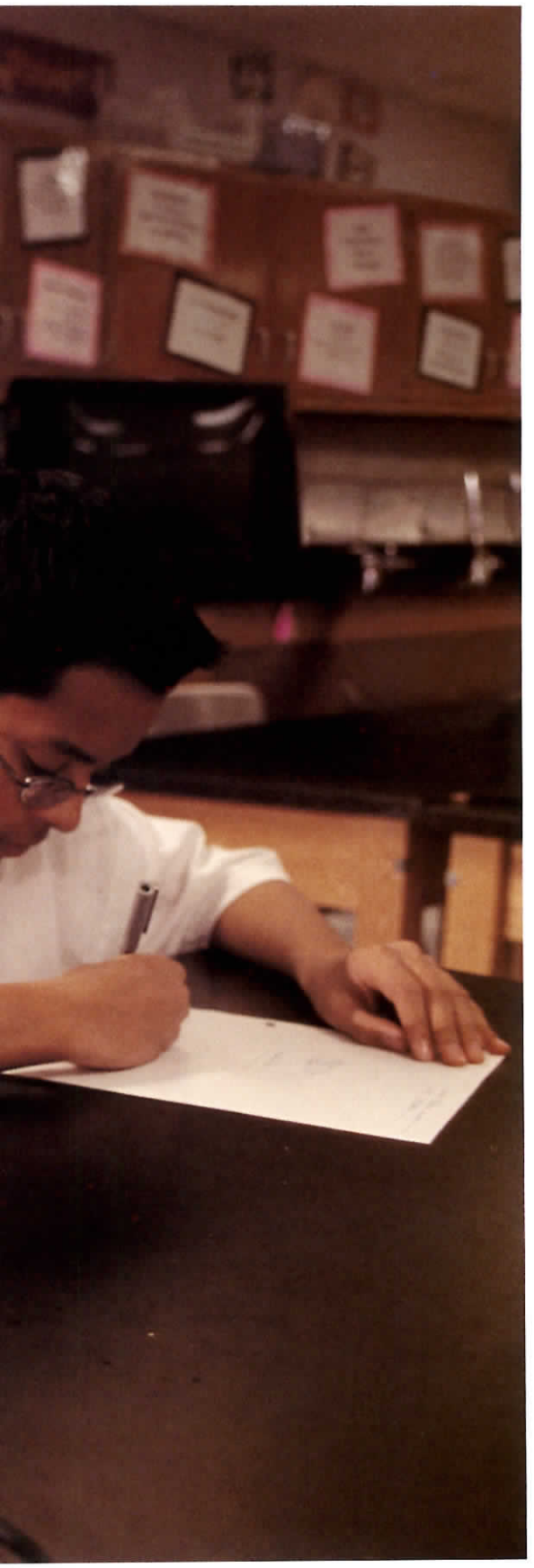

PART 3 Completing the Cycle

LESSON 13

Anchor Activity

COURTESY OF CAROLINA BIOLOGICAL SUPPLY COMPANY

This bat-eating snake is capable of swallowing creatures twice its diameter.

COURTESY OF CAROLINA BIOLOGICAL SUPPLY COMPANY

How long would you last lying on the ice with no clothes for protection?

INTRODUCTION

Did you ever wonder how a snake can devour things more than twice its diameter? Or how a seal keeps from freezing in subzero temperatures? In this lesson, you will work with your group to explore what constitutes a habitat and to investigate a vertebrate—an animal with a backbone—such as that snake or seal. Your group then will divide into pairs. One pair will investigate how the vertebrate's body structure affects various aspects of its life, from what it eats and how it gets its food, to how it interacts with its own species and others. The other pair of students will research the vertebrate's habitat. Your group will work as a team to present your findings to the class. Your teacher will discuss the options for presenting your final product. You also will read a true story about an organism called *Daphnia* and its connections to Charles Darwin and his theory of evolution.

OBJECTIVES FOR THIS LESSON

Read about factors that determine where an organism lives.

Select a vertebrate and research how the structure of its body parts influences the way those parts function.

Research your vertebrate's habitat to discover the biotic and abiotic factors that might affect its ability to survive.

Share your findings with the class using a presentation method approved by your teacher.

Read about an organism called *Daphnia* and decide whether its rapid evolution supports Charles Darwin's ideas.

Getting Started

1. Read silently as a classmate reads aloud the Introduction to this lesson.

2. Watch the videotape *Body by Design: Form and Function* and take notes based on your teacher's instructions.

3. Brainstorm with your group a list of vertebrate body parts with unique adaptations for performing one or more functions.

