Chapter 31 Organizer

Refer to pages 4T-5T of the Teacher Guide for an explanation of the National Science Education Standards correlations.

Section	Objectives	Activities/Features
Section 31.1 **Reptiles** National Science Education Standards UCP.1-5; C.3, C.5, C.6; G.3 ($1\frac{1}{2}$ sessions, $\frac{1}{2}$ block)	1. **Compare** the characteristics of different groups of reptiles. 2. **Explain** how reptile adaptations make them suited to life on land.	**Inside Story:** An Amniotic Egg, p. 844 **Careers in Biology:** Wildlife Artist/ Photographer, p. 846 **Focus On** Dinosaurs, p. 850
Section 31.2 **Birds** National Science Education Standards UCP.1-5; A.1, A.2; C.3, C.5; F.4, F.5; G.1-3 ($2\frac{1}{2}$ sessions, 1 block)	3. **Interpret** the phylogeny of birds. 4. **Explain** how bird adaptations make them suited to life on land. 5. **Relate** bird adaptations to their ability to fly.	**MiniLab 31-1:** Comparing Feathers, p. 853 **Inside Story:** Flight, p. 855 **MiniLab 31-2:** Feeding the Birds, p. 856 **Problem-Solving Lab 31-1,** p. 857 **Design Your Own BioLab:** Which egg shape is best? p. 860 **Biology & Society:** Illegal Wildlife Trade, p. 862

Need Materials? Contact Carolina Biological Supply Company at 1-800-334-5551 or at **http://www.carolina.com**

MATERIALS LIST

BioLab

p. 860 modeling clay, cardboard, metric ruler, string, hard-boiled egg, Ping-Pong ball, golf ball, balance, protractor

MiniLabs

p. 853 contour feather, down feather, hand lens, paper, pencil
p. 856 1-gallon plastic milk bottles, wire, bird seed (assorted varieties)

Alternative Lab

p. 842 thermometer, black paper, white paper, transparent tape, lamp, metric ruler, modeling clay, small metal cans (2)

Quick Demos

p. 842 live or mounted reptile specimens
p. 848 plastic dinosaur models
p. 854 recording of bird songs and calls

Key to Teaching Strategies

- L1 Level 1 activities should be appropriate for students with learning difficulties.
- L2 Level 2 activities should be within the ability range of all students.
- L3 Level 3 activities are designed for above-average students.
- ELL ELL activities should be within the ability range of English Language Learners.
- COOP LEARN Cooperative Learning activities are designed for small group work.
- P These strategies represent student products that can be placed into a best-work portfolio.
- These strategies are useful in a block scheduling format.

Reptiles and Birds

Teacher Classroom Resources

Section	Reproducible Masters	Transparencies
Section 31.1 **Reptiles**	**Reinforcement and Study Guide,** pp. 137-138 L2 **Content Mastery,** pp. 153-154, 156 L1	**Section Focus Transparency 75** L1 ELL **Basic Concepts Transparency 54** L2 ELL **Basic Concepts Transparency 55** L2 ELL **Reteaching Skills Transparency 45** L1 ELL
Section 31.2 **Birds**	**Reinforcement and Study Guide,** pp. 139-140 L2 **Concept Mapping,** p. 31 L3 ELL **Critical Thinking/Problem Solving,** p. 31 L3 **BioLab and MiniLab Worksheets,** pp. 139-142 L2 **Laboratory Manual,** pp. 219-228 L2 **Content Mastery,** pp. 153, 155-156 L1 **Tech Prep Applications,** pp. 39-40 L2	**Section Focus Transparency 76** L1 ELL **Basic Concepts Transparency 56** L2 ELL **Basic Concepts Transparency 57** L2 ELL **Reteaching Skills Transparency 46** L1 ELL

Assessment Resources

Chapter Assessment, pp. 181-186
MindJogger Videoquizzes
Performance Assessment in the Biology Classroom
Alternate Assessment in the Science Classroom
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 31 quiz

Additional Resources

Spanish Resources ELL
English/Spanish Audiocassettes ELL
Cooperative Learning in the Science Classroom COOP LEARN
Lesson Plans/Block Scheduling

NATIONAL GEOGRAPHIC Teacher's Corner

Products Available From Glencoe

To order the following products, call Glencoe at 1-800-334-7344:

CD-ROMs

NGS PictureShow: Structure of Vertebrates 1
NGS PictureShow: Structure of Vertebrates 2

Curriculum Kit

GeoKit: Fish, Reptiles, and Amphibians

Transparency Set

NGS PicturePack: Structure of Vertebrates 1
NGS PicturePack: Structure of Vertebrates 2

Products Available From National Geographic Society

To order the following products, call National Geographic Society at 1-800-368-2728:

Video

Reptiles and Amphibians

Index to National Geographic Magazine

The following articles may be used for research relating to this chapter:

"Ravens: Legendary Bird Brains," by Douglas H. Chadwick, January 1999.
"Dinosaurs Take Wing," by Jennifer Ackerman, July 1998.

GLENCOE TECHNOLOGY

The following multimedia resources are available from Glencoe.

Biology: The Dynamics of Life

CD-ROM ELL

Video: *Feeding Snake*
Exploration: *The Five Kingdoms*
BioQuest: *Biodiversity Park*
Video: *Sea Turtle*
Exploration: *Bird Adaptations*
Video: *Eagles*
Video: *Shorebirds*
Video: *Bird Courtship*

Videodisc Program

Snake Feeding
Sea Turtle

The Infinite Voyage

The Great Dinosaur Hunt

Chapter 31

Getting Started Demo

Naturalist Display reptilian skulls or skeletons. Have students compare and contrast them. Point out the locations of the appendages on the skeletons, or, if a snake is displayed, the absence of appendages. Discuss the location of the appendages in relation to life on land.

Theme Development

Evolution is one theme woven throughout the chapter and is apparent in the discussions of the movement of animals to land and how dinosaurs may have evolved into birds. **Unity within diversity** is exemplified by the features reptiles have in common and by a discussion of adaptations that led to the classification of reptiles into different orders. Similarly, birds have features in common but also have adaptations that make them suited for particular habitats.

0:00 Out of Time?

If time does not permit teaching the entire chapter, use the BioDigest at the end of the unit as an overview.

Resource Manager

Section Focus Transparency 75 and Master L1 ELL

Chapter

31 Reptiles and Birds

What You'll Learn

- You will compare and contrast various reptiles and birds.
- You will identify reptile and bird adaptations that make these groups successful.

Why It's Important

Studying reptiles, the first animals to become independent of water, can help you understand the adaptations required for life on land. Birds are endotherms and have feathers and wings, adaptations that enable them to live anywhere on Earth.

Getting Started

Naming Reptiles

There are more than 7000 known species of reptiles. *How many species of reptiles can you name?*

interNET CONNECTION To find out more about reptiles and birds, visit the Glencoe Science Web Site. **www.glencoe.com/sec/science**

What does a legless, cold-blooded viper with poisonous fangs have in common with a bird? Think about scales and shelled eggs. Scientists hypothesize that reptiles are the ancestors of birds.

Multiple Learning Styles

Look for the following logos for strategies that emphasize different learning modalities.

- ***Kinesthetic*** Quick Demo, p. 842; Meeting Individual Needs, pp. 844, 851; Portfolio, p. 850
- ***Visual-Spatial*** Biology Journal, p. 844; Tech Prep, pp. 845, 858; Portfolio, pp. 847, 853, 856
- ***Interpersonal*** Project, p. 846; Quick Demo, p. 848; Meeting Individual Needs, p. 857
- ***Linguistic*** Portfolio, p. 848; Biology Journal, p. 854; Check for Understanding, p. 858
- ***Logical-Mathematical*** Meeting Individual Needs, p. 855
- ***Auditory-Musical*** Quick Demo, p. 854
- ***Naturalist*** Check for Understanding, p. 848; Activity, p. 849

Section

31.1 Reptiles

SECTION PREVIEW

Objectives

Compare the characteristics of different groups of reptiles.

Explain how reptile adaptations make them suited to life on land.

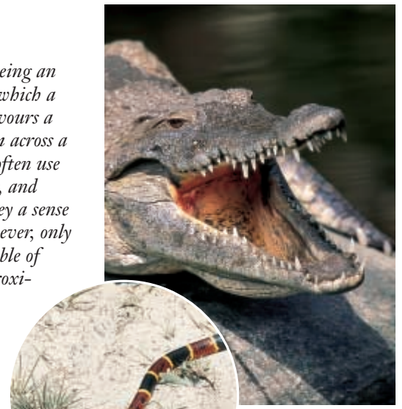
Vocabulary

amniotic egg
Jacobson's organ

WORD Origin

reptile
From the Latin word *repere*, meaning "to creep." A reptile is an animal with dry skin, legs under the body, and amniotic eggs.

You may remember seeing an adventure movie in which a ferocious crocodile devours a villain who is trying to swim across a jungle river. Moviemakers often use crocodiles, alligators, lizards, and snakes in their films to convey a sense of fear to the audience. However, only a few reptile species are capable of killing humans. Of the approximately 120 species of snakes found in the United States, the poisonous ones include the rattlesnakes, moccasins, copperheads, and coral snakes.



Nile crocodile and coral snake (inset)

What Is a Reptile?

At first glance, it may be difficult to determine how a legless snake is related to a tortoise. Snakes, turtles, alligators, and lizards are an extremely diverse group of animals, yet all share certain traits that place them in the class Reptilia.

Early reptiles, such as the cotylosaur (kaht ul oh SOR) shown in ***Figure 31.1***, were the first animals to become adapted to life on land. All reptiles have adaptations that enable them to complete their life cycles entirely on land. These adaptations released the cotylosaurs and other reptiles from the need to return to swamps, lakes, rivers, ponds, or oceans for reproduction.

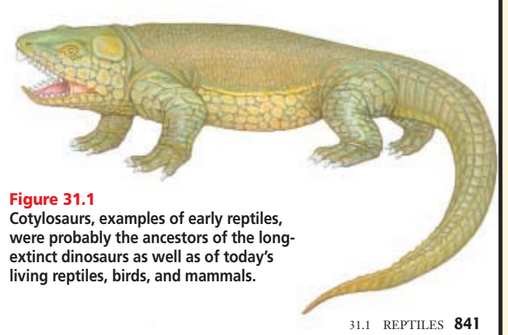


Figure 31.1
Cotylosaurs, examples of early reptiles, were probably the ancestors of the long-extinct dinosaurs as well as of today's living reptiles, birds, and mammals.

Assessment Planner

Portfolio Assessment
- **Alternative Lab, TWE,** pp. 842-843
- **Assessment, TWE,** pp. 847, 849, 856
- **Portfolio, TWE,** pp. 847, 848, 850, 853, 856
- **MiniLab, TWE,** p. 856

Performance Assessment
- **BioLab, SE,** pp. 860-861
- **MiniLab, SE,** pp. 853, 856
- **Alternative Lab, TWE,** pp. 842-843
- **Problem-Solving Lab, TWE,** p. 857
- **Assessment, TWE,** p. 859

Knowledge Assessment
- **Section Assessment, SE,** pp. 849, 859
- **Chapter Assessment, SE,** pp. 863-865
- **Assessment, TWE,** p. 858
- **BioLab, TWE,** pp. 860-861

Skill Assessment
- **Assessment, TWE,** p. 853
- **MiniLab, TWE,** p. 853

Prepare

Key Concepts

Students will study the features reptiles have in common and learn about the adaptations of crocodiles, alligators, lizards, snakes, and turtles. Origins of reptiles and their amniotic eggs are considered and discussed in terms of the movement of animals to land.

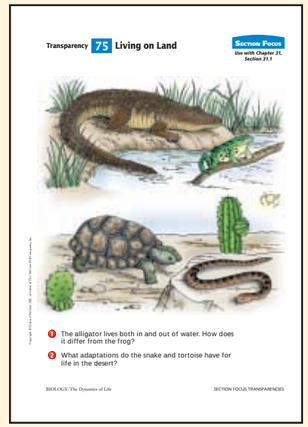
Planning

- For the Quick Demos, borrow live or mounted reptiles and purchase small plastic dinosaurs.
- For the Alternative Lab, gather thermometers, black and white paper, tape, lamps, rulers, empty frozen juice containers, and clay.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 75** on the overhead projector and have students answer the accompanying questions. L1 ELL



2 Teach

Discussion

Ask students to share their experiences and feelings about reptiles, especially snakes. If they express fear, ask why they think that they have this fear. Point out that most primates show an instinctive fear of snakes. Ask students why they think this is so.

Quick Demo

Kinesthetic Obtain live or mounted specimens of reptiles for students to examine. Point out the scaly skin. Make sure students have an opportunity to touch the skin and see that it is not slimy, a common misconception.

