

1. Discuss the differences in form between an albatross wing, a hummingbird wing and a sparrow wing. How do the different wing structures relate to their function?
2. Birds have unique physical and behavioral adaptations that allow them to survive and prosper in their habitats. Discuss the problems that might arise when a bird is introduced to a new habitat, or their native environment is changed in some way.
3. Have students theorize on how birds like penguins and ostriches evolved into flightless animals. Ask students to think about the ways in which their environments forced these birds out of the air.

Follow-up Activities

- Have students observe migratory birds locally and choose an indigenous species to study. In a report, have them present reasons why birds migrate, the conditions that trigger migration in a given species, where they migrate to and how they make the journey (how fast, how high do they fly?).
- Instruct students to build a number of bird feeders for placement on the school campus. Using field guides and binoculars, have students identify as many birds as they can, keeping a notebook that lists the genus, species, date and time of day observed, along with notes on behavior for each bird. For unknown species, encourage detailed note-taking about color, body structure and eating habits so that identification might be possible by a local expert. Ask students to sketch the birds in their notebooks.
- In groups of two, have students create a poster of a bird order, providing images, characteristics and examples of at least three birds in the order. Tell students to point out similarities and differences among the animals, focusing on structure, diet, habitat and behavior. Have them look into non-scientific classifications of these birds to see if the two classification systems overlap.
- Have students research how knowledge about birds has helped people develop and perfect air travel for humans.
- For centuries, humans have dreamed of being able to fly. Have students search out examples of this desire in works of literature, mythology, dream symbolism and art in order to compose a piece of creative writing that examines "If only I could fly like the birds."

Internet Resources

- whyfiles.news.wisc.edu/006migration/bird_strategy.html
"How Birds Migrate" offers a wealth of information on bird migration, including how they navigate, some flight strategies birds utilize in the air and a special section on the world's largest migration of raptors.
- north.audubon.org/
"Wild Wings Heading North" is an informative site from the National Audubon Society that provides a detailed look at a migration season.
- www.owlpages.com/
"The Owl Pages" examines the physiology, mythology and reproduction of owls from all over the world. Also features a large gallery of owl photos and their typical calls.

- octopus.gma.org/surfing/antarctica/penguin.html
The Gulf of Maine Aquarium presents information about penguin adaptations at this Web site, along with teaching ideas that encourage students to use the scientific method..
- wings.ucdavis.edu/Book/Animals/intermediate/birds-01.html
This excellent K-8 Aeronautics Web site describes the characteristics of birds that make flight a possibility, discusses the mechanics of flight and lists a great number of interdisciplinary bird lessons and activities.
- www.earthfoot.org/backyard/birds.html
The Earthfoot Web site contains information on bird watching, as well as interesting facts about bird behavior and anatomy.

Suggested Print Resources

- Doris, Ellen. *Ornithology*. Thames & Hudson, New York, NY; 1994.
- Johnson, Jinny. *Simon & Schuster Children's Guide to Birds*. Simon & Schuster Books for Young Readers, New York, NY; 1996.
- Kalman, Bobbie. *What is a Bird?* Crabtree Publishing, New York, NY; 1999.
- Lynch, Wayne. *Penguins!* Firefly Books, Toronto, Canada; 1999.
- Taylor, Barbara. *The Bird Atlas*. DK Publishing, New York, NY; 1993.
- Weidensaul, Scott. *Birds*. Scholastic, Inc., New York, NY; 1998.

TEACHER'S GUIDE CONSULTANT

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Birds

Grades 5-8

Students in grade 5-8 classrooms possess a wide range of background knowledge. Student response to this video program is sure to be varied, so the teachers for these grades need all the help they can get! This guide has been designed to help science teachers in grades 5-8 by providing a brief synopsis of the program, pre-viewing and follow-up questions, activities, vocabulary and additional resources.

Before Viewing: Extensive research tells how important it is for the teacher to discover what the students know — or think they know — about a topic, before actually starting a new unit. Therefore, after prompting discussion with the pre-viewing questions, lead your class to create a "Everything We Think We Know About..." list. You may also wish to preview key vocabulary words, and have students raise additional questions they hope will be answered.

After Viewing: Have your students share video excerpts that fascinated or surprised them, then challenge your students to prove or disprove the accuracy of the facts they put on their "Everything We Think We Know About..." list. Discuss what else they learned and use the follow-up questions and activities to inspire further discussion. Encourage students to research the topic further with the Internet and reading resources provided.

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Program Summary

With approximately 9,000 different types of birds in Class Aves, ornithologists — the scientists who study birds — divide them scientifically into smaller groups called orders. There are approximately 30 separate orders of birds, and they can also be grouped in non-scientific categories like waterfowl, song-birds, hunting birds and flightless birds.

Like any other class of animals, birds share a number of common characteristics. Most importantly, all birds have one unique characteristic that is not shared by any other living thing on the Earth — they have bodies covered in feathers. Some of the types of feathers that cover an adult bird's body include contour feathers, that give a bird's body its outline, shape and color, and soft down feathers that keep a bird warm. In addition, all birds have wings, lay eggs, are warm-blooded and are vertebrates.

The adaptations that make flight possible for most birds are also unique. They have hollow, lightweight bones; a beak instead of teeth; specialized pectoral muscles and a highly specialized brain for motor coordination. However, while we often equate birds with the ability to fly, there are a number of species that cannot take to the air, including the penguin and ostrich.