4. Share your list with the class.

Inquiry 13.1
Introducing the Research Project

ANCHOR ACTIVITY

1. Listen while your teacher introduces the Anchor Activity, including appropriate research methods, reference requirements, deadlines, and presentation formats. Follow along as your teacher reviews Student Sheet 13.1: Anchor Activity Schedule and Table 13.1: Anchor Activity Scoring Rubric. Your teacher will tell you the appropriate point values for each part of the scoring rubric.

2. Follow along while students take turns reading "Habitats" at the end of this lesson to find out more about habitats in general.

MATERIALS

For you

1 copy of Student Sheet 13.1: Anchor Activity Schedule

For each group of 4 students

1 copy of Inquiry Master 13.1: Lists of Vertebrates

Choosing a Vertebrate

1. Work with your group to choose a vertebrate to research. Refer to a variety of sources including the lists provided by your teacher, your school media center, and your own resources.
2. Obtain your teacher's approval for your group's final choice.
3. Decide which pair from your group will research how your vertebrate's various body parts are suited to their functions and which pair will research the vertebrate's habitat.

ANIMALS WITH BACKBONES

A vertebrate is an organism with a backbone. Vertebrates are grouped within the phylum Chordata of the Animal kingdom and are further separated into five major classes:

Class Mammalia—Warm-blooded animals with hair or fur and mammary glands

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This brown bear, with its thick coat of fur, is a rugged specimen of a mammal.

Class Aves—Warm-blooded animals with feathers and hollow bones

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These waxed albatrosses are warm-blooded, which means that their bodies maintain a constant internal body temperature. What do you think "cold-blooded" means?

Class Reptilia—Cold-blooded animals with scales that lay their eggs on land

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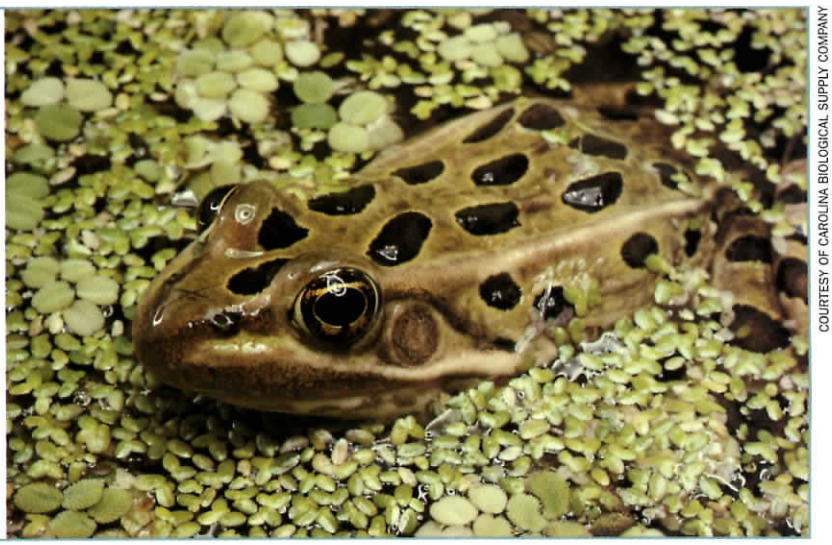
This snake has a threatening rattle that wards off enemies.

Class Amphibia—Cold-blooded animals that live part of their life in water and part on land (they breathe by means of gills when young, but develop lungs as adults); they lay their eggs in water



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This leopard frog is well camouflaged amidst the duckweed. The position of its eyes allows it to observe its surroundings without exposing its whole body to predators.

Class Pisces—Cold-blooded animals that live in water (they are often divided into smaller groups, such as jawless fish, cartilage fish, and bony fish)

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This green sunfish is just one of many species of sunfish you might find in a pond or lake.

Gathering Data

1. The pair that is researching body parts should take the following steps:

A. Discuss the videotape *Body by Design: Form and Function,* which featured the numerous ways in which body structures are adapted to perform their functions.

B. Conduct your research using a variety of references including books, encyclopedias, CD-ROMs, DVDs, videotapes, and the Internet. Remember to research both internal and external structures. Your final report must include the scientific name of your vertebrate and at least five structures and how they are suited for performing their functions.