GLENCOE TECHNOLOGY

VIDEODISC
The Secret of Life
Reptile/Bird Heart

Resource Manager

Basic Concepts Transparency 54 and Master L2 ELL

Reptiles have scaly skin

Unlike the moist, thin skin of amphibians, reptiles have a dry, thick skin covered with scales. Scaly skin, as shown in ***Figure 31.2***, prevents the loss of body moisture and provides additional protection from predators. Because gas exchange cannot occur through scaly skin, reptiles are entirely dependent on lungs as their primary organ of gas exchange.

Skeletal changes in reptiles

Look again at the illustration of the cotylosaur. This reptile had legs that were placed more directly under the body rather than at right angles to the body as in early amphibians. This positioning of the legs provides greater body support and makes walking and running on land easier for reptiles. They have a good chance of catching prey or avoiding predators. Reptiles also have claws that help them obtain food and protect themselves. Additional evolutionary changes in the structure of the jaws and teeth of early reptiles allowed them to exploit other resources and niches on land.

Some reptiles have four-chambered hearts

Most reptiles, like amphibians, have three-chambered hearts. Some reptiles, notably the crocodilians, have a four-chambered heart that completely separates the supply of blood with oxygen from blood without oxygen. The separation enables more oxygen to reach body tissues. This separation is an adaptation that supports the higher level of energy use required by land animals.

Reptiles reproduce on land

Reptiles reproduce by laying eggs on land. Unlike amphibians, reptiles have no aquatic larval stage, and thus are not as vulnerable to water-dwelling predators as young amphibians are. Reptile hatchlings look just like adults, only smaller.

Although all of the adaptations discussed so far enabled reptiles to live successfully on land, the evolution of the amniotic egg was the adaptation that liberated reptiles from a dependence on water for reproduction. An **amniotic egg** (am nee OHT ihk) provides nourishment to the embryo and contains membranes that protect it while it develops in a terrestrial environment. The egg functions as the embryo's total life-support system. Read the *Inside Story* on the next page to find out what the food supply is for a reptile embryo.

Figure 31.2
Scales on a reptile's skin overlap like tiles on a roof.

A The scales of reptiles, unlike the separate glossy scales of fishes, are part of the skin itself. The scales are all connected to one another by hinges of skin.

B To grow, young reptiles molt. Old scaly skin is replaced by new skin. Even the lenses of a reptile's eyes are replaced during a molt.

All reptiles have internal fertilization. The eggs are laid after fertilization, and embryos develop after eggs are laid. Most reptiles lay their eggs under rocks, bark, grasses, or other surface materials, but a few dig holes or collect materials for a nest. Most reptiles provide no care for hatchlings, but female crocodiles have been observed guarding their nests from predators.

Reptiles are ectotherms

Even though reptiles are different from amphibians in many ways, they are similar in one way. Both amphibians and reptiles are ectotherms. Their body temperatures depend on the temperatures of their environments. In the cool morning, a turtle might pull itself out of the pond or swamp and bask on a log in the sunlight until noon. Then, when the temperature gets a little too warm, the turtle may slip back into the cool water. This example shows that even though reptiles cannot control their body temperatures internally, they can use behavioral adaptations to compensate for changes in environmental temperature. ***Figure 31.3*** shows other examples of behavioral adjustment of body temperature in reptiles.

Because reptiles are dependent on the temperatures of their surroundings, they do not inhabit extremely cold regions. Reptiles are common in temperate and tropical regions, where climates are warm, and in hot desert climates. Many species of reptiles become dormant during cold periods in moderately cold environments such as in the northern United States.

Figure 31.3
Different reptiles regulate their body temperatures by a variety of behaviors.

A A chuckwalla keeps its temperature constant by lying in the shade of a large rock.

B A bearded lizard suns itself to get warm in the morning.

How reptiles obtain food

Like other animals, reptiles have adaptations that enable them to find food and to sense the world around them. Most turtles and tortoises are too slow to be effective predators, but that doesn't mean they go hungry. Most are herbivores, and those that are predators prey on worms and mollusks. Snapping turtles, however, are extremely aggressive, attacking fishes and amphibians, and even pulling ducklings under water.

Lizards primarily eat insects. The marine iguana of the Galapagos Islands is one of the few herbivorous lizards, feeding on marine algae. The Komodo dragon, the largest lizard, is found on several islands in Indonesia, north of Australia. It is an efficient predator, sometimes even of humans. Although lizards such as the Komodo dragon may look slow, they are capable of bursts of speed, which they use to catch their prey.

Enrichment

Interpersonal Ask a group of students to research the requirements for temperature, light, and diet for a lizard suited for terrarium life. Have them set up a terrarium and care for the lizard. L2 COOP LEARN

NATIONAL GEOGRAPHIC

VIDEODISC
GTV: Planetary Manager
Animal, Side 2

Internet Address Book

internNET CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

Alternative Lab

Body Color Adaptations

Purpose
Students observe how color affects the rate at which organisms absorb heat.

Materials
thermometer, black paper, white paper, tape, lamp, metric ruler, empty frozen juice containers with holes in one end, clay

Procedure
Give students the following directions.

1. Make a data table for starting temperature, final temperature, and total temperature change for a black can and a white can.
2. Cover one can with black paper and the other with white paper. Tape the paper in place.
3. Place a thermometer into the hole in each can top and secure it with clay. Make sure the hole is tightly sealed.
4. Place both cans about 5 cm away from the bulb of a lamp. Do not turn on the lamp.
5. Record the starting temperature of both cans in your data table.
6. Develop a hypothesis as to which can will show a higher temperature at the end of 10 minutes.
7. Turn on the lamp and allow it to shine on both cans for 10 minutes.
8. Record the final temperature of both cans. Calculate the total change in temperature for each can and record it in your data table.

Expected Results
The black can will absorb more heat.

Analysis

1. Which color, black or white, had the greater temperature change after being heated for 10 minutes? *black*
2. Which color absorbs light better and warms up faster? *black*
3. Did your data support your hypothesis? Explain. *Yes, if students said that the black can would absorb more heat.*
4. Which should absorb more light from the sun, a dark animal or a light animal? Why? *Dark; dark colors absorb more light and heat up more quickly.*

Assessment

Portfolio The ability to change skin color is an adaptation in many reptiles. Ask students to explain how this adaptation may help reptiles survive. They should include their explanation in their portfolios. Use the Performance Task Assessment List for Writing in Science in **PASC,** p. 87. L2 P

INSIDE STORY

Purpose

Students will study the amniotic egg and learn how this adaptation enabled reptiles to live out of water.

Teaching Strategies

- Ask students to carefully open a raw chicken egg and note the shell, albumen, yolk, and the tough membrane inside the shell. Ask what parts of the egg shown in the Inside Story are missing from their egg. L1 ELL

Visual Learning

- Challenge students to describe the differences between frog eggs and turtle eggs. *The frog eggs are surrounded by a jellylike substance that requires moisture. The reptile eggs are covered by a shell.* Ask how these differences might reflect the environment in which each of these animals live. *Frogs must live near water for reproduction; reptiles do not depend upon water for reproduction.*

Critical Thinking

Reptile eggs have a leathery, flexible shell. Bird eggs have a hard, but breakable, shell. Reptile eggs can withstand burial because they are flexible.

Resource Manager

Reteaching Skills Transparency 45 and Master L1 ELL

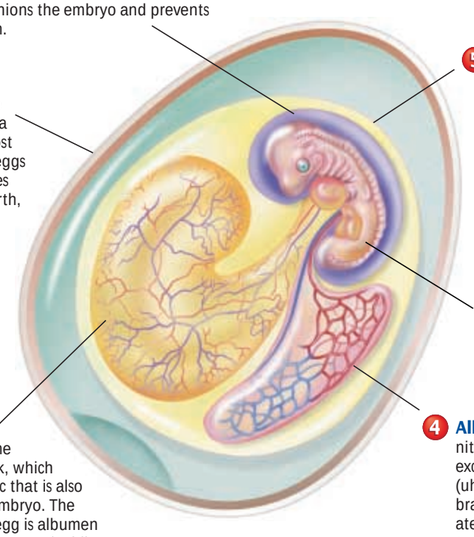
INSIDE STORY

An Amniotic Egg

The evolution of the amniotic egg was a major step in reptilian adaptations to land environments. Amniotic eggs enclose the embryo in amniotic fluid, provide a source of food in the yolk, and surround both embryo and food with membranes and a tough, leathery shell. These structures in the egg help prevent injury and dehydration of the embryo as it develops on land.

Critical Thinking ***How is the leathery covering of a reptile egg more suited to being laid deep in the sand than a hard-shelled bird egg would be?***

Hatchling turtle with egg tooth



1. **Amnion** The amnion (AM nee ahn) is a membrane filled with fluid that surrounds the developing embryo. The fluid-filled amnion cushions the embryo and prevents dehydration.
2. **Shell** The reptile egg is encased in a leathery shell. Most reptiles lay their eggs in protected places beneath sand, earth, gravel, or bark.
3. **Yolk** The main food supply for the embryo is the yolk, which is enclosed in a sac that is also attached to the embryo. The clear part of the egg is albumen (al BYEW mun), a source of additional food and water for the developing embryo.
4. **Allantois** The embryo's nitrogenous wastes are excreted into the allantois (uh LANT uh wus), a membranous sac that is associated with the embryo's gut. When a reptile hatches, it leaves behind the allantois with its collected wastes.
5. **Chorion** The chorion (KOR ee ahn) is a membrane that forms around the yolk, allantois, amnion, and embryo. It allows gas exchange during respiration.
6. **Egg tooth** A reptile hatches by breaking its shell with the horny tooth on its snout. This egg tooth drops off shortly after hatching.

Embryo

Figure 31.4
Many reptiles are skillful predators that obtain prey in a variety of ways.

A The Komodo dragon is a predator that can kill animals as large as a deer or even a water buffalo. Adult Komodo dragons can reach a length of more than 3 m.

B The snapping turtle is common in North America. It has strong claws and a hooked beak that is sharp enough to bite through a person's fingers.

Snakes are also effective predators. Some, like the rattlesnake, have poison fangs that they use to subdue or kill their prey. A constrictor wraps its body around its prey, tightening its grip each time the prey animal exhales. Two of these reptiles are shown in ***Figure 31.4.***

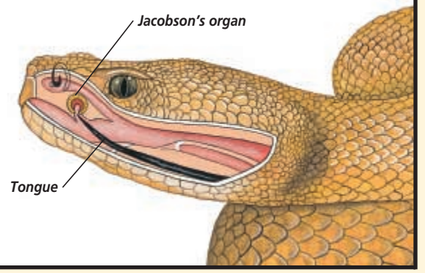
How reptiles use their sense organs

Reptiles have a variety of sense organs that help them detect danger or potential prey. How does a rattlesnake know you are nearby? The heads of some snakes, as shown in ***Figure 31.5,*** have heat-sensitive organs or pits that enable them to detect tiny variations in air temperature brought about by the presence of warm-blooded animals. Snakes and lizards are equipped with a keen sense of smell. Have you ever seen a snake flick out its tongue? The tongue is picking up chemical molecules in the air. The snake draws its tongue back into its mouth and inserts it into a structure called **Jacobson's organ,** described in ***Figure 31.5.***

Figure 31.5
Snakes have sense organs that enable them to detect prey or identify chemicals in their environment.

A Rattlesnakes have a pair of heat-sensitive pits below their eyes that enable them to detect prey in total darkness.

B The long, flexible tongue of snakes and lizards picks up molecules in the air and transfers them to the Jacobson's organ in the roof of the animal's mouth for chemical analysis.



Visual Learning

Figure 31.4 Ask students why the snapping turtle is such an effective predator. *It has a flexible neck and a strong, horny beak.*

Misconception

Many people believe that the age of a rattlesnake can be determined by counting the number of rattles on its tail. However, because a new rattle forms each time the snake molts, and molting can occur many times each year, there is no correlation between the number of rattles and the age of the snake.

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Video: *Feeding Snake*
Disc 4

VIDEODISC
Biology: The Dynamics of Life
Snake Feeding (Ch. 6)
Disc 2, Side 1, 30 sec.

BIOLOGY JOURNAL

Protecting Local Reptiles

Visual-Spatial Ask students to contact their state or local division of wildlife to find out about programs underway to protect locally endangered reptiles. Ask them to prepare an illustrated report of their findings that identifies the endangered reptiles in their area. L2

MEETING INDIVIDUAL NEEDS

Learning Disabled

Kinesthetic Have students make a cross-sectional model of an amniotic egg. They can use materials such as clay, plastic food wrap, and aluminum foil to represent membranes. L1 ELL

TECHPREP

Reptile Exhibits

Visual-Spatial Tell students that they are herpetologists at a large zoo. They must prepare plans and sketches of an exhibit for an unusual reptile. Have students select the reptile and then research its needs for space, food, and other care. They should show a care schedule on the sketch they make of the exhibit. L2 COOP LEARN

Careers in Biology

Career Path

Courses in high school: art, photography, and biology.
College: courses in art, art history, photography, and zoology.
Other education sources: community art classes

Career Issue

Ask students if they think wildlife benefits or suffers when artists or photographers invade their habitats. Have the students provide examples to support their opinions.

