



WAVE on Wheels Outreach

Penguin Presentation

Grades 6 – 8

Time requirement

1 Hour

Group size and grade

Up to 50 students maximum

Materials

1 African Penguin

Penguin Artifacts Bin

Penguin Emergency Backpack

Penguin Pedestal

WAVE Tablecloth

Goal

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

Objectives

1. Students will be able to list 5 adaptations a penguin has for aquatic life including a combination of internal and external body parts as well as behaviors.
2. Students will be able to list at least 5 species of penguin and identify that some penguins live in warm environments.
3. Students will be able to discuss biological factors relating to penguin population numbers, individual growth rates, and reproductive 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 penguin conservation efforts as well as how they can help save penguins and other aquatic animals.
6. Students will be able to design and describe a method for monitoring and minimizing human impacts on penguin environments.

Theme

Penguins are unique aquatic birds that play an important role in their environment.

Kentucky Core Academic Standards – Science

Sixth – 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 – 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 – MS. Interdependent Relationships in Ecosystems

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

Eighth – 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

Penguin Adaptations as Aquatic Birds

Penguins fly differently than other birds: not in the sky, but underwater, and can swim up to 12 mph. Due to the small muscles at the base of their feathers, which bind them closely to their bodies, penguins are considered waterproof. To reinforce their waterproof coat, the feathers are covered in a waxy substance that repels water. This substance is secreted at the base of the tail and distributed throughout the coat during preening. Flighted birds have hollow, light-weight bones, that create a lighter body to increase flying ability. Penguins, on the other hand, have heavy, thick bones which are durable enough to withstand propulsion while swimming. Penguins, like other aquatic birds, also have webbed feet for better locomotion in the water.

Penguins have several unique adaptations that help them survive in their environment. Penguins are black on the back and white on the front, which is observed as a type of camouflage known as countershading. Countershading aids many aquatic animals, including sharks, as they are more difficult to see considering their light undersides blend in with the sunlight if a predator is looking up from below. If a predator is looking down from above, the darker upper body blends in with the ocean depths which are black as sunlight completely dissipates. Penguins also have excellent eye sight for above and below water, and they possess an extra eyelid, called a nictitating membrane, that functions similar to underwater swim goggles. Penguins are not just good swimmers, but also good divers. Emperor penguins hold the record of diving to depths of over 1,700 feet and holding their breath for more than 11 minutes. At these depths, the pressure on their body and internal organs is 40 times the amount of pressure at the surface. Studies have hypothesized that penguins avoid low-oxygen problems and nitrogen narcosis, where nitrogen painfully enters the blood, by diverting blood flow to only essential organs.

In recent years, the African penguin population has been in decline to the point of claiming the title as an endangered species. Many factors have contributed to the decline of the population, inhibiting growth and development. Examples include but are not limited to: guano depletion, as it has been collected for commercial exploitation, forcing the penguins to relocate their nesting sites; egg collection for human consumption; and shifting fish stocks, as overfishing continues to be a prevalent environmental issue. These various factors have affected the individual and population growth of the African penguin species. Being forced to adapt to alternate environments with the possibility of an alteration in their primary diet may also result in genetic variations within these individuals.

Penguins are among the most social species of bird. All 18 species live in large groups, or rookeries, that may include thousands of individuals. These large groups allow penguins to survive in the harshest environments as they huddle to stay warm. Large hunting groups and migration groups also reduced 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. Unlike elephants and many other social animals, penguins do not have a group leader for the colony. However, there is some evidence there are levels of dominance in the group. Within these large groups, individual family units are able to locate each other as each penguin has a distinct vocalization. Family units spend much time together feeding, sleeping, and cooperatively preening. Since a penguin cannot reach all feathers on its body, a preening partnership allows all feathers to stay in prime condition and strengthens the social bond.

The African penguin is a monogamous species, meaning that it remains with one partner throughout their life, unless extenuating circumstances, such as predation of a partner, occur. They breed in colonies on rocky shores, which serve as strategic places to avoid predation, and return to the same breeding and nesting site each year. The African penguin has an extended breeding period which allows them to breed throughout the year, peaking in reproduction during various times depending on the region. Incubation of the eggs is a responsibility shared by both parents, a benefit that compasses the shared conservation of energy and risk of predation for each other, but a constant level of protection for the offspring. Each parent is equipped with an incubation pouch to keep the eggs at a constant temperature. Eggs hatch asynchronous, or not at the same time, usually being about a day or two apart. A penguin hatchling grows very quickly reaching full size in about two months; however, maturation with adult plumage does not occur until a year later. Parent penguins remain as a safeguard to their young for the first month of their life, after which they only remain dependent on their parents for food for a continued duration of two more months before becoming completely independent.

Penguin Diets

African penguins are carnivorous birds which feed on a variety of fish, such as herring, anchovies, sardines, and occasionally smaller crustaceans and squid. Their tongues are armed with sharp, backward-facing barbs that prevent prey from escaping. They can eat about 1 pound of food per day, or about 15% of their body weight. With that in perspective, it's no surprise that an African penguin poops about every 20 minutes, or around 72 times a day.