2. The pair that is researching your vertebrate's habitat should take the following steps:

A. Include in your research those factors caused or produced by living beings (biotic) and those factors not caused or produced by living beings (abiotic). Examples of biotic factors include the following:

- predators, or lack of them
- food preferences and supply
- population density
- other species with which your vertebrate interacts in its habitat
- disease

Examples of abiotic factors include the following:

- temperature range
- precipitation
- water
- topography
- wind
- shelter
- nesting site and a place to raise young
- escape routes from predators

B. Also include information on the impact of your vertebrate and its habitat on humans and vice versa. Include drawings, photos, or computer-generated images of your vertebrate's habitat, preferably with an image of your vertebrate included.

C. Conduct your research using a variety of references including books, encyclopedias, CD-ROMs, DVDs, videotapes, and the Internet.

Presenting Your Research Project

1. Your group will share its research project with the class. Listen while your teacher reviews various product and presentation options.

2. Your pair may choose any of the presentation methods approved by your teacher. Each pair in your group may choose different methods. Whatever method you choose, remember that the pair researching body parts must include in its final product all of the elements listed in "Gathering Data" Step 1.B, and the pair researching habitats must include all of the elements listed in "Gathering Data" Steps 2.A and 2.B.

3. If your pair decides to create a poster, for example, you would take the following steps:

A. Prepare a draft of your poster on 8½″ × 11″ paper for approval by your teacher. Include your research sources on a separate piece of paper.

B. After receiving your teacher's approval, transfer your information to a 24″ × 36″ poster. Figure 13.1 illustrates one way of documenting research findings in the form of a poster. Several, but certainly not all, of this familiar vertebrate's structures are labeled, with a brief explanation of their functions.

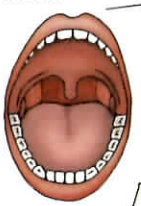
4. If you choose a presentation method other than a poster, ask your teacher how to provide a draft of your research for approval.

5. Arrange time for you and your partner to practice your presentation. Use the scoring rubric on Table 13.1 as a guide for assessing your project. Your teacher will explain the point values for each step of each rubric.

Homo sapiens

Hair: Provides insulation and protection from injury. May vary in color, diameter, texture, and surface area coverage. The degree of insulation and protection is dependent partially on these variables.

Teeth:



Back teeth are flat for chewing.

Front teeth are sharp and pointed for tearing. These features allow humans to eat a variety of foods.

Brain: Large, well-developed brain; capable of advanced reasoning and decision-making, which contributes to the human's ability to survive change and develop complex behavior patterns.

Outer ear: Outer funnel that collects sound and directs it inward to the middle and inner ear. Only mammals have this funnel-shaped outer ear. Scientists are unclear whether it helps humans hear better.

Joint: Place where bones meet. Bones are connected by elastic ligaments that permit flexibility and movement.

Figure 13.1 *A vertebrate in action*

Table 13.1 Anchor Activity Scoring Rubric

Quality of Content on Vertebrate Form and Function	Points Possible
Final product displays exemplary coverage of at least 5 vertebrate structures and their functions. Research and references exceed the minimum requirements.	
Final product displays above-average coverage of at least 5 vertebrate structures and their functions. Research and references are above average.	
Final product displays satisfactory coverage of at least 5 vertebrate structures and their functions. Research and references are sufficient.	
Final product displays below-average coverage of at least 5 vertebrate structures and their functions. Research and references are insufficient.	
Final product displays limited or no coverage of vertebrate structures and functions. Few or no sources of information are evident.	

OR

Quality of Content on Vertebrate Habitat	Points Possible
Final product displays exemplary coverage of biotic and abiotic factors in the vertebrate's habitat. Research, visuals, and references exceed the minimum requirements.	
Final product displays above-average coverage of biotic and abiotic factors in the vertebrate's habitat. Research, visuals, and references are above average.	
Final product displays satisfactory coverage of biotic and abiotic factors in the vertebrate's habitat. Research, visuals, and references are sufficient.	
Final product displays below-average coverage of the biotic and abiotic factors in the vertebrate's habitat. Research and references are insufficient.	
Final product displays limited or no coverage of the biotic and abiotic factors in the vertebrate's habitat. Few or no sources of information are evident.	

AND

Presentation Design and Appearance	Points Possible
Final product clearly, effectively, and creatively displays the main ideas. It is well organized and attractive.	
Final product clearly and effectively displays the main ideas. It is organized and relatively attractive.	
Final product communicates some of the main ideas but is lacking in organization and structure. The appearance is satisfactory.	
Final product ineffectively communicates the main ideas, lacks detail and structure, and is unorganized and unattractive.	