For More Information

For more information on becoming a wildlife artist or photographer, students can write to:

Wildlife Artists Association
c/o Larry Waggoner
P.O. Box 33757
Granada Hills, CA 91394

Display

Visual-Spatial Assign groups of students orders of reptiles to research. Have them find out population distribution and prepare a map showing this distribution. Display these maps on the bulletin board. L2 COOP LEARN

Careers in Biology

Wildlife Artist/Photographer

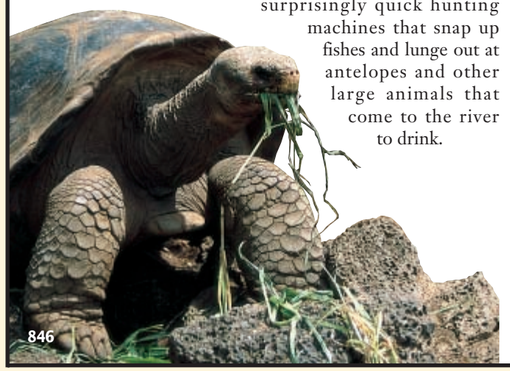
If you are determined and patient, you can combine your love of nature and your artistic skills into a career as a wildlife artist or photographer.

Skills for the Job

Some wildlife artists/photographers spend weeks in the wilderness to find subjects for their art. Others draw, paint, or photograph animals in zoos or nature preserves. Becoming an artist or photographer depends more on your natural abilities than training, but art or photography courses can help strengthen your skills. Many wildlife artists also study biology or zoology so they can better understand their subjects. It can take years before artists are able to support themselves by selling their work, so many have another job, such as teaching art in a high school or college or giving private lessons.

internet CONNECTION For more careers in related fields, be sure to check the Glencoe Science Web Site.
www.glencoe.com/sec/science

Figure 31.6
In the past, sailors killed Galapagos tortoises for food. As a result, their numbers declined rapidly.



Diversity of Reptiles

Gracefully gliding snakes and quickly darting lizards are grouped together in the order Squamata. Turtles, slowly plodding and carrying heavy shells, belong to the order Chelonia. Basking crocodiles and alligators, classified in the order Crocodilia, may look clumsy but are surprisingly quick hunting machines that snap up fishes and lunge out at antelopes and other large animals that come to the river to drink.

Turtles have shells

Turtles are the only reptiles protected by a shell made up of two parts. The dorsal part of the shell is the carapace, and the ventral part of the shell is the plastron. The vertebrae and ribs of turtles are fused to the inside of the carapace. A turtle's muscles are attached to the shell. Most turtles have a shell made out of hard, bony plates. In a few species, the shell is a covering made of tough, leathery skin.

Some turtles are aquatic, and some live on land. Turtles that live on land are called tortoises. Most turtles can draw their limbs, tail, and head into their shells for protection against predators. Although turtles have no teeth, they do have powerful jaws with a beaklike structure that is used to crush food.

Tortoises live on land, foraging for fruit, berries, and insects. The largest tortoises in the world, shown in ***Figure 31.6,*** are found on the Galapagos Islands off the coast of Ecuador.

Some adult marine turtles swim enormously long distances to lay their eggs. Like salmon, these turtles return from their feeding grounds to the place where they hatched. For example, green turtles travel from the coast of Brazil to Ascension Island in the Atlantic, a distance of more than 4000 km.

Crocodiles include the largest living reptiles

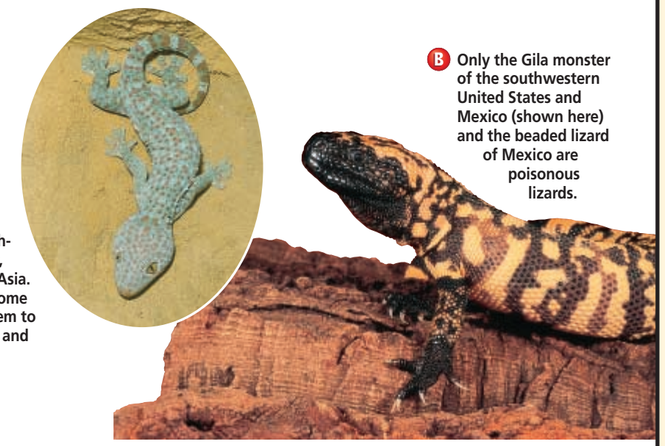
In contrast to marine turtles, crocodiles don't migrate. They may spend their days alternately basking in the sun on a riverbank and floating like motionless logs. Only their eyes and nostrils remain above water. Crocodiles can be identified by their long, slender snouts, whereas alligators have short, broad snouts. Both animals have powerful jaws with sharp teeth that can drag prey underwater and hold it there until it drowns. The American alligator is found throughout many of the freshwater habitats of the southeastern United States. The American crocodile can be found only in saltwater and estuarine habitats in southern Florida. The American alligator can reach a length of 5 m. Other crocodilians, such as the Nile crocodile of Africa, can grow even longer.

Both alligators and crocodiles lay eggs in nests on the ground. Unlike other reptiles, these animals stay close to their nests and guard them from predators. Several crocodilian species have been observed holding their newly-hatched offspring gently in their mouths as they carried them to the safety of the water.

Figure 31.7
Lizards have many adaptations that enable them to live in a variety of different habitats.

A **Geckos are small, nocturnal lizards that live in warm climates, such as those of the southern United States, West Africa, and Asia. The toe pads of some geckos enable them to walk across walls and ceilings.**

B **Only the Gila monster of the southwestern United States and Mexico (shown here) and the beaded lizard of Mexico are poisonous lizards.**



Snakes and lizards are found in many environments

Lizards, shown in ***Figure 31.7,*** are found in many types of habitats in all but the polar regions of the world. Some live on the ground; some burrow; some live in trees; and some are aquatic. Many are adapted to hot, dry climates.

Snakes, in contrast to most vertebrates, have no limbs and lack the bones to support limbs. Exceptions are pythons and boas, which retain bones of the pelvis. The many vertebrae of snakes permit fast undulations through grass and over rough terrain. Some snakes even swim and climb trees.

Snakes usually kill their prey in one of three ways. Remember that constrictors wrap themselves around their prey. If you ever watch someone handle a constrictor, you will notice that the handler never lets the snake start to wrap around his or her body. The snake is always held carefully so that its tail does not cross over its own head to begin a coil. Common constrictors include boas, pythons, and anacondas.

Venomous snakes use poison to kill their prey. These include rattlesnakes, cobras, and vipers, which inject poison from venom glands,

Assessment

Portfolio Have students prepare a public service announcement that would help people with their fear of snakes. Students should include information they have learned about snakes. Have them include their announcements in their portfolios. L1 P

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Exploration: *The Five Kingdoms*
Disc 3
BioQuest: *Biodiversity Park*
Disc 3, 4
Video: *Sea Turtle*
Disc 4

VIDEODISC
Biology: The Dynamics of Life
Sea Turtle (Ch. 5)
Disc 2, Side 1, 38 sec.

Resource Manager

Basic Concepts Transparency 55 and Master L2 ELL

PROJECT

Protecting the Environment

Interpersonal Ask students to role play a citizen group debating the protection of a beach where endangered green sea turtles nest. Have them work in groups of 3 to 4 and assume the role indicated on a card you have prepared. Have them do some research on their assigned roles. Cards should identify the following roles: teenage surfer, mayor, condominium developer, beach home owner, turtle biologist, president of the Turtle Protection Society, beach concession owner, state wildlife protection officer. Prior to role playing, students should prepare an outline of points that will be presented by the character he or she assumes. L2 COOP LEARN

Portfolio

Comparing Alligators and Crocodiles

Visual-Spatial Students often confuse alligators and crocodiles. Have students study pictures of alligators and crocodiles shown in magazines or reference books. Ask them to study the features of the two animals, paying attention to the shapes of their heads. Direct students to make a drawing of an alligator and a crocodile on the same sheet of paper. Ask students to include captions for their drawings that explain how alligators and crocodiles can be distinguished from one another based upon the shapes of their heads. Have them include the habitat ranges of the American alligator and crocodile. L2 P

Quick Demo

Interpersonal Purchase a variety of plastic dinosaurs from a toy store. Have students form cooperative groups and give each group a different dinosaur. Ask them to select one of the features of their dinosaur and speculate about how it evolved. Ask them to present their explanations to the class. Follow this exercise with a review of the basic ideas about evolution. Challenge students to revise their explanations by including the terms variation and natural selection in their explanations. Have students conclude their explanations with the idea that only the dinosaurs best suited to their environments survived to produce offspring like themselves. L2 COOP LEARN

3 Assess

Check for Understanding

Naturalist Have students brainstorm a list of concepts they learned about reptiles. Write the list on the chalkboard and ask students to classify each concept as being related to adaptations, characteristics, origins, or the evolution of reptiles. L3

Reteach

Visual-Spatial For each reptile group, have students develop a table with the following heads: Representative organisms, Habitat, Food getting, Reproduction, Locomotion, Respiration, and Protection. Have students complete their tables and then review them as a class. L2

Figure 31.8
Many poisonous snakes have hollow fangs for injecting venom supplied by a venom gland. Venom may either paralyze the prey so it cannot run away or kill the prey immediately.

shown in ***Figure 31.8.*** Most snakes are neither constrictors nor poisonous. They get food by grabbing it with their mouths and swallowing it whole. Snakes eat rodents, amphibians, insects, fishes, eggs, and other reptiles.

The fourth order of reptiles, Rhynchocephalia, is represented by one living species, the tuatara, ***Figure 31.9.*** The tuatara is the only survivor of a primitive group of reptiles, most of which died out 100 million years ago.

Figure 31.9
The tuatara, *Sphenodon punctatus,* is found only in New Zealand. It has ancestral features, including teeth fused to the edge of the jaws, and a skull structure similar to that of early Permian reptiles.

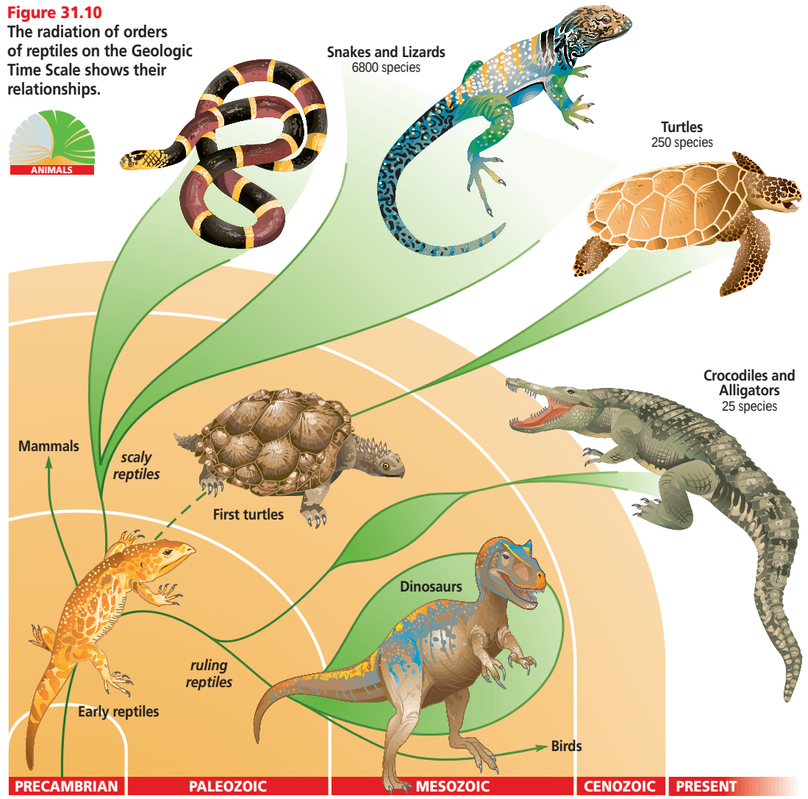
Origins of Reptiles

You may have marveled at dinosaurs ever since you were very young. These animals were the most numerous land vertebrates during the Mesozoic Era. Some were the size of chickens, and others were the largest land dwellers that ever lived. Read the *Focus On* at the end of this section to learn more about dinosaurs.

The ancestors of snakes and lizards are traced to a group of early reptiles, called scaly reptiles, that branched off from the ancient cotylosaurs. The name "scaly reptiles" may be misleading because it implies that other reptiles lacked scales—which is not true. Although the evolutionary history of turtles is incomplete, scientists have suggested that they may also be descendants of cotylosaurs. Dinosaurs and crocodiles are the third group to descend from cotylosaurs, as you can see in ***Figure 31.10.***

Although scientists used to think that birds arose as a separate group from this third branch, there is now much fossil evidence that leads biologists to suggest that birds are the living descendants of the dinosaurs.

