



## **WAVE on Wheels Outreach**

### **Croc Talk**

### **Grades 9-12**

#### **Time requirement**

1 Hour

#### **Group size and grade**

Up to 50 students maximum

#### **Materials**

1 American Alligator

Crocodylian Artifacts Bin

WAVE Tablecloth

#### **Goal**

Through a live alligator encounter, students will be excited, engaged, and educated about the wonders of crocodylian life and the importance of conservation.

#### **Objectives**

1. Students will be able to list 5 adaptations a crocodylian has for aquatic life including a combination of internal and external body parts as well as behaviors.
2. Students will be able to physically differentiate between an alligator and a crocodile.
3. Students will be able to define natural selection and discuss its effects on crocodylian adaptations.
4. Students will be able to discuss biological factors relating to crocodylian population numbers, individual growth rates, and reproduction success.
5. Students will be able to discuss social behavior strategies among crocodylians.
6. Students will be able to discuss crocodylian conservation efforts as well as how they can help save crocodylians and other aquatic animals.

7. Students will be able to design and describe a method for monitoring and minimizing human impacts on crocodilian environments.

## **Theme**

Crocodilians are unique reptilian species that play an important role 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**

### *Crocodilians are Reptiles*

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

### *A Crocodile or an Alligator*

The term “croc” is used to describe any member of the crocodilian species: alligators, crocodiles, caimans, and gharials. Alligators and crocodiles are commonly misidentified, but by

observing several key differences, it is easy to tell them apart. Alligators reach average lengths of 15 feet and weigh up to 1,000 pounds while crocodiles can grow over 20 feet long and weigh more than 2,300 pounds. Alligators are primarily freshwater crocs with a “U” shaped snout, whereas crocodiles are capable of living in saltwater and possess a “V” shaped snout. In alligators, the upper jaw is wider than the lower and completely overlaps which results in their lower teeth being almost completely hidden when the mouth closes. In crocodiles, the upper jaw and lower jaw are approximately the same size so upper and lower teeth are visible when the mouth is closed. Both species have specialized glands which secrete salt, but the crocodile’s glands are better adapted to a saltwater environment while the alligator’s glands have faded in function.

Another physical difference is their coloration. The two species of alligator tend to be almost black in coloration while most species of crocodile tend to be a greenish-grey. Darker coloration in alligators allows for better camouflage in muddy, shady freshwater environments. This coloration also allows better heat absorption from the sun allowing alligators to survive in cooler climates. Greenish-grey coloration allows crocodiles to blend in to algae-filled or sunlit saltwater environments. Lighter coloration does not absorb heat as well so crocodiles are restricted to warmer climates.

### *Crocs in the Ecosystem*

Crocodylians serve an important role in the ecosystem. “Gator holes” are dug by a croc using its feet and snout. The holes collect water and are used as a refuge by surrounding wildlife during the dry season and a lure for prey by the croc. Crocodylians are also scavengers, which means they feed on the carcasses of dead animals, which balances populations and rids the area of disease and debris.

### *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 crocodylians can be effected by many environmental and genetic factors. Crocodylians 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 typically 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.

Some crocodylians also show symbiotic relationships with other species including mutualistic relationships between the Egyptian Plover and the Nile Crocodile. A few species have even been known to “play”. In captivity as well as in the wild, crocodylians have been observed playing with, biting, and pushing a floating ball, blowing bubbles under water, carrying bright flowers in their mouth and placing them in various locations, and even repeatedly surfing in waves along coastlines.

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.

### *Natural Selection*

Crocodylian ancestry dates as far back as dinosaurs and potentially even beyond. A recent find in North Carolina suggests crocodylian ancestors pre-date dinosaurs going back over 230 million years. This prehistoric beast was an upright, bipedal, 9-foot crocodile ancestor known as *Carnufex carolinensis*, or the Carolina Butcher, and was eventually outcompeted by true dinosaurs. For over 200 million years, crocodiles have survived in a physiology similar to modern quadrupedal species. The largest species was *Sarcocuchus* capable of growing more than 40 feet, weighing 10 tons, and believe to have preyed on Tyrannosaurus Rex! How they survived the mass extinct of dinosaurs 65 million years ago is unclear; however, there are many theories. These theories 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 other adaptations. Natural selection of adaptations takes time, and if the environmental conditions changed too fast, the species would not have been able to adapt so quickly. For dinosaurs, the environment changed too quickly for natural selection to allow for adaptation to the newer climate, food supplies, temperatures, and basic needs. Crocodylians on the other hand, were able to survive the new environmental conditions, slowly adapting over millions of years to adapt to these new factors.

### *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, and 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.

### *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 crocodylian species is critical. The Association of Zoos and Aquariums' (AZA) Crocodylian 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 crocodylians. 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 crocodylian 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 crocodylians of Florida are naturally the apex predator; however, these non-native snakes are now competing with, and eating, native crocodylian species.

## Vocabulary

Congregation – a group of alligators

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

Genetics – the science of heredity, dealing with resemblances and differences of related organisms resulting from the interaction of their genes and the 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

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

Play behavior - activities performed for self-amusement that have behavioral, social, and psychomotor rewards

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).

- 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/>

Alligator Information - <http://myfwc.com/wildlifehabitats/managed/alligator/facts/>

Alligator Information - [http://www.biokids.umich.edu/critters/Alligator\\_mississippiensis/](http://www.biokids.umich.edu/critters/Alligator_mississippiensis/)