Table 13.1 Anchor Activity Scoring Rubric (continued)

Presentation to Class	Points Possible
Presenter clearly, effectively, and creatively communicated the required information in a style appropriate for the audience.	
Presenter clearly and effectively communicated the required information in a style appropriate for the audience.	
Presenter communicated some of the required information, but presentation lacked some detail, organization, and structure.	
Presenter ineffectively communicated the required information; the presentation lacked considerable detail, organization, and structure.	

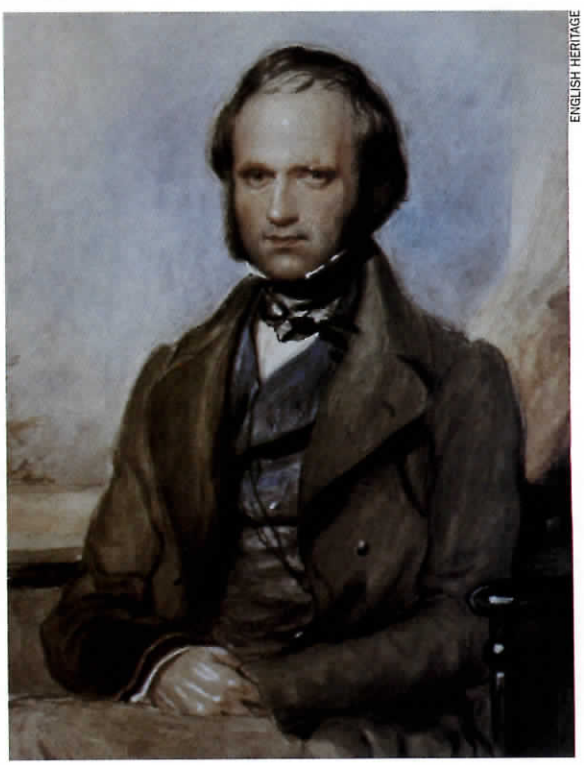
REFLECTING ON WHAT YOU'VE DONE

Read the following passage about Charles Darwin and the article entitled "*Daphnia*'s Change of Appetite." Then write a minimum of 150 words explaining which of Darwin's ideas are addressed in the reading selection and how those ideas are supported. Turn in your work to your teacher by the date requested in the schedule provided on Student Sheet 13.1.

Charles Darwin and His Theory of Evolution

In 1859, British naturalist Charles Darwin published his groundbreaking book, *Origin of Species.* In this remarkable book, Darwin explained his theory of evolution, which was based on many years of observations. The book illustrated several important points:

- Many variations exist within species. For example, some humans are taller than others; some giraffes have longer necks than others.
- All organisms compete for the resources they need to survive.
- Organisms can produce more offspring than can survive given the quantity of resources available.
- Organisms that are fit and better able to deal with changes in their environment tend to survive and reproduce, passing their desirable traits on to their offspring. This is known as "natural selection," or "survival of the fittest."



Charles Darwin

Daphnia's Change of Appetite

Have you ever thrown away something you were about to eat because it did not smell right? Or dumped milk down the drain because it seemed spoiled? If so, you probably did the right thing. Eating or drinking food that has spoiled can make you sick.

But what if *all* your food turned bad and you had nothing else to eat? If your body would not accept the bad food, you would starve. In the natural world, many creatures face this problem. This is especially true of organisms that live in lakes close to cities and towns, where pollution often is a problem.

Pollution from human activity has gradually poisoned the food of many aquatic, or water-dwelling, organisms. Because these organisms live within confined bodies of water, they can't leave their homes to seek cleaner waters. If none of the organisms is able to survive the pollution, the entire species will perish in that habitat.

CHARLEDONEZAN

Pollution often limits the types of organisms that are able to survive in a lake or pond.

What's for Dinner?

In Lake Constance in Germany, one tiny creature has defied the odds. It is called *Daphnia,* and it belongs to a biological class called Crustacea. The best-known crustaceans are shrimp, crabs, and lobsters. *Daphnia* is much smaller than any of these. You might call it a "shrimp's shrimp."

Since 1970, human-caused pollution in Lake Constance has killed off much of *Daphnia*'s one-time favorite food—harmless green algae. While the green algae could not survive the pollution, a different species, a poisonous blue-green form of algae called *Cyanobacteria,* flourished. It now dominates the lake. *Cyanobacteria* is not only dangerous to

Daphnia; humans also can get very sick if they drink water containing these algae.

After the harmless green algae were gone, *Daphnia* in Lake Constance turned to the other available source of food—the dangerous *Cyanobacteria.* Surprisingly, the entire population of *Daphnia* did not die off. Those rare *Daphnia* endowed with genes that allowed them to tolerate the new diet of *Cyanobacteria* survived, reproduced, and passed on their tolerance

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