Figure 31.10
The radiation of orders of reptiles on the Geologic Time Scale shows their relationships.



Section Assessment

Understanding Main Ideas

1. Choose one adaptation of early reptiles and explain how it enabled these animals to live on land.
2. Describe two ways in which turtles protect themselves.
3. How do snakes use the Jacobson's organ for finding food?
4. How are modern reptiles like dinosaurs?

Thinking Critically

5. Explain how the development of a dry, thick skin was an adaptive advantage for reptiles.

Skill Review

6. **Classifying** Set up a classification key that allows you to identify a reptile as a snake, lizard, turtle, or crocodile. For more help, refer to *Organizing Information* in the **Skill Handbook.**

Extension

Linguistic Ask a group of students to find a children's story, folktale, or nursery rhyme that depicts reptiles in a negative way. Ask them to rewrite the story so the reptile is depicted in a positive way. Ask them to read the before and after versions of the story to the class. L2

Assessment

Portfolio Ask students to write a letter to the editor of their local newspaper to inform people about endangered or threatened reptiles that live in their area. Make sure students have researched the topic and include important facts in their letters. Have students include their letters in their portfolios.

4 Close

Activity

Naturalist Ask students in their groups to develop a television commercial in which a nonpoisonous reptile speaks about how it wants to be treated by people, what its habitat and food requirements are, and why it should not be feared. L1

Portfolio

Linguistic There are many misconceptions about reptiles. Ask students to look up and place in their portfolios information regarding misconceptions about reptiles. L1 P

Resource Manager

Content Mastery, p. 154 L1
Reinforcement and Study Guide, pp. 137-138 L2

Section Assessment

1. Reptile legs are located under the body rather than out to the sides, and they have clawed toes. The body structure and claws enhanced their movement on land.
2. Turtles can draw limbs, heads, and tails into their hard shells. Turtles may also use their powerful jaws to crush other animals.
3. The tongue picks up chemicals in the air. The snake then draws its tongue back into its mouth and inserts it into the Jacobson's organ for chemical analysis.
4. They have the same reptilian features as dinosaurs—dry, thick scaly skin, clawed toes, and the amniotic egg.
5. Dry, thick skin prevented reptiles from drying out on land.
6. Make sure that students start with general features of reptiles, such as scaly dry skin, claws, amniotic eggs, and being ectothermic. Then, they should use the main features for each group.

Focus On

Dinosaurs

Purpose

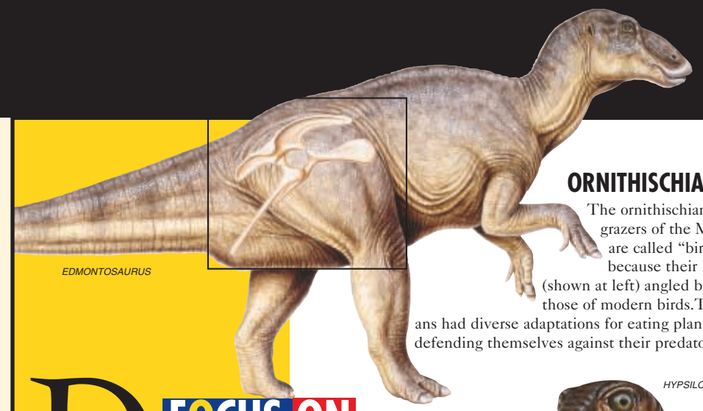
Students learn about dinosaurs, including how they are classified. They explore theories about how dinosaurs became extinct.

Background

Most students will be familiar with dinosaurs such as *Stegosaurus*, *Apatosaurus*, *Tyrannosaurus*, and *Diplodocus*. However, they may not be aware of the different time periods during which each of the more familiar dinosaurs lived. Explain that some dinosaur species evolved, lived, and often went extinct as other dinosaur species became the dominant land animals. When scientists discuss the extinction of the dinosaurs, they are talking about the species that existed about 65 million years ago, not all the dinosaurs that lived and became extinct before that time.

Teaching Strategies

- Arrange a class trip to a museum that has a dinosaur exhibit. Ask students to examine the skulls and feet of the dinosaurs on display and hypothesize what their habitats and diets might have been. L1
- Have interested students research and report on animals that were not dinosaurs that lived at the same time as the dinosaurs. Suggestions include: the flying pterosaurs, fishlike plesiosaurs, and sailback reptiles such as *Dimetrodon*. L2
- Have students develop a time line that traces the development of animals from the earliest reptiles to the beginning of the Age of Mammals. Instruct students to include both plants and animals on their time lines. L2



EDMONTOSAURUS

ORNITHISCHIANS

The ornithischians were the grazers of the Mesozoic. They are called "bird-hipped" because their hip bones (shown at left) angled backwards like those of modern birds.The ornithischians had diverse adaptations for eating plants and for defending themselves against their predatory relatives.

FOCUS ON Dinosaurs

HYPSILOPHODON

Dinosaurs ruled the world for 130 million years, throughout the Mesozoic era. Paleontologists have identified several hundred species of dinosaurs, and about a dozen new types are unearthed each year. Descended from ancient reptiles, dinosaurs are grouped into two general categories—ornithischians and saurischians—based on the structure of their hip bones.

PARASAUROLOPHUS

CORYTHOSAURUS

A FLEET-FOOTED HERBIVORE

Slender, graceful *Hypsilophodon* (above) was one of the fastest-moving ornithischians. With long hind legs adapted for running, this 1.5-meter herbivore probably was able to outdistance most predators with ease. *Hysilophodon* had a sharp beak and small overlapping teeth suited for grinding leaves and other plant material.

BODY ARMOR

Many slow-moving ornithischians had elaborate body armor. Seven meters long and built like an armored tank, *Euoplocephalus* was a peaceful grazer that must have frustrated many a hungry carnivore. Its body was completely encased in bony plates—even the eyelids were bone-reinforced. It had a tail tipped with a massive bone "club." When threatened, *Euoplocephalus* could have hugged the ground and swung its club-studded tail from side to side to protect itself.

EUOPLOCEPHALUS

THE DUCKBILLS

There were many species of duck-billed dinosaurs. All had long tails, oddly shaped "bills," webbed fingers, and hooflike, three-toed hind feet. Despite the duckbills' webbed fingers, most paleontologists now think that duckbills lived on land. Some species, such as *Parasaurolophus* (left), had large, hollow crests on their heads that may have amplified whatever sounds these dinosaurs made. Fossil evidence indicates that duckbills were social animals that moved in herds and cared for their young.

FOOT OF LARGE THEROPOD

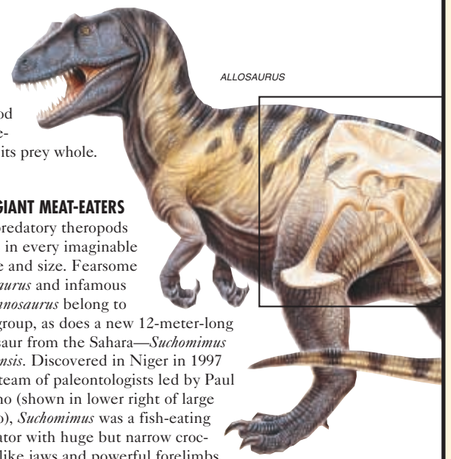
COMPSOGNATHUS

SAURISCHIANS

The "lizard-hipped" dinosaurs, or saurischians, had hip bones (shown below) like those of modern-day lizards, with the pubic bone projecting forward. Two major groups of saurischians are the theropods, or three-toed carnivores, and the sauropods, or long-necked herbivores.

THE SMALLEST DINOSAUR

Less than a meter long, *Compsognathus* (above), which means "pretty-jawed," was the smallest of all dinosaurs. A delicate predator, this diminutive theropod probably hunted lizards and small mammals. A double-hinged jaw made it easy for *Compsognathus* to swallow its prey whole.



ALLOSAURUS

PALEONTOLOGIST SERENO AND TEAM IN NIGER

THE GIANT MEAT-EATERS

Big predatory theropods came in every imaginable shape and size. Fearsome *Allosaurus* and infamous *Tyrannosaurus* belong to this group, as does a new 12-meter-long dinosaur from the Sahara—*Suchomimus tenerensis*. Discovered in Niger in 1997 by a team of paleontologists led by Paul Sereno (shown in lower right of large photo), *Suchomimus* was a fish-eating predator with huge but narrow crocodilelike jaws and powerful forelimbs with long thumb claws. Although *Suchomimus*, which means "crocodile mimic," was adapted to eating large fish, it probably stalked terrestrial prey as well.

SERENO AT THE NATIONAL GEOGRAPHIC SOCIETY WITH CAST SKULL OF *SUCHOMIMUS TENERENSIS*

BIG BROWSERS

The largest dinosaurs ever to roam Earth's surface were the long-tailed, long-necked, barrel-bodied sauropods such as *Seismosaurus*, *Diplodocus*, and *Apatosaurus*. These enormous plant-eaters—*Seismosaurus* was 36 meters long and weighed between 80 and 100 tons—could have browsed on leaves high in the treetops. Sauropods had small jaws and teeth. Their leafy meals were ground up in their stomachs with the help of sharp-edged pebbles, called gastroliths, that were probably swallowed along with their food.

APATOSAURUS

EXPANDING Your View

1. **THINKING CRITICALLY**
Compare and contrast the feeding adaptations of a plant-eating ornithischian and a meat-eating saurischian.

2. **JOURNAL WRITING**
Research the hypothesis that the dinosaurs disappeared as the result of a mass extinction caused by a giant meteor or asteroid colliding with Earth. What evidence exists to support this hypothesis? Share your findings with the class in an oral report.

Portfolio

Modeling Dinosaur Bones

Kinesthetic Have students obtain information on the sizes and shapes of dinosaur bones. Ask them to work in small groups to use the information obtained to build a life-sized model of a dinosaur bone using pâpier maché and chicken wire. L2 P COOP LEARN

GLENCOE TECHNOLOGY

VIDEODISC

The Infinite Voyage *The Great Dinosaur Hunt, Newborns: Examining Dinosaur Eggs* (Ch. 7)
8 min. 30 sec.

MEETING INDIVIDUAL NEEDS

Visually Impaired

Kinesthetic Purchase scientifically accurate plastic dinosaur models from a toy store. Allow visually impaired students to handle the toys to develop an understanding of the shapes and features of these animals. Help students estimate the true size of the actual organisms. L1 ELL

GLENCOE TECHNOLOGY

VIDEODISC

The Infinite Voyage *The Great Dinosaur Hunt, "The Great American Bone Rush"* (Ch. 3), 2 min.

Display

Interpersonal Prepare a large outline map of the world. Post the map on a classroom wall or bulletin board. Provide students with the resources necessary to identify where in the world different types of dinosaur fossils have been found. Have students work together to create a key that identifies each location according to dinosaur type on the map. L2 COOP LEARN

Misconception

Explain to students that movies often lead people to believe that humans and dinosaurs existed at the same time. Emphasize that dinosaurs became extinct at the end of the Cretaceous period, 65 million years ago. Explain that humans have existed on Earth for fewer than 2 million years. Use these facts to demonstrate that humans and dinosaurs did not occupy Earth at the same time.

Answers to Expanding Your View

1. The ornithischians had adaptations, such as duckbills, that enabled them to eat plants. The saurischians were carnivores with heavy jaws and sharp teeth.
2. Dinosaurs became extinct at the end of the Cretaceous period, 65 million years ago. This corresponds to the age of a meteorite that hit Earth near the Yucatan Peninsula in Mexico.

Prepare

Key Concepts

Students will study the adaptations that make birds suited to life on land and enable them to fly. Bird classification will be presented and the origins of birds will be considered.

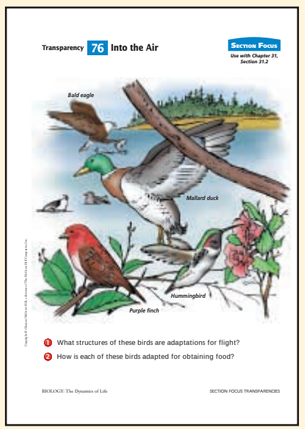
Planning

- Purchase recordings of bird calls for the Quick Demo.
- Purchase down and contour feathers and gather bird field guides for the MiniLabs.
- Gather clay, cardboard, rulers, string, hard-boiled eggs, Ping-pong balls, golf balls, balances, and protractors for the BioLab.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 76** on the overhead projector and have students answer the accompanying questions. L1 ELL



SECTION PREVIEW

Objectives

Interpret the phylogeny of birds.

