



## **WAVE on Wheels Outreach**

### **Penguin Presentation**

#### **Grades 3 – 5**

#### **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 identify penguin diets and how they eat.
3. Students will be able to list at least 3 species of penguin and identify that some penguins live in warm environments.

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.

## **Theme**

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

## **Kentucky Core Academic Standards – Science**

### **Third – 3. *Interdependent Relationships in Ecosystems***

3-LS2-1. Construct an argument that some animals form groups that help members survive

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

LS2.D: Social Interactions and Group Behavior

### **Third – 3. *Inheritance and Variation of Traits: Life Cycles and Traits***

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment

### **Fourth – 4. *Structure, Function, and Information Processing***

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

LS1.A: Structure and Function

### **Fifth – 5. *Matter and Energy in Organisms and Ecosystems***

5-PS3-1. Use models to describe that energy in animal's food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

PS3.D: Energy in Chemical Processes and Everyday Life

### **Fifth – 5. *Earth's Systems***

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and 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 to be 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 penguins, as they are 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 mostly black as the sunlight completely dissipates. Penguins 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. 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 11 minutes. At these depths, a 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.

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 allow 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 that there are some 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 strengthen a social bond.

### *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. More is being investigated, such as conservation of fish stocks, and immediate response to oil spills for species rescue.

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 an organization located in South Africa that works directly with the endangered African penguin and other shore bird species. In 2013, they requested funding for the upkeep and management of their chick-rearing unit for African penguins. The fund has also supported The Punta San Juan Project—Protecting One of the World's Largest Colonies of Humboldt Penguins. Information about other penguin research projects are available from the Penguin Taxon Advisory Group (TAG).

### **Vocabulary**

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

Behavior – Anything that an organism does involving action and response to stimulation.

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.

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.

Guano – Penguin feces or poop

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

Photosynthesis – The complex process by which carbon dioxide, water, and certain inorganic salts are converted into carbohydrates by green plants, algae, and certain bacteria, using energy from the sun and chlorophyll

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.

Rookery - A breeding place or colony of gregarious birds

Trait – A distinguishing characteristic or quality.

### **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).

- Energy Pipeline – Students will (1) explain why energy dissipates at each trophic level, (2) contrast the transfer of energy and the recycling of organic material within an ecosystem, and (3) relate the role of each trophic level to ecosystem dynamics.
- Grasshopper Gravity – Students will (1) describe the relationship between the structure and function of grasshopper; (2) generalize that wildlife ranges from small to large organisms and exists in a variety of forms; and (3) recognize that people have influence on other animals, and with that influence comes the responsibility to act with compassion.
- Graphanimal – Students will identify characteristic life forms in two different environments.
- Playing Lightly on the Earth – Students will (1) distinguish between games that are damaging and not damaging to the environment, and (2) invent games with a benign effect on the environment.
- Surprise Terrarium – Students will (1) identify camouflage as an example of an adaptation, and (2) describe the importance of adaptations to animals.
- Too Close for Comfort – Students will (1) describe possible negative consequences for people and wildlife under conditions of crowding, and (2) identify ways people can behave in order to reduce negative consequences of crowding for wildlife.
- What Bear Goes Where? – Students will (1) identify three species of bears and their habitats, and (2) generalize that animals have adapted in order to live where they do.

Book - Mr. Popper's Penguins by Richard and Florence Atwater

### **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://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](http://www.simtech.net/upload/Newsletter16_2.pdf)