Birds also have specialized means to digest food. Since they have no teeth, birds utilize their beaks to tear or break food apart. Birds also have a space in their throat called a crop, where they store undigested food. Large muscles around their stomachs called gizzards break down the food, grinding seeds and other foods into digestible pieces.

This program also covers bird reproduction, migration and the many different kinds of relationships birds have with the environments in which they live. While human civilization has had a devastating impact on the habitats in which birds live, humans have also helped to restore the populations of several endangered species, including the California condor and the great white heron.

Vocabulary

The following words are included for teacher reference or for use with students. They are listed in the order in which they appear in the video.

Class Aves — The scientific name for the group of animals known as birds.

ornithologists — Scientists who study birds.

order — The scientific term used to divide organisms from a class into groups that share broad common characteristics. There are approximately 30 orders in the Class Aves.

plumage — Feathers, the characteristic that makes birds unique.

Archaeopteryx — A reptile-like bird whose fossilized remains are the oldest bird fossils found.

contour feathers — The large feathers of a bird's wings and tail that provide shape, protection and coloration.

barbs — The fine, thread-like parts of a bird's feather connected to the quill.

quill — Also called the shaft; the stiff, hollow part of a bird's feather.

vane — The web-like surface of a feather created when barbs link together.

down feathers — The fuzzy, soft feathers that keep a bird warm. They cover the bodies of newly hatched birds and remain underneath the contour feathers of adult birds.

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vertebrates — Animals with internal backbones made up of small bones called vertebrae. These bones provide support for the animal's muscles and organs, while providing protection for the animal's spinal nerves.

warm-blooded — A term describing animals that maintain a nearly constant body temperature that is not influenced by the temperature of their environment.

pectoral muscles — The powerful chest muscles that birds flex to move their wings.

lift — The upward force caused by increases in air speed above an airborne object and a decrease in air pressure. The resulting increase in air pressure beneath the object opposes the force of gravity and allows birds and aircraft to fly. Swiss scientist Daniel Bernoulli first described this effect in the eighteenth century.

air resistance — The force due to air particles that slows down motion.

elliptical wings — The wings, found on birds such as sparrows and woodpeckers, that allow for sharp turns and prevent stalling at slow speeds.

high-speed wings — The wings found on birds such as hummingbirds that are flat and narrow at the tips, allowing quick and sudden movements.

soaring wings — The wings found on birds such as the albatross, which are designed long and narrow for high speed and high lift.

drag — The force of resistance in movement through air or water.

hydrodynamic — Designed to move through the water with ease.

carnivores — Animals that eat other animals.

herbivores — Animals that eat only plants.

insectivores — Animals that eat only insects.

crop — An area in a bird's throat used to store and soften undigested food.

gizzard — Large muscles surrounding the digestive tract of a bird, used to grind food.

incubation — Keeping eggs warm and protected from the time eggs are laid until they hatch.

brooder — A heated structure used for raising young birds.

migration — The process by which birds travel to more favorable climates where food is plentiful and their young can be raised.

symbiosis — The close association between organisms of different species where at least one organism benefits from the association.

predator — An animal whose food is primarily obtained by the killing and consumption of other animals.

bird of prey — A carnivorous bird whose diet consists of meat.

Pre-viewing Discussion

Before students generate their list of "Everything We Think We Know About..." for this topic, stimulate and focus their thinking by raising these questions so that their list will better reflect the key ideas in this show:

1. What are the characteristics of a bird?
2. What specific body parts enable a bird to fly?
3. How do birds eat?
4. Can all birds fly?

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After the class has completed their "Everything We Think We Know About..." list, ask them what other questions they have that they hope will be answered during this program. Have students listen closely to learn if everything on their class list is accurate and to hear if any of their own questions are answered.

Focus Questions

1. About how many different types of birds are there?
2. What is the scientific name for the class of animals known as birds? How many orders are birds divided into?
3. What are some of the non-scientific classifications that birds are grouped in?
4. What is the one unique characteristic of birds that differentiates them from all other creatures?
5. Why is the ability to fly or the ability to lay eggs not considered to be a unique characteristic of birds?
6. How did the discovery of Archaeopteryx provide a link between birds and reptiles?
7. What are two types of feathers found on birds? What are their functions?
8. What are barbs? How do barbs create a vane?
9. Besides feathers, what are the other characteristics of members of Class Aves?
10. How are a bird's bones adapted to aid in flight?
11. Why are pectoral muscles important for flight?
12. What do a bird's wings and the wings of an aircraft have in common?
13. How does air pressure relate to flying?
14. What theory did Bernoulli contribute to our understanding of flight?
15. What types of movement do elliptical wings allow? Name some birds with elliptical wings.
16. Why have some birds lost the ability to fly?
17. What features make penguins hydrodynamic?
18. What are some reasons that birds migrate? Why do many birds travel in large groups?
19. How do migrating birds know where to go?

Follow-up Discussion

Research indicates that students will retain their previous misconceptions about a topic, in preference to new information, until they actively recognize and correct their own errors. Therefore, it is important to have your students re-examine the facts/beliefs they put on their "Everything We Think We Know About..." list. It might also be helpful to review the list by marking each entry with a "+" or "-" to show which facts were correct and which were incorrect.

Discussions that ensue from thought-provoking questions provide a good way to assess the overall depth of student understanding. The following are some suggested discussion questions.

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