Penguin Predators

There are many predators that feed on African penguins, on land and sea. On the shore, snakes and mongooses hunt for penguin eggs, while leopards have been observed hunting adults. Marine predators include sharks, fur seals, orca, and the number one predator of penguins, leopard seals. A common misconception is that polar bears are also penguin predators. Polar bears are only found near the arctic circle or North Pole, whereas penguins remain in the Southern Hemisphere only. Therefore, these two animals would never come in contact with one another.

The Role of the Penguin in the Ecosystem

Because of their dual environments of both land and sea, penguins play an important role in the oceanic and terrestrial ecosystems. Over various regions of diverse climates, penguins serve as a source of prey for leopard seals, sharks, and orcas in the water and foxes, mongoose, and leopards on land. Penguins are also predators themselves, affecting populations of various fish, crustaceans, and squid. Penguin feces provide nutrients to the oceanic and terrestrial land, as microorganisms and bacteria feed upon the wastes they provide. A few burrowing species also disrupt the ground, directly effecting the landscape.

Species of Penguin

Throughout the southern hemisphere there are 18 types, or species, of penguin. The largest penguin species is the emperor penguin reaching heights up 45 inches. This large size has allowed the species to adapt to frigid temperatures of -40 degree Fahrenheit. The smallest penguin is the fairy, or little blue, penguin only reaching 13 inches in height. The small size may have been an adaptation to less food intake, warmer climates, or an increase ability to hide and seek shelter. Of the 18 species, 7 live in warm weather environments including the African black-footed penguin. Warm weather penguins lack feathers on the lower leg, while cold weather penguins have feathers down to their feet. Warm weather penguins also have a bald patch on their head which serve as a release point for heat.

Food Web Connections

As with most predators, penguins 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 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 penguin 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 orca, shark, or leopard seal.

Penguin Conservation

Unfortunately, the African penguin species is endangered, which means there has been a 50-70% decline in population reduction rates. Current reasons for the reduction in recent years are over-fishing, oil pollution, and the collection of guano and eggs. Predation also serves as a factor, considering the observation of the African penguin's newest predator, the leopard seal. Hope lies in the protection of this species under the classification of the endangered status. Breeding grounds are preserved as national parks or nature reserves, and guano and egg

collections have been outlawed. Still, penguins may be caught as bycatch in other fisheries, accidentally drowning in nets. Increased pressure of fishery competition can also have an indirect yet effect on penguin species. As more prey items are harvested from the oceans, fewer food resources are left for tertiary consumer predators, which in turn begin hunting new prey, such as penguins. In a direct manner, over-fishing takes prey straight from penguins, as they are predators themselves, turning the situation into a condition of limiting resources. A limiting resource is an environmental condition that limit the growth, abundance, or distribution of an organism or a population of organisms in an ecosystem. Recall the fact that an adult penguin may consume 15% of its body weight daily, and an African penguin weighs about 8 pounds. Therefore, an African penguin consumes on average 438 pounds of food per year. An average human, weighing significantly larger, may reach 1,000 pounds annually.

The WAVE Foundation's Aquatic Conservation Fund supports a variety of organizations whose chief mission is to protect natural resources and environments. SANCCOB (Southern African Foundation for the Conservation of Coastal Birds) is a non-profit organization whose primary objective is to reverse the decline of seabird populations through the rescue, rehabilitation, and release of ill, injured, abandoned and oiled seabirds – especially endangered seabirds like the African penguin. Over the past 50 years, this organization has treated more than 95,000 seabirds and has confirmed that the oil spill response actions alone have increased the African penguin population by 19%. The fund has also supported The Punta San Juan Project– Protecting One of the World's Largest Colonies of Humboldt Penguins. This project has introduced a variety of environmental changes to support local seabirds including adding cement artificial nests on the outskirts of breeding colonies. The project also collects annual survey data on population numbers, egg counts, and successful birth counts. Information about other penguin research projects are available from the Penguin Taxon Advisory Group (TAG).

Vocabulary

Asynchronous – Lack of temporal concurrence; absence of synchronism.

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

Fusiform – Torpedo shaped, tapering at both ends.

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

Guano – Penguin feces or poop

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.

Monogamous – The condition of having only one mate during a breeding season or during the breeding life of a pair.

Nitrogen narcosis – An effect on the brain of gaseous nitrogen that occurs to SCUBA divers and potentially diving animals including pain, drowsiness, and/or drunkenness

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.

Reproduction – The production of offspring by a sexual or asexual process.

Rookery - A breeding place or colony of gregarious birds

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.

Penguin Watch - <http://www.penguinwatch.org/>

Resources

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

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

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

<http://www.arkive.org/african-penguin/spheniscus-demersus/>

<http://marinebio.org/species.asp?id=646>

<http://www.arkive.org/african-penguin/spheniscus-demersus/>

<http://www.mysticaquarium.org/animals-and-exhibits/species-of-the-month/652-african-penguin>

<http://a-z-animals.com/animals/african-penguin/>

http://ecos.fws.gov/tess_public/profile/speciesProfile;jsessionid=354BAD592C2D8B57025B388561F112C0?spcode=B0FM

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

http://www.simtech.net/upload/Newsletter16_2.pdf