Explain how bird adaptations make them suited to life on land.

Relate bird adaptations to their ability to fly.

Vocabulary

feather
sternum
endotherm
incubate

Section

31.2 Birds

Have you ever seen a robin tug on a worm that is struggling to stay in the soil? Maybe you have had a chance to see the amusing antics of a chickadee hopping on a snow-covered branch in the forest. Almost everyone admires birds. The brilliant flash of a bluebird's wings, the uplifting sound of a bird's song that fills the woods on a spring morning, and the effortless soaring of a redtail hawk have always fascinated and delighted people.

Robin and chickadee (inset)

What Is a Bird?

After conquering the sea and land, vertebrates took to the air, where there was a huge source of insect food and a refuge from land-dwelling predators. The existence of more than 8600 species of modern birds, class Aves, shows that flight was a successful adaptation for survival. Except for domestic animals and humans, the most common vertebrates you see in your daily life are birds. Biologists sometimes refer to birds as feathered dinosaurs. Fossil evidence seems to indicate that birds have evolved from small, two-legged dinosaurs called theropods, illustrated in ***Figure 31.11.*** Like reptiles, birds have clawed toes and scales on their feet. Fertilization is internal and shelled amniotic eggs are produced in both groups.

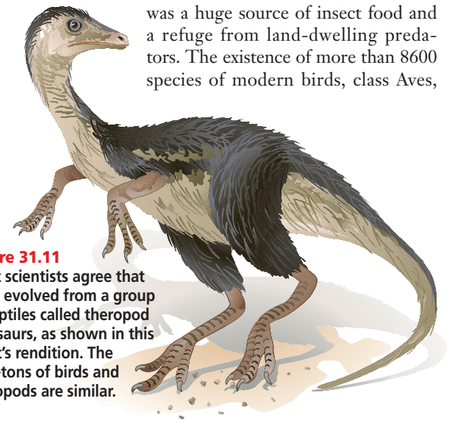


Figure 31.11
Most scientists agree that birds evolved from a group of reptiles called theropod dinosaurs, as shown in this artist's rendition. The skeletons of birds and theropods are similar.

Birds have feathers

Birds can be defined simply as the only living organisms with feathers. A **feather** is a lightweight, modified scale that provides insulation and enables flight, illustrated in ***Figure 31.12.*** You may have seen a bird running its bill through its feathers while sitting on a tree branch or on the shore of a pond. This process, called preening, keeps the feathers in good condition for flight. The bird also uses its beak to rub oil from a gland near the tail onto the feathers. This process is especially important for water birds as a way to waterproof the feathers. You can compare types of bird feathers in the *MiniLab* on this page.

Even with good care, feathers wear out and must be replaced. The shedding of old feathers with the growth of new ones is called molting. Most birds molt in late summer. However, most do not lose their feathers all at once and are able to fly while they are molting. Wing and tail feathers are usually lost in pairs so that the bird can maintain its balance in flight.

Birds have wings

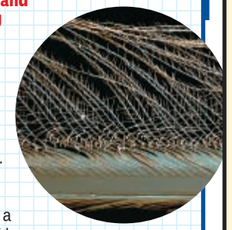
A second adaptation for flight in birds is the modification of the front limbs into wings. Powerful flight muscles are attached to a large breastbone called the **sternum** and to the upper bone of each wing. The sternum looks like the keel of a sailing boat and is important because it supports the enormous thrust and power produced by the muscles as they move to generate the lift needed for flight.

Flight requires energy

Flight requires high levels of energy. Several factors are involved in maintaining these high energy levels. First, a bird's four-chambered, rapidly beating heart moves oxygenated blood quickly throughout the body. A chickadee's heart, for example, beats 1000 times a minute. Compare this to a human heart, which beats 70 times a minute. This efficient circulation supplies cells with the oxygen needed to produce energy.

MiniLab 31-1 Comparing and Contrasting

Comparing Feathers Birds have two kinds of feathers. Contour feathers used for flight are found on a bird's body, wings, and tail. Down feathers lie under the contour feathers and insulate the body.



Magnification: 120×

Procedure

1. Examine a contour feather with a hand lens, and make a sketch of how the feather filaments are hooked together.
2. Examine a down feather with a hand lens. Draw a diagram of the filaments of the down feather.
3. Fan your face with each feather separately. Note how much air is moved past your face by each type of feather. **CAUTION:** ***Wash your hands after handling animal material.***

Analysis

1. How does the structure of a contour feather help a bird fly?
2. How does the structure of a down feather keep a bird warm?
3. How can you explain the differences you felt when fanning with each feather?

Figure 31.12
Feathers streamline a bird's body, making it possible for the bird to fly.

A **Fluffy down feathers have no hooks to hold the filaments together. Down feathers act as insulators to keep a bird warm.**

B **A large bird can have 25 000 or more contour feathers with a million tiny hooks that interlock and make the feathers hold together, making a "fabric" suited for flight.**

BIOLOGY JOURNAL

Observing Birds

Linguistic Have a live canary, parakeet, or parrot in class. Have students observe behavior such as how it uses its beak in feeding and drinking. Have them also observe perching and reactions to objects in its cage, such as mirrors and bells. Ask students to write their observations in their journals. L1 ELL

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Exploration: *Bird Adaptations*
Disc 4

Portfolio

Simulating Flight

Visual-Spatial Ask students to make a "flip book" of a flying bird. Have them cut eight 3 × 5 index cards in half and draw a sequence of a bird in flight on the 16 cards. Have them arrange the cards in sequence, and then flip through the cards quickly to observe the sequence of a bird flying. L2 ELL P

Resource Manager

Section Focus Transparency 76 and Master L1 ELL
Reteaching Skills Transparency 46 and Master L1 ELL
Basic Concepts Transparency 56 and Master L2 ELL
BioLab and MiniLab Worksheets, p. 139 L2

2 Teach

MiniLab 31-1

Purpose
Students will compare the structures of down and contour feathers and determine how each is adapted to a specific function.

Process Skills
observe and infer, compare and contrast

Teaching Strategies
- Use a binocular microscope or a hand lens to observe feathers.

Expected Results
Contour feathers consist of barbules with hooks that connect the barbs, forming a streamlined feather. Down feathers do not have hooks on their barbules. They are soft and do not take on a specific shape. More air can be moved with the contour feather.

Analysis
1. Contour feathers are sleek and streamlined and can move a lot of air.
2. Down feathers are irregular in shape and, when piled together, form air spaces that trap body heat.
3. The contour feather barbules stay together and move air. The down feather barbules cannot move air because they do not stay together.

Assessment

Skill Explain that some birds have feathers called powder-down feathers. The tips of these feathers disintegrate into powder that has waterproofing characteristics and luster. Have students hypothesize how this type of feather may help some birds survive. Use the Performance Task Assessment List for Formulating a Hypothesis in **PASC,** p. 21. L2

Quick Demo

Auditory-Musical Play selections from a recording of bird songs that includes courtship, territorial, and distress calls, as well as calls made to the young. Ask students to list the stimuli that might cause birds to sing each of these songs. L2

Enrichment

Visual-Spatial Ask students to photograph native birds and prepare a slide presentation for the class. Challenge students to use field guides to identify each bird, its habitat, food sources, and unusual habits. L2 ELL

GLENCOE TECHNOLOGY

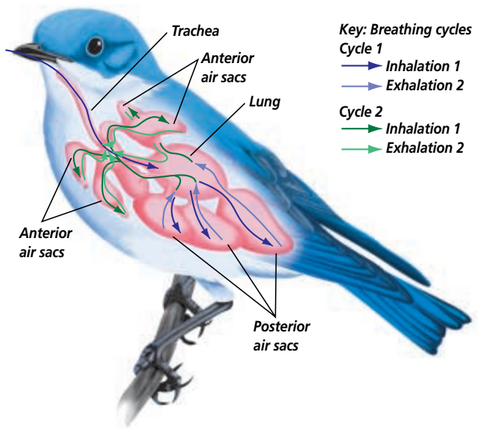
VIDEODISC
The Secret of Life
Bird-Air Exchange

Resource Manager

Critical Thinking/Problem Solving, p. 31 L3
Concept Mapping, p. 31 L3 ELL
Laboratory Manual, pp. 219-228 L2

Second, a bird's respiratory system supplies oxygenated air to the lungs when it inhales as well as when it exhales. A bird's respiratory system consists of lungs and anterior and posterior air sacs. During inhalation, oxygenated air passes through the trachea and into the lungs, where gas exchange occurs. Most of the air, however, moves through the lungs and passes directly into the posterior air sacs. When a bird exhales deoxygenated air from the lungs, oxygenated air returns to the lungs from the posterior air sacs. At the next inhalation, deoxygenated air in the lungs passes into the anterior air sacs. Finally, at the next exhalation, air passes from the anterior air sacs out of the trachea. Thus, air follows a one-way path in a bird. You can see the path air follows in a bird's respiratory system in ***Figure 31.13.*** How much of the air that a bird inhales is passed into the posterior air sacs? Find out in the *Inside Story.*

Figure 31.13
Birds require a great deal of oxygen because their large flight muscles expend huge amounts of ATP. Follow the arrows to see how air passes through a bird's respiratory system. Notice that when a bird inhales, inhalation cycles 1 and 2 occur simultaneously.



Birds are endotherms

Birds are able to maintain the high energy levels needed for flight because they are endotherms. An **endotherm** is an animal that maintains a constant body temperature that is not dependent on the environmental temperature.

Birds have a variety of ways to save or give off their body heat in order to maintain a constant body temperature. Feathers reduce heat loss in cold temperatures. The feathers fluff up to trap a layer of air that limits the amount of heat lost. Responses to high temperatures include flattening the feathers and holding the wings away from the body. Birds also pant to increase respiratory heat loss.

A major advantage of being endothermic is that birds can live in all environments, from the hot tropics to the frigid Antarctic. However, birds and other endotherms must eat large amounts of food to sustain these higher levels of energy. Find out what kinds of food local birds prefer by doing the *MiniLab* that follows the *Inside Story.*

Reproduction in birds

Birds, like reptiles, reproduce by internal fertilization and lay amniotic eggs inside a nest. Bird eggs are encased in a hard shell, unlike the leathery shell of a reptile. Bird nests may be made out of bits of straw and twigs, or they may consist of just a depression scratched into the sand. Some nests are elaborate structures that are added to yearly. Whatever the type of nest, birds do not leave the eggs to hatch on their own. Instead, birds **incubate** or sit on their eggs to keep them warm, turning the eggs

INSIDE STORY

Flight

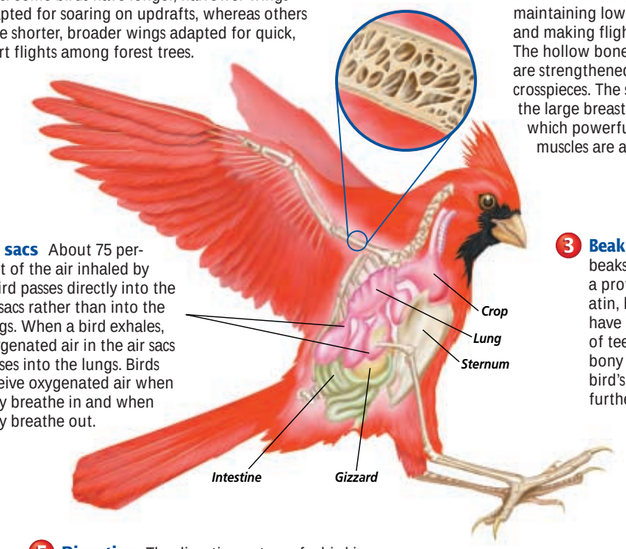
Humans have always dreamed of being able to fly. The popularity of hang gliding and parachute jumping may reflect these dreams. For birds, the ability to fly is the result of complex selective pressures that led to the evolution of many adaptations.

Critical Thinking ***Wing shapes reflect how birds fly. Describe as many ways as you can remember seeing birds fly.***

Male cardinal

1 Wings Birds have a variety of wing shapes and sizes. Some birds have longer, narrower wings adapted for soaring on updrafts, whereas others have shorter, broader wings adapted for quick, short flights among forest trees.

2 Hollow bones Birds' bones are thin and hollow, thereby maintaining low weight and making flight easier. The hollow bones of birds are strengthened by bony crosspieces. The sternum is the large breastbone to which powerful flight muscles are attached.



6 Air sacs About 75 percent of the air inhaled by a bird passes directly into the air sacs rather than into the lungs. When a bird exhales, oxygenated air in the air sacs passes into the lungs. Birds receive oxygenated air when they breathe in and when they breathe out.

3 Beaks Birds have beaks made out of a protein called keratin, but they do not have teeth. The lack of teeth or a heavy bony jaw reduces a bird's weight even further.

