small brains and can easily be confused by food items. Sea turtles eat jellyfish, and if a plastic bag gets into the water it resembles a jellyfish. The turtle may think it is food and consume it causing severe issues to their body. It is also important to avoid bright lights by beaches because sea turtle hatchlings use the light of the moon to find water. They will seek to brightest horizon which may sometimes be in the wrong directions thanks to human influences. Increased pressure from other fisheries can also have an indirectly negative effect on turtle species. As more prey items are harvested from freshwater environments and oceans, fewer food resources are left for predators. A limiting resource is an environmental condition that limits the growth, abundance, or distribution of an organism or a population of organisms in an ecosystem.

The WAVE Foundation's Aquatic Conservation Fund supports a variety of organizations whose chief mission is to protect natural resources and environments. Each year, the Newport Aquarium, in partnership with the North Carolina Wildlife Resources Commission's Sea Turtle Project, receives a hatchling loggerhead sea turtle that needs rehabilitation. Newport Aquarium biologists care for this turtle for about a year, and then return the young sea turtle to the ocean. Over the past several years the fund has purchased a satellite tag for the sea turtles. Guests are not only able to watch the young turtle grow over the course of a year, but then have the opportunity to follow its movements after being released by in the wild. The information gathered from the tags will relay crucial information to better understand sea turtle behavior, migratory patterns, etc. The tag is linked with [seaturtle.org](http://www.seaturtle.org) and tracking information can be found online at the link:

http://www.seaturtle.org/tracking/index.shtml?tag_id=142039&full=1&lang.

The fund also supports a small island in Florida that is doing big work toward protecting sea turtles. They placed billboards on the island to educate vacationers about how they can protect the nesting sea turtles during their visit. The messages include turning off lights during nesting season, not interacting with a beached female or hatchlings if observed on the shore, and communicating the location of new nests to the appropriate local watch group so they can closely monitor the nest and collect valuable data. To take further action, the Conservation Fund also adopted a sea turtle nest and covered the costs of the protection until it hatches. Nest protection may include a predator exclusion device, clear markings so people stay away, or nest excavation and captive incubation on occasion.

Vocabulary

Adaptation – the process by which an animal or plant species becomes fitted to its environment through body parts and behaviors

Carapace - the hard upper shell of a turtle, crustacean, or arachnid

Conservation – the study of the loss of Earth's biological diversity and ways this loss can be prevented

Consumers – organisms of an ecological food chain that receive energy by consuming other organisms

Diversity – the variety of life found in a place on Earth or the total variety of life on Earth

Environment – the external conditions, resources, stimuli etc. with which an organism interacts

Habitat – the place where an organism or a community of organisms lives, including all living and nonliving factors or conditions of the surrounding environment

Limiting factor - a factor present in an environment that controls a process, particularly the growth, abundance or distribution of a population of organisms in an ecosystem

Mutualism - two organisms of different species exist in a relationship in which each individual benefits from the activity of the other

Natural selection - process by which organisms that are better adapted to their environment tend to survive longer and reproduce more succeeding generations than those individuals that are less well adapted

Oviparity - producing eggs that mature and hatch after being expelled from the body

Photosynthesis - process by which green plants and some other organisms use sunlight to synthesize foods from carbon dioxide and water

Plastron - the part of a turtle shell forming the underside

Predator – an animal whose diet consists of other animals

Prey – an animal who is eaten by other animals, or predators

Producers – an organism that produces its own food (i.e. using photosynthesis) serves as a source of food for other organisms in a food chain

Symbiotic - organisms that live together; however, the relationship is not necessarily beneficial to both. (ie parasite-host)

Vicarious learning - a change in behavior due to the experience of observing a model

Extension Activities

Project WILD Activities. Please contact your state Project WILD coordinator for more information. See <http://projectwild.org/KentuckyCoordinator.htm> (for Kentucky) or <http://www.projectwild.org/ProjectWILDCoordinators.htm> (for other states).

- Back from the Brink – Students will (1) explain the reasons for the decline of certain wildlife species and describe methods used in species recovery, (2) describe the effects of the decline and recovery of wildlife on people and the environment, (3) analyze issues surrounding the decline and recovery of wildlife species and examine strategies to resolve those issues, and (4) describe the importance of an environmentally literate citizen base to the success of the recovery project.
- Bird Song Survey – Students will identify and describe the importance of bird counting as one means of inventorying wildlife populations.
- Can Do! – Students will (1) identify a problem involving wildlife in their community, (2) suggest and evaluate alternative means by which to either solve the problem or at least improve the situation, (3) successfully undertake the project, and (4) analyze and

describe the process by which they successfully solved the problem or improved the situation.

- Know the Legislation: What's in It for Wildlife? – Students will (1) describe the legislative process in which a bill becomes law, (2) identify points when private citizens can have an effect on the legislative process, and (3) evaluate the effectiveness of the legislative process from the perspective of the students' personal experience.
- Turkey Trouble – Students will (1) define and give examples of exponential and linear growth rates in wildlife populations, and (2) describe factors that affect and limit growth of wildlife populations.
- We're in This Together – Students will (1) identify environmental problems of concern to both people and wildlife, and (2) generalize that people, domesticated animals, and wildlife are subject to similar environmental problems.
- Wildlife Issues: Community Attitude Survey – Student will (1) assess the values held by various groups and individuals regarding a selected issue, and (2) distinguish between beliefs, values, and attitudes.
- Wildlife Research – Students will (1) identify reasons for research related to wildlife, (2) evaluate appropriate kinds of research related to wildlife, and (3) design and conduct a wildlife research project.

Resources

WAVE Foundation <http://www.wavefoundation.org>

Project Wild <http://www.projectwild.org>

Project Wet <http://www.projectwet.org>

Project Learning Tree <http://www.plt.org>

Endangered Species Information -

<http://education.nationalgeographic.org/media/endangered/>

Turtle Information - <http://ocean.si.edu/slideshow/meet-seven-sea-turtle-species>

Turtle Information - <http://animals.sandiegozoo.org/animals/turtle-tortoise>