



WAVE on Wheels Outreach

Scales and Tails Presentation

Grades 6-8

Time requirement

1 Hour

Group size and grade

Up to 50 students maximum

Materials

1 Turtle specie, 1 Snake specie, 1 Lizard or Crocodilian Specie
Turtle Snake and Lizard or Croc Artifacts Bin
WAVE Tablecloth

Goal

Through live turtle, snake, and lizard/crocodilian encounters, students will be excited, engaged, and educated about the wonders of reptile life and the importance of conservation.

Objectives

1. Students will be able to list 5 adaptations reptiles have including a combination of internal and external body parts as well as behaviors.
2. Students will be able to list at least 7 reptile species and identify a unique characteristic to that species.
3. Students will be able to discuss biological factors relating to reptilian population numbers, individual growth rates, and reproduction success.
4. Students will be able to describe that all energy in a food web originated from the sun.

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

Theme

Reptiles are unique group of animals that play an important role in their environments.

Kentucky Core Academic Standards – Science

Sixth Grade – MS. Matter and Energy in Organisms and Ecosystems

06-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organism and populations of organisms in an ecosystem.

LS2.A: Interdependent Relationships in Ecosystems

Seventh Grade – MS. Growth, Development, and Reproduction of Organisms

07-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

07-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Eighth Grade – MS. Interdependent Relationships in Ecosystems

08-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Eighth Grade – MS. Human Impacts

08-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

ESS3.C: Human Impacts on Earth Systems

Background

What are Reptiles

Turtles, snakes, lizards, and crocodilians are reptiles. Reptiles are cold-blooded or ectothermic animals, which means they depend on external sources to maintain their body temperatures. Basking in the warmth of the sun during the day and seeking shelter at night to avoid cold keeps their body temperature at an optimum level. Reptiles also must avoid overheating, so if daytime temperatures are high, they seek

shelter underground or underwater to avoid absorbing too much heat. Scales or scutes protect reptiles from abrasion and loss of body moisture. Reptiles breathe air through lungs. Most reptiles hatch from eggs which are typically covered in soft, leathery shells.

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 specie'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 typical 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.

A Croc's Adaptations to Aquatic Life

A croc has many features which make it suitable for living in water. Large, powerful tails are used for propelling through the water, while strong webbed feet are ideal for paddling. The dark, bumpy appearance provides camouflage resembling a floating log. Crocs also have excellent eye sight for both above and below water, and they possess an extra eyelid, called a nictitating membrane, that functions similar to underwater swim goggles. Their ears are hidden behind slits that close when they dive under water. Their bite force is second to none in the animal kingdom, up to 3,700 pounds (the weight of an adult walrus) per square inch (about the size of your thumbnail). Ouch!

Growth rates of crocodilians can be effected by many environmental and genetic factors. Crocodilians 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.

Crocodylians are typical thought of as solitary animals. There have been many research studies conducted on the feeding habitats of crocodylians to determine if groups observed feeding together are cooperatively hunting or opportunistically feeding in areas with high prey volume. Results are mixed as well as opinions on social hunting behavior. On the other hand, crocodylian prey species frequently use social grouping behavior to increase their survival rates. Small schools of fish or large herds of wildebeest all use social groups to protect the population from over-predation. Typically at the first sign of danger, young members of the group are moved into the middle of the group giving them the most protection and greatest survival rates.

With breeding season in the spring, female alligators lay between 30 and 50 leathery eggs in mid-summer. The mother alligator then buries the eggs in a nest and remains close by, protecting them from egg-stealing predators such as raccoons. Since alligators lack gender-determining chromosomes, temperature differentiation leads to male or female offspring. Cooler, shaded areas of the nest led to more females and warmer, sun-lit areas led to more males. If the mother gator senses too much pressure from an unsafe situation, she will gather the eggs in her mouth and relocate her offspring to a new nesting site. After hatching, the mother alligator takes her young immediately to the water in her mouth. Once in the water, the mother and her hatchlings form a social group called a pod, which offers protection from predators, lasting anywhere from a few months to a few years.

Croc Diets

Crocodylians are carnivores that eat a variety of animals near their habitats which may include but are not limited to: fish, turtles, birds, frogs, pigs, deer, buffalo, and monkeys. Crocs swallow their prey whole rather than chewing. They will tear off large portions, if the animal is too large to swallow whole, by a process called the death roll. After biting the prey the croc rolls around, essentially juggling its food around in its mouth until the right position is reached to toss its head back and slide the food down its throat. Some species of croc can eat up to half of their body weight in one meal. These large meals are converted into fat reserves located in the tail, and these fat reserves may allow a croc to survive over a year without eating.