5 Digestion The digestive system of a bird is adapted for dealing with large quantities of food that must be eaten to maintain the level of energy necessary for flight. Because birds have no teeth, many swallow small stones that help to grind up food in the gizzard.

4 Legs The legs of birds are made up of mostly skin, bone, and tendons. The feet are adapted to perching, swimming, walking, or catching prey.

BIOLOGY JOURNAL

Raising an Issue

Linguistic Have students write letters to elected officials about national and local issues regarding birds and ways to protect habitat in your area. Students should address such issues as habitat destruction, lead-shot poisoning of waterfowl, illegal trade in pet birds, and poisoning through pesticides, oil spills, and chemical dumping. Students should place their letters in their journals. L3

MEETING INDIVIDUAL NEEDS

Gifted

Logical-Mathematical Ask students who have an interest in mathematics to make up a series of math problems dealing with wing beats for other students to solve. Provide students with the following data: number of wing beats per 10 seconds—crow 20, robin 23, pigeon 30, starling 45, chickadee 270, hummingbird 700. An example of a problem may be: If a crow, robin, pigeon, and starling each flew in the same direction at a starting speed of 48 km per hour, how many times would each flap its wings if they flew 24 km? L3

INSIDE STORY

Purpose

Students will gain an understanding of the adaptations that enable birds to fly.

Teaching Strategies

- Ask students to bring beef and chicken bones to class. Have them compare the density of the two types of bones by finding the mass of each bone and dividing it by the volume of each bone as determined by water displacement in a graduated cylinder. *Students will find that the density of chicken bones is less than the density of beef bones.* L2
- Obtain a turkey gizzard from a meat market. Use the gizzard to point out its thick muscles. Elicit reasons why the gizzard has such thick muscles.

Visual Learning

- Obtain or borrow a mounted skeleton of a bird. Point out how the bones are thin and lightweight. Point out the size of the sternum and ask students to compare the sternum of a bird with their own sternum.
- Obtain slides of birds in flight. Ask students to examine the wing shapes and determine the type of flight unique to each bird. Explain that elliptical wings are adapted for quick movements. Wings that sweep back and taper to a slender tip promote high speed. Soaring birds have broad wings.

Critical Thinking

soaring, diving, flapping, hovering, quick turning

DESIGN YOUR OWN BioLab The BioLab at the end of the chapter can be used at this point in the lesson.

MiniLab 31-2

Purpose
Students will construct bird feeders and learn what types of foods birds prefer.

Process Skills
compare and contrast, recognize cause and effect, interpret data, classify

Teaching Strategies
- Show photos or slides of common local birds.
- Have students use binoculars to observe the birds that visit their feeders.

Expected Results
Depending on region, students may find cardinals, jays, woodpeckers, nuthatches, juncos, chickadees, sparrows, finches, tufted titmouse, mourning doves, and many other local and migrating bird species.

Analysis
1. Sunflower seeds will attract a large variety of birds.
2. It is likely that birds will visit the same feeder over and over again, unless the feeder runs out of food.
3. Ideal bird food would have a mixture of a variety of seeds that would appeal to many different birds.

Assessment
Portfolio Ask students to summarize data collected by watching birds. They should record not only the types of birds seen and the foods preferred, but other interactions of birds, such as aggressive behavior and feeding methods. Use the Performance Task Assessment List for Making Observations and Inferences in **PASC,** p. 17. L2 P

MiniLab 31-2 Comparing and Contrasting

Feeding the Birds In the winter, it may be difficult for some birds to find food, especially if you live in an environment often blanketed with snow. Making a bird feeder and watching birds feed can be an enjoyable activity for you that may save some birds from starvation. If you do begin feeding birds in the winter, continue to feed them until natural food again becomes available in the spring.

Procedure
1. Obtain several large, plastic milk bottles. Cut two holes 5 cm from the base on opposite sides of each bottle, each about 8 cm^2. These are the openings birds will use to find the food inside.
2. Place small drainage holes in the bottom of each bottle. Hang the bottles from wires strung through small holes in the neck of each one.
3. Place a different kind of seed (sunflower seeds, hulled oats, cracked corn, wheat, thistle, millet) in different bottles. Add new seed when needed.
4. Using a bird guide, make a list of numbers and kinds of birds that frequent each feeder, noting the type of food offered.

Analysis
1. What type of seed attracted the largest variety of bird types?
2. Did any birds visit more than one feeder?
3. What do you think an ideal bird food would be?

periodically so that they develop properly. In some species of birds, both parents take turns incubating eggs; in others, only one parent does so. Bird eggs are distinctive, and often the species of bird can be identified just by the color, size, and shape of the eggs the bird lays. You can find out more about the adaptative value of bird egg shape in the *BioLab* at the end of this chapter.

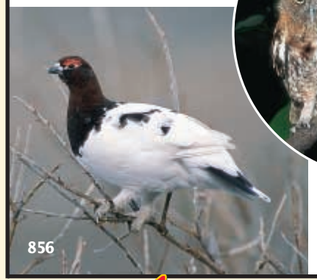
Diversity of Birds

Unlike reptiles, which take on a wide variety of forms from legless snakes to shelled turtles, birds are all very much alike in their basic form and structure. You have no difficulty recognizing a bird.

In spite of the basic uniformity of birds, they do exhibit specific adaptations, depending on the environment in which they live and the food they eat. As shown in ***Figure 31.14,*** ptarmigans have feathered legs and feet that serve as snowshoes in the winter, making it easier for the birds to walk in the snow. Penguins are flightless birds with wings and feet modified for swimming and a body surrounded with a thick layer of insulating fat.

Figure 31.14
Examine these birds and infer where they live and how they are adapted to their environments.

Ptarmigan



Screech owls

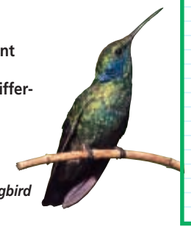
Adélie penguins

Large eyes, an acute sense of hearing, and sharp claws make owls well-adapted, nocturnal predators able to swoop with absolute precision onto their prey. However, many bird species are now threatened with extinction due to changes in their habitats. Read the *Problem-Solving Lab* to see in which countries birds are endangered. Then read the *Biology & Society* feature at the end of this chapter to learn how illegal trade in wildlife threatens birds and other animals.

The shape of a bird's beak gives clues to the kind of food the bird eats, as you can see in ***Figure 31.15.*** Hummingbirds have long beaks that are used for dipping into flowers to obtain nectar. Hawks have large, curved beaks that are adapted for tearing apart their prey. Pelicans have huge beaks with pouches that they use as nets for capturing fish. The short, stout beak of a goldfinch is adapted to cracking seeds.

Figure 31.15
The beaks of different species of birds are adapted to eating different kinds of food.

Hummingbird



Pelican

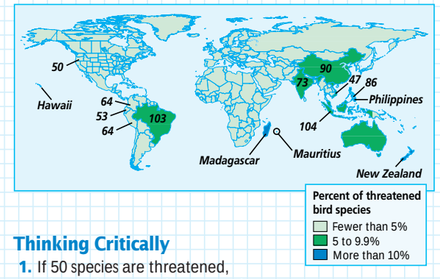
Hawk

Goldfinch

Problem-Solving Lab 31-1 Analyzing Information

Where are the most endangered bird species? More than 100 bird species have become extinct in the last 400 years.

Analysis
Examine the world map. The key at the bottom right shows the number of bird species that are currently threatened with extinction.The numbers appearing on the map indicate the actual number of threatened bird species in specific countries.



Thinking Critically
1. If 50 species are threatened, what is the approximate number of bird species in the United States? (Hint: 2.5 percent of the bird species in the U.S. are threatened.)
2. It is estimated that about 11 percent or 1107 of the world's bird species are threatened. About how many bird species are there in the world?
3. Hawaii, the Philippines, New Zealand, and Madagascar all show the highest percent of threatened species. What common geographical feature do these four areas share?
4. Use the map to support the fact that many areas have a lower number of threatened species and offer an explanation as to why this is so.

Problem-Solving Lab 31-1

Purpose
Students will determine that bird species decline is most apparent on islands because of habitat destruction.

Process Skills
think critically, recognize cause and effect, analyze information, apply concepts, use numbers, define operationally, predict

Teaching Strategies
- Review the mathematics needed to calculate the total number of species if students know the number threatened and that this number is close to 2.5%. Give them a sample problem to work, such as: 50 species: 2.5% = total U.S. species: 100%.
- Review the mathematics needed to calculate the total number of bird species. Give them a sample problem to work, such as: 1107 species: 11% = total world species: 100%.
- Provide students with references or dictionaries to look up the definitions asked for.

Thinking Critically
1. close to 2000
2. close to 10 000
3. all are islands
4. Europe and Africa have very low numbers of threatened species. Both parts of the world involve large areas that still provide enough new space for species to move to when their natural habitat is destroyed.

Assessment
Performance Ask students to research the success of capture, breeding, and release programs for certain bird species in the United States, such as the whooping crane, and write a newspaper article describing these programs. Use the Performance Task Assessment List for Newspaper Article in **PASC,** p. 69. L2

Portfolio

Making a Flyway Map
Visual-Spatial Provide students with a blank map of the world. Ask them to use a field guide to find the bird migration routes for the migrating birds of your area. Ask students to plot these data on their maps using a different color of pencil for each route. L1 ELL P

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Video: *Penguins,* Disc 4
Video: *Eagles,* Disc 4
Video: *Shorebirds,* Disc 4

MEETING INDIVIDUAL NEEDS

Learning Disabled
Interpersonal Bring to class a variety of tools such as a nutcracker, large net, chisel, hammer, tweezers, toothpicks, and a spatula. Have students imagine that each tool represents a bird's beak. Ask them to identify the type of wild food a bird would eat if it had a beak similar to each tool. L1 ELL COOP LEARN

Resource Manager

BioLab and MiniLab Worksheets, p. 140 L2

TechPrep

Photographing Birds

Visual-Spatial Provide students with equipment to photograph or videotape local birds in their habitats. Have students display their work and discuss in groups the habitat of each bird, the type of food it eats, and adaptations it has for its way of life. L2

COOP LEARN

Assessment

Knowledge Have each student write two questions about birds. Divide the class into pairs of students, and have them quiz each other. L1

3 Assess

Check for Understanding

Linguistic Ask students to write a letter that begins, "This is everything I know about birds...." Have them summarize what they have learned about birds in this letter. Have students then write a second paragraph that begins, "What I still don't understand about birds is...." Have them exchange letters with another student. Each student should write a response to the other in which they try to explain what their partner doesn't understand. If they both have the same area of weaknesses, they should exchange information with someone else. L2

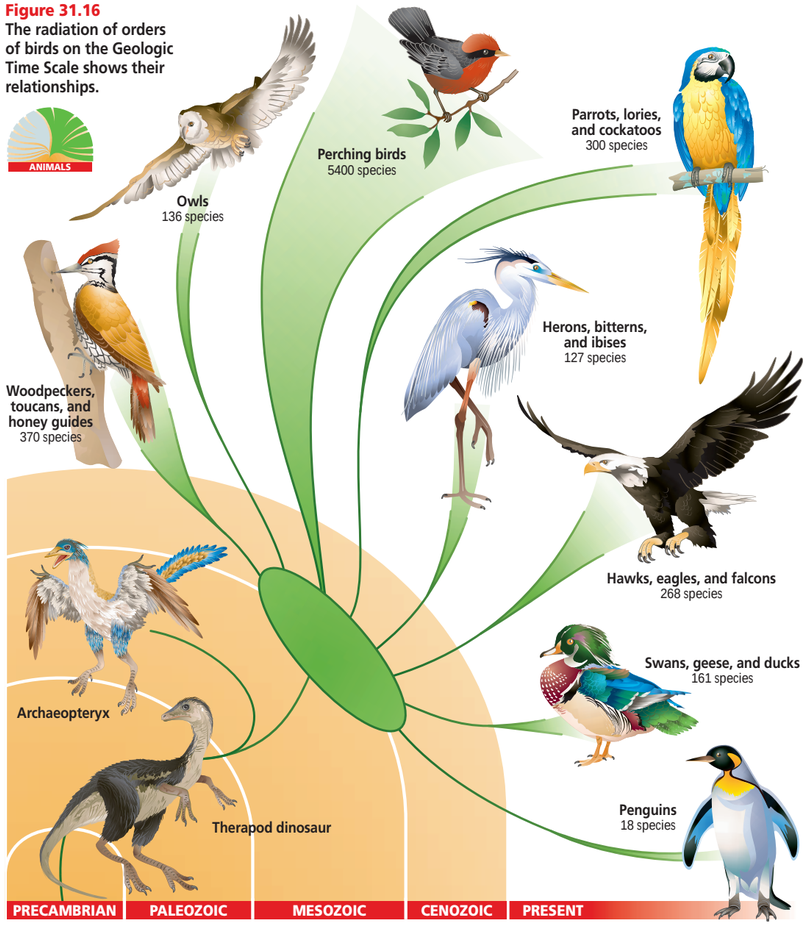
Reteach

Visual-Spatial Give students field guides to birds of your area. Ask them to observe birds for several days, identify them, and explain how each is adapted to its way of life. L1

Origins of Birds

Current thoughts about bird evolution are illustrated in ***Figure 31.16.*** Scientists hypothesize that today's birds are derived from an evolutionary line of dinosaurs that did not become extinct. ***Figure 31.17*** shows the earliest known bird in the fossil record, *Archaeopteryx*. At first, scientists thought that *Archaeopteryx* was a direct ancestor of modern birds; however, some paleontologists now think that it most likely did not give rise to any other bird groups. *Archaeopteryx* was about the size of a crow and had feathers and wings like a modern bird. But it also had teeth, a long tail, and clawed front toes, much like a reptile.

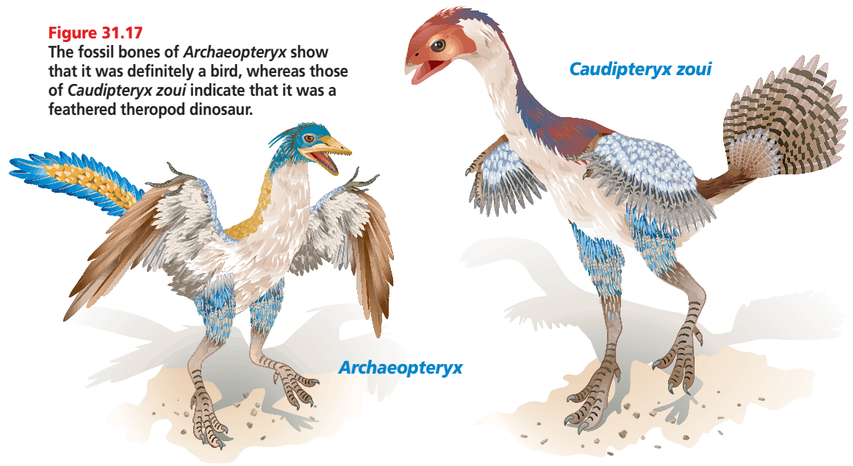
Figure 31.16
The radiation of orders of birds on the Geologic Time Scale shows their relationships.



Fossil finds in China support the idea that birds evolved from dinosaurs. The fossil theropod shown in ***Figure 31.17*** was a two-legged, meat-eating, running dinosaur. It had feathers similar to those of modern birds. Scientists hypothesize that these early feathers helped insulate the animal, or perhaps were adapted for camouflage or courtship behavior. Most scientists studying the origins of birds hypothesize that feathers came first, and flight evolved later.

But feathers aren't the only features shared by modern birds and some theropod dinosaurs. Both also have a sternum, a wishbone, shoulder blades, flexible wrists, and three fingers on each hand.

Figure 31.17
The fossil bones of *Archaeopteryx* show that it was definitely a bird, whereas those of *Caudipteryx zoui* indicate that it was a feathered theropod dinosaur.



Section Assessment

Understanding Main Ideas
1. Why is the lack of teeth in birds an adaptation for flight?
2. Explain how air sacs improve a bird's ability to obtain the energy necessary for flight.
3. How does being an endotherm have adaptive value for birds that live in polar regions?
4. What features of birds enable them to live on land?

Thinking Critically
5. Large, flightless birds once were common in areas that did not have large, carnivorous predators. Many of these birds are now extinct. What hypothesis can you suggest for the evolution and extinction of large, flightless birds?

Skill Review
6. **Making and Using Tables** Make a table that summarizes the adaptations birds have that enable them to fly. For more help, refer to *Organizing Information* in the **Skill Handbook.**

Cultural Diversity

Sankar Chatterjee and Bird Evolution

The evolutionary history of birds is currently under debate by scientists. In your discussions of bird evolution, introduce students to the research and hypotheses of Indian-American paleontologist, Sankar Chatterjee.

Chatterjee is best known for his 1986 discovery of *Protoavis*, a 225 million-year-old fossil that may turn out to be the earliest known bird. Have students research the various hypotheses of bird evolution and initiate a discussion about the evidence used in each hypothesis. L3

Section Assessment

1. Without teeth, birds are lighter for flight.
2. When a bird exhales, oxygenated air in the air sacs passes into the lungs, thereby increasing the amount of oxygen available to the bird to generate energy needed for flight.
3. Endotherms can regulate their body temperature regardless of what the environmental temperature is, and therefore, can keep warm even in cold areas.
4. lungs, wings, legs, beaks, internal fertilization, shelled, amniotic eggs
5. They filled a niche not otherwise occupied (large ground feeder). Wings became unimportant to survival, becoming vestigial over time.
6. Make sure students' tables include all the features listed on pages 852 through 854.

Extension

Kinesthetic Have students obtain small birds such as Cornish game hens, chickens, or quail from a meat market or grocery store. The birds should be boiled and all meat removed from the bones. Have students assemble the skeleton using sturdy glue and thin wire. L2

ELL

Assessment

Performance Have students sketch a scale map of the school grounds or a spot near the school on a sheet of butcher paper. Have students indicate how the area could be made a more suitable bird habitat. Have them work in groups to add features to their maps that would make their areas more attractive to birds. Books about attracting birds in all types of environments from the inner city to the suburbs are available at libraries. L2

ELL COOP LEARN

4 Close

Activity

Ask students to develop a hypothesis and experimental plan to determine why flamingos stand on one leg. L2

Resource Manager

Content Mastery, pp. 153, 155-156 L1
Reinforcement and Study Guide, pp. 139-140 L2
Basic Concepts Transparency 57 and Master L2 ELL

DESIGN YOUR OWN BioLab

Time Allotment
One class period

Process Skills
collect data, compare and contrast, identify and control variables, design an experiment, draw a conclusion, experiment, formulate models, hypothesize, interpret data, measure in SI, organize data

Preparation

Possible Hypotheses
If shape controls rolling, then different shapes will roll different distances and different shapes will form different patterns.

GLENCOE TECHNOLOGY

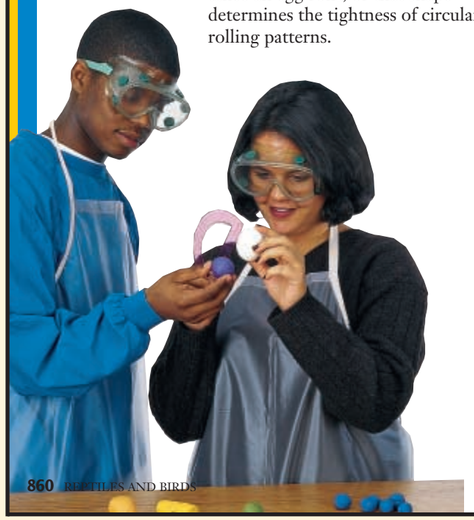
CD-ROM
Biology: The Dynamics of Life
Video: *Bird Courtship*
Disc 4

Resource Manager
BioLab and MiniLab Worksheets, pp. 141-142 L2

DESIGN YOUR OWN BioLab

Which egg shape is best?

Not all bird eggs have the same shape. An ostrich egg is almost totally round. Chicken eggs are almost a perfect oval on one end. Cliff-dwelling birds such as the common guillemot (Uria aalge) *have eggs that come almost to a point on one end. Why the variety of shapes? Is there any adaptive benefit to this variety of shapes? Could egg shape be related to where the bird nests?*



Preparation

Problem
What shape would be best for an egg to reduce the distance it could roll if pushed from a nest?

Hypotheses
There are several hypotheses that you can test. Your hypothesis might be that egg shape influences the distance an egg rolls, or that shape determines the tightness of circular rolling patterns.

Objectives
In this BioLab you will:
- **Design** an experiment to test your hypotheses.
- **Model** different egg shapes and egg masses.
- **Experiment** to test your hypotheses.
- **Draw conclusions** based on your experimental data.

Possible Materials
clay
cardboard ramp
ruler
string
hard-boiled egg
Ping-Pong ball
golf ball
balance
protractor

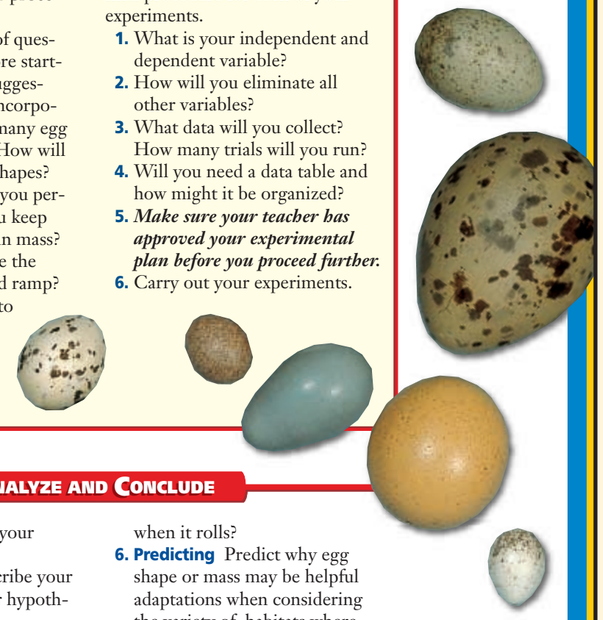
Safety Precautions
Always wear goggles in the lab.

Skill Handbook
Use the **Skill Handbook** if you need additional help with this lab.

Plan the Experiment

1. Decide on a way to test your group's hypothesis. Keep the list of available materials in mind as you plan your procedure.
2. There are a number of questions to be asked before starting. Here are some suggestions. How will you incorporate a control? How many egg shapes will you test? How will you model your egg shapes? How many trials will you perform? How might you keep egg models identical in mass? How will you measure the angle of the cardboard ramp? Where will you start to measure distance rolled?

Check the Plan
Discuss the following points with other group members to decide the final procedure for each of your experiments.
1. What is your independent and dependent variable?
2. How will you eliminate all other variables?
3. What data will you collect? How many trials will you run?
4. Will you need a data table and how might it be organized?
5. ***Make sure your teacher has approved your experimental plan before you proceed further.***
6. Carry out your experiments.



Analyze and Conclude

1. **Hypothesizing** Record your hypothesis.
2. **Interpreting Data** Describe your results after testing your hypothesis.
3. **Concluding** Do your data support your hypothesis? Explain using both quantitative and qualitative observations.
4. **Identifying Variables** What were your independent and dependent variables?
5. **Concluding** In general, how does mass influence the distance an egg will roll? How does egg shape influence the distance an egg will roll or the pattern taken when it rolls?
6. **Predicting** Predict why egg shape or mass may be helpful adaptations when considering the variety of habitats where birds live.

Going Further

Knowledge Find out the chemical and physical nature of bird shells. Find out how and where birds produce a shell.

interNET CONNECTION To find out more about birds and bird eggs, visit the Glencoe Science Web Site.
www.glencoe.com/sec/science

DESIGN YOUR OWN BioLab

Analyze and Conclude

1. Student answers will vary. Example: Egg shape will not influence path that the egg follows.
2. Student answers will vary. Example: Round eggs roll in straight lines whereas oval or pointed eggs roll in a circular pattern.
3. Student answers will vary. Example: Heavy round eggs rolled farther (26 cm) than lighter round eggs (22 cm).
4. Student answers will vary. Example: independent variable, egg shape; dependent variable, distance rolled.
5. A greater mass results in a longer distance rolled. Oval or pointed eggs roll a shorter distance and form a circular path; the more pointed the end, the tighter the circular path.
6. Round shapes aid birds that nest on flat ground. Oval or pointed eggs aid birds that nest on slanted ground or on cliffs.

Assessment

Knowledge Ask students to write a short report on their experimental findings and to emphasize how egg shape has adaptive value for birds. Use the Performance Task Assessment List for Lab Report in **PASC,** p. 47. L2

Going Further

Have students research the variety in egg shell coloration. Have them correlate this variety in coloration with natural selection and species survival. L3

Plan the Experiment

Teaching Strategies
- Students should work in groups of three or four with specific duties being assigned to each student within the group.
- Balances may be shared among groups.
- Class discussion at the conclusion would be meaningful to see the variety of hypotheses tested and conclusions reached.

Possible Procedures
- To make egg models, students could mold clay around golf or ping pong balls or real eggs.
- The mass of the models can be kept fairly constant by adding or removing clay.

Data and Observations
Round eggs will roll the farthest. Eggs of higher mass will roll farther than lighter eggs. Pointed eggs or oval (normal egg shape) eggs will roll in a circular pattern and total distance will be less than total distance rolled for round eggs.

Biology & SOCIETY

Purpose

Encourage students to become aware of the illegal wildlife trade, and how consumer demand for wildlife and wildlife products drives the market for products made from threatened and endangered species.

Background

It may come as a surprise to students that the United States is probably the largest single consumer of wildlife in the world. Wildlife trade in the U.S. represents roughly one-fifth of the global wildlife market. Many animals and wildlife products are bought and sold legally in the U.S., but many others are not. In a recent survey conducted by TRAFFIC, the wildlife trade monitoring organization supported by the World Wildlife Fund and the World Conservation Union (IUCN), traditional packaged medicines containing (or purporting to contain) tiger or rhino body parts were easy to find for sale in many large cities, even though the trade of such products is illegal. Fewer than 6000 tigers and 12 000 rhinos remain in the wild.

Teaching Strategies

- As a class project, contact the U.S. Fish and Wildlife Service for information about the illegal wildlife trade. Have students create posters showing ways in which people can help reduce the worldwide demand for products made from threatened and endangered animals and plants.
- Visit a zoo that participates in a nationally accredited captive breeding program for threatened or endangered species.

Biology & SOCIETY

Illegal Wildlife Trade

In May 1998, the U.S. Fish and Wildlife Service broke up an international smuggling ring. Their three-year investigation—code-named Operation Jungle Trade—ended in the arrest of smugglers operating in a dozen countries. In what illegal products were these criminals trafficking? Not diamonds or drugs, but rare birds.

An international treaty called CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) makes it illegal to buy or sell many of the world's threatened and endangered animals and plants, or products made from them. Despite this global agreement, the illegal wildlife trade is a multi-billion-dollar-a-year business.

Species for sale Some people pay large sums of money for parrots, tropical fish, monkeys, snakes, and lizards to add to animal collections or keep as exotic pets. Worldwide, millions of illegal wildlife products—from jewelry made from sea turtle shells to snow leopard coats and lizard skin belts—are bought and sold annually on the wildlife black market. Many traditional remedies manufactured in certain countries are made with body parts from rare species, including endangered tigers and rhinos.

Confiscated products from endangered species and a jaguar skin (inset)

Different Viewpoints

For some people, owning an unusual pet or wearing clothing or jewelry made from endangered species is a status symbol. They feel if they have the money, they should be able to buy whatever they want. Far more people support the illegal wildlife trade without realizing it by buying sea shells, coral jewelry, ivory trinkets, and animal skin accessories sold as souvenirs in many countries. Some users of traditional remedies believe strongly in the power of parts of certain endangered animals or plants to enhance physical attractiveness or treat physical conditions and don't think about protecting endangered wildlife.

The ethics of wildlife trade The illegal wildlife trade is pushing many species to the brink of extinction. With every extinction, Earth's already dwindling biodiversity shrinks a little more. Once a given species is gone, wildlife traders will turn to a different one to try to meet the demands of consumers. Education, stricter laws regulating wildlife trade, and better law enforcement are needed to bring the booming illegal wildlife trade under control.

Investigating the Issue

Analyzing the Issue In the United States alone, hundreds of different kinds of plants are collected and sold for use in the medicinal plant trade. In small groups, discuss how the increasing popularity of herbal medicines—many of which are made from plants that grow in the wild—could endanger numerous plant species.

interNET CONNECTION To find out more about the illegal wildlife trade, visit the Glencoe Science Web Site.
www.glencoe.com/sec/science

Investigating the Issue

Students should understand that using plant and animal resources wisely and sustainably will help ensure a continuing supply of medicines.

Going Further

Linguistic Have students write an essay on the following question: Would you buy a product if you were aware that it was made from the body parts of an endangered species? L2

Chapter 31 Assessment

Summary

Section 31.1

Reptiles

Main Ideas

- Reptiles are ectotherms that have dry, scaly skin; legs under the body; internal fertilization; and amniotic eggs. Most reptiles have three-chambered hearts. Some reptiles have four-chambered hearts.
- Present-day reptiles belong to one of four groups. Turtles have shells and no teeth. Crocodiles and alligators have streamlined bodies and powerful, toothed jaws. Lizards have a variety of adaptations, including long bodies, tails, and short limbs. Snakes have no limbs.
- The ancestors of present-day reptiles arose from ancient cotylosaurs, which were also the ancestors of the dinosaurs.

Vocabulary

amniotic egg (p.842)
Jacobson's organ (p.845)

Section 31.2

Birds

Main Ideas

- Birds have adaptations for flight including feathers; a keel-shaped sternum; a four-chambered heart; endothermy; thin, hollow bones; a beak; and air sacs.
- Birds may be derived from a line of dinosaurs that did not become extinct.

Vocabulary

endotherm (p.854)
feather (p.852)
incubate (p.854)
sternum (p.853)

Understanding Main Ideas

1. Scientists hypothesize that _____ were the ancestors of birds.
   a. fishes **c.** reptiles
   b. amphibians **d.** mammals
2. Of the following, which is NOT an example of a reptile?
   a. snake **c.** salamander
   b. turtle **d.** lizard
3. For gas exchange, reptiles are dependent on _____.
   a. gills **c.** skin and lungs
   b. skin **d.** lungs
4. Which of the following is NOT a characteristic of reptiles?
   a. has three- or four-chambered heart
   b. lays amniotic eggs
   c. has legs flexed under the body
   d. has external fertilization
5. Why don't reptiles inhabit extremely cold regions on Earth?
   a. They have moist skin that would freeze in the cold.
   b. They are ectotherms.
   c. They lay eggs in water and water would freeze in the cold.
   d. They are endotherms.

GLENCOE TECHNOLOGY

VIDEOTAPE
MindJogger Videoquizzes
Chapter 30: *Reptiles and Birds*
Have students work in groups as they play the videoquiz game to review key chapter concepts.

Resource Manager

Chapter Assessment, pp. 181-186
MindJogger Videoquizzes
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 31 quiz

Main Ideas

Summary statements can be used by students to review the major concepts of the chapter.

Using the Vocabulary

To reinforce chapter vocabulary, use the Content Mastery Booklet and the activities in the Interactive Tutor for Biology: The Dynamics of Life on the Glencoe Science Web Site.
www.glencoe.com/sec/science

THE PRINCETON REVIEW

All Chapter Assessment questions and answers have been validated for accuracy and suitability by The Princeton Review.

Understanding Main Ideas

1. c
2. c
3. d
4. d
5. b

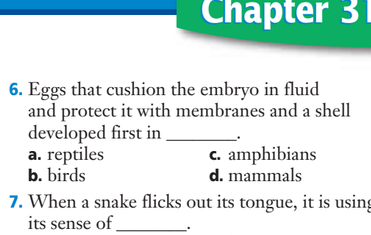
6. a
7. b
8. b
9. a
10. c
11. endotherm
12. heat-sensitive
13. nesting in trees
14. Crocodilians
15. flight
16. removes waste (allantois)
17. scales, claws, amniotic eggs
18. membranes
19. feathers
20. Jacobson's

Applying Main Ideas

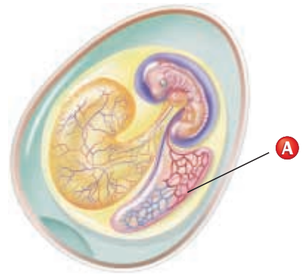
21. Birds are endotherms and maintain a constant body temperature regardless of the temperature of their environment.
22. Sea turtles might not recognize their nesting beaches and they may not lay eggs. Sea turtles migrate back to the beaches where they hatched to lay eggs. The release of chemicals into the water may alter the water chemistry in such a way that turtles may not be able to recognize the area.
23. The allantois collects nitrogenous wastes. The embryo inside an amniotic egg gets food from the yolk. The chorion permits gas exchange. The shell, fluids, and membranes cushion and protect the developing embryo.
24. *Caudipteryx* is a fossil dinosaur with feathers similar to those of modern birds. *Archaeopteryx* is the earliest fossil bird with feathers and wings.

Chapter 31 Assessment

6. Eggs that cushion the embryo in fluid and protect it with membranes and a shell developed first in _____.
   a. reptiles **c.** amphibians
   b. birds **d.** mammals
7. When a snake flicks out its tongue, it is using its sense of _____.
   a. vision **c.** hearing
   b. smell **d.** touch
8. From what group of reptiles do most scientists agree birds evolved?
   a. cotylosaurs **c.** therapsids
   b. theropods **d.** turtles
9. The function of down feathers is _____.
   a. insulation **c.** preening
   b. flight **d.** molting
10. The earliest known fossil bird with feathers is _____.
    a. *Caudipteryx* **c.** *Archaeopteryx*
    b. an ostrich **d.** a pigeon
11. A penguin can live in Antarctica because it is a(n) _____.
12. Some snakes can find their prey even in the dark because they have _____ pits along their upper jaws.
13. In the cladogram below, you can see that a shorter beak and _____ evolved after skeletal fusion.



14. _____ move faster than all other reptiles because their cells get more oxygen through their hearts.
15. The large breastbone of a bird is an adaptation that aids in _____.
16. What function does the structure labeled A in the diagram below perform in the amniotic egg?



17. What are three features that modern-day reptiles and birds share?
18. In the amniotic egg, the chorion and the amnion are _____ that permit gas exchange and protect the developing embryo.
19. Birds can be distinguished from all other living animals because they have _____.
20. A snake's sense of smell is located in its _____ organ.

Applying Main Ideas

21. Why are birds able to inhabit more diverse environments than reptiles?
22. Newly developed industries that locate on shorelines often release chemicals into the ocean. How might this development affect sea turtles that use these areas to breed? Explain.
23. Explain how the amniotic egg maintains homeostasis.
24. Discuss why the fossils of *Archaeopteryx* and *Caudipteryx* are significant in explaining the evolutionary history of birds.

Test-Taking Tip

THE PRINCETON REVIEW

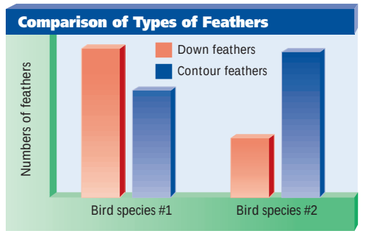
Your Answers Are Better Than the Test's

When you know the answer, answer the question in your own words before looking at the answer choices. Often, more than one answer choice will look good, so arm yourself with yours before looking.

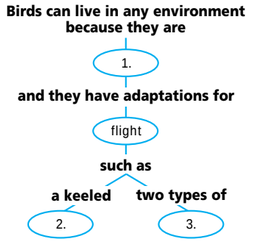
Chapter 31 Assessment

Thinking Critically

25. **Interpreting Data** A biologist counts the feathers on the bodies of two different species of birds. The data are represented in the graph below. What might be inferred about the type of environments in which the birds live?



26. **Comparing and Contrasting** Most reptiles lay between one and 200 eggs at a time. Amphibians lay thousands of eggs at a time. Is there an adaptive advantage to laying fewer eggs on land? Explain.
27. **Concept Mapping** Complete the concept map by using the following vocabulary terms: sternum, feathers, endotherms.

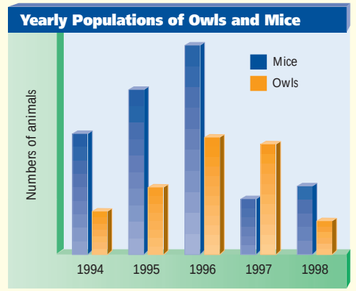


CD-ROM

For additional review, use the assessment options for this chapter found on the ***Biology: The Dynamics of Life Interactive CD-ROM*** and on the Glencoe Science Web Site.
www.glencoe.com/sec/science

Assessing Knowledge & Skills

A biologist is comparing yearly censuses of owls and mice found in one area. The data obtained are represented in the graph below.



Interpreting Data Study the graph and answer the following questions.

1. In most years, there are _____.
   a. more mice than owls
   b. more owls than mice
   c. the same number of owls as mice
   d. twice as many owls as mice
2. The best explanation for the fluctuations in owl populations is that the owl population increases and decreases in response to _____.
   a. the size of the mouse population
   b. the decrease in the mouse population
   c. the increase in the mouse population
   d. the 4-year cycle of the mouse population
3. **Formulating Hypotheses** Examine the graph again and assume that the key is changed to the following: purple represents a certain type of eagle and yellow represents rabbits. Make a hypothesis about the relationship between eagles and rabbits.

Chapter 31 Assessment

Thinking Critically

25. Bird species 1 probably lives in a colder environment than does bird species 2.
26. The shelled eggs of the reptile are more protected than the amphibian eggs, so they have a greater chance of producing live young. Also, energy is conserved when fewer eggs are produced.
27. 1. Endotherms; 2. Sternum; 3. Feathers

Assessing Knowledge & Skills

1. a
2. a
3. There are more eagles than rabbits in any one year, except 1997. Eagles exert pressure on the rabbit population, but because eagles also eat many other animals, they do not completely decimate the rabbit population in any one year. In years with fewer eagles, more rabbits survive.