Lizard Adaptations

Lizards are a large and widespread group of approximately 4,470 reptiles, ranging across all continents except Antarctica. Lizards typically have limbs and external ears. Many lizards can detach their tails in order to escape from predators, but this trait is not universal. Sight is quite important for most lizards for locating prey and communication. Many lizards have highly acute color vision needing to rely heavily on body language and movements to define territory, resolve disputes, and entice mates. Some species of lizard also utilize bright, highly visible colors as defense against predators when necessary.

Growth rates of lizards can be effected by many environmental and genetic factors. Lizards 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.

Social behavior in lizard species ranges from primarily solitary individuals to long lasting family units. Researchers in Australia discovered that the threatened great desert burrowing skink forms stable families, and these families construct and maintain elaborate underground homes. This is currently the only lizard known to live together with immediate family members that also invest in the construction of long-lasting homes.

Snake Adaptations

Snakes include approximately 2,920 species of elongate, legless reptiles that can be found on every continent except Antarctica. Most species are non-venomous and those that have venom use it primarily to kill and subdue prey rather than for self-defense. Some possess venom potent enough to cause painful injury or death to humans. The skeleton of most snakes consists solely of the skull, hyoid, vertebral column, and ribs. The skull of the snake consists of a solid braincase, and a flexible ligament that allows jaws to separate widely and joins the left and right lower jaws. The skin of a snake is covered in scales. The eyelids of a snake are transparent scales that remain motionless. Snakes shed the outer layer of skin in one layer to replace old, worn skin and get rid of parasites. An older snake may shed its skin only once or twice a year, but a younger snake may shed up to four times a year. All snakes are strictly carnivorous, eating small animals including lizards, other snakes, small mammals, birds, eggs, fish, snails or insects. Snakes use smell to track their prey by using a forked tongue to collect airborne

particles then passing them to the Jacobson's organ in the mouth for examination. The fork in the tongue gives the snake a directional sense of smell and taste simultaneously.

Growth rates of snakes can be effected by many environmental and genetic factors. Snakes 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.

Social behavior in snakes is similar to other reptiles ranging from loners to very gregarious species. Female timber, or canebrake, rattlesnakes have been observed forming birthing rookeries with other snakes. Studies have further shown that these females care for their young and associate more with related individuals than unrelated snakes suggesting they can recognize family members. Rattlesnakes also exhibit social defensive behavior and maternal defense of young.

Food Web Connections

As with most apex predators, crocodylians 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, an algae are labeled as producers. An animal, such as a deer, 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 croc who eats the deer 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, python, or komodo dragon.

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.

Croc Conservation

About 40 years ago, American alligators were close to extinction. Because the fashion industry targeted alligator skin for exotic leather products, the American alligator was listed as an endangered species in 1967. Fortunately, by 1987, alligators made a comeback thanks to the conservation efforts of several organizations. These efforts sustained, and the American alligator was removed from the Endangered Species list. As of today, alligator harvesting is being regulated closely by state authorities in the form of hunting permits. Alligator skin and meat is still desired; however, a portion of the profits generated from these goods are contributed to alligator management and research.

Increased pressures from invasive species and reduced prey populations can have negative effects on crocodylian species. As more prey items are harvested from the environment, either by humans or invasive species such as the Burmese python, fewer

food resources are left for large 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. Habitat reduction and fragmentation may also be a limiting factor. Consider the fact that an adult American alligator may have a home range of over 1,000 acres.

Ongoing and future research in the conservation and preservation of crocodilian species is critical. The Association of Zoos and Aquariums' (AZA) Crocodilian Advisory Group (CAG) has supported several conservation efforts and research projects in recent years. These efforts include habitat restoration & reintroduction (including radio tracking) of the Chinese Alligator (*Alligator sinensis*). The Chinese alligator is considered one of the most critically endangered crocodilians. This is a result of near total habitat loss and extremely small and fragmented wild populations. Plans for population recovery lie mostly with wetland restoration and the reintroduction of captive-reared animals.

Another project supported by the CAG was sending crocodilian biologists to India during the large die-off of the Indian Gharial (*Gavialis gangeticus*). After 2007, the wild population size was estimated to be 250 breeding adults. This drastic reduction in numbers over a 60-year period has been attributed to a number of factors including: habitat alteration, hunting for skins, harvest for medical uses, egg collection, and accidental drowning in fishing nets. Human influences on riverine habitats are another major threat to the Gharial, with sand-mining, agriculture, irrigation channels, dams, barrages, and modifications to the river course all combining to create an irreversible loss of Gharial habitat.

Finally, CAG is supporting community level education and conservation programs for the Philippine Crocodile (*Crocodylus mindorensis*). The Mabuwaya Foundation has used a combination of communication, education, and public awareness campaigns, community empowerment and local capacity building to implement localized protection strategies. A local protection group of farmers and fishermen has been trained to manage sanctuaries. In order to increase hatchling survival rates and assist in the recovery, a head-start program successfully raises and releases juveniles.

The National Park Service, in partnership with other organizations, is working on another ongoing project in the Florida everglades in the management of the highly invasive species, the Burmese python. These snakes are capable of reaching lengths of 23 feet and having the diameter of a telephone pole. Native crocodilians of Florida are naturally the apex predator; however, these non-native snakes are now competing with, and eating, native crocodilians species.

Lizard Conservation

The most endangered group of lizards in the world are the Caribbean island rock iguanas. Governments, academics, nongovernment organizations and private stakeholders are collaborating on more than 20 projects focused on alleviating threats to iguanas, changing public perceptions and ensuring long-term financial, government and public support for iguana conservation. Iguanas are seed dispersers and are vital to

the ecosystem and help to maintain healthy native plant communities. Several iguana species exist as single populations with no more than a few hundred individuals. Invasive, introduced mammalian predators such as feral cats and dogs, as well as pigs and goats, are the greatest threat to many iguana species and their habitats. Other significant threats include habitat destruction by charcoal production and land development, collection for the pet trade, hunting, vehicular mortality, and competition and interbreeding with the introduced, invasive common green iguana.

Snake Conservation

The St. Lucia racer is one of the rarest animals on the planet with as few as 18 individuals estimated at one time. These snakes were decimated by the arrival of the invasive mongooses in the late 19th century. Humans introduced the mongoose as a control mechanism for venomous snakes on the island; however, the mongoose does not discriminate. By 1936, the St. Lucia racer was declared extinct. Thanks to local groups such as the British conservation group Flora & Fauna International a small success story may be in the making. In 1995, only 50 St. Lucia racers remained on Earth, but thanks to protective measures their population has swelled to 900.

Vocabulary

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

Camouflage - Concealing coloration, background matching in animals, the use of biological coloration to mask location, identity, and movement, providing concealment from prey and protection from predators.

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.

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

Invasive species - An alien species whose introduction may cause environmental harm

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.

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.

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)

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).

- Bearly Growing – Students will compare similarities and difference between the growth of black bears and humans.
- Bottleneck Genes – Students will (1) describe biodiversity as it relates to natural systems, species, or individuals; (2) articulate that genetic diversity is essential to the health of a species because it facilitates adaptation to change and provides sources for new genetic material; (3) explain how natural selection favors individuals with traits adapted to their environment; and (4) explain that for a wildlife population to sustain itself, there must be enough habitat to support a healthy-sized population that will carry a healthy-sized gene diversity.
- Career Critters – The students will (1) identify five examples of how wild animals and plants can be used to manage some environmental problems, and (2) describe and give examples of an organism and its niche.
- Carrying Capacity – Students will (1) formulate and test hypotheses related to wildlife populations and carrying capacity, and (2) describe the significance of carrying capacity.
- Changing Attitudes – Students will (1) give an example of a change in attitudes related to a wild animal or the environment, and (2) describe factors that may influence changes in attitudes.
- Ecosystem Facelift – Students will (1) describe interactions or interdependency of organisms within an ecosystem; (2) articulate that managing an ecosystem as a whole, and not just for one or a few species, is essential for ensuring ecosystem diversity; and (3) relate the increase of wildlife populations to the improvement of habitats.
- Ethi-Reasoning – Students will (1) examine their own values and beliefs related to wildlife and other elements of the environment, (2) listen to and respect the right of other to maintain different values and beliefs, and (3) evaluate possible actions they might take that have an effect on wildlife and the environment.
- Litter We Know – Student will (1) identify and evaluate ways that litter pollution can endanger wildlife, and (2) propose ways to help eliminate these dangers to humans and wildlife.
- Oh Deer! – Students will (1) identify and describe food, water, and shelter as three essential components of habitat; (2) describe factors that influence carrying capacity; (3) define “limiting factors” and give examples; and (4)

recognize that some fluctuations in wildlife populations are natural as ecological systems undergo constant change.

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/>

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

Crocodile Information - <http://crocodilian.com/cnhc/cbd-faq-q1.htm>

Snake Information - <http://www.reptilegardens.com/reptiles/snakes/>

Reptile Information - <http://animals.nationalgeographic.com/animals/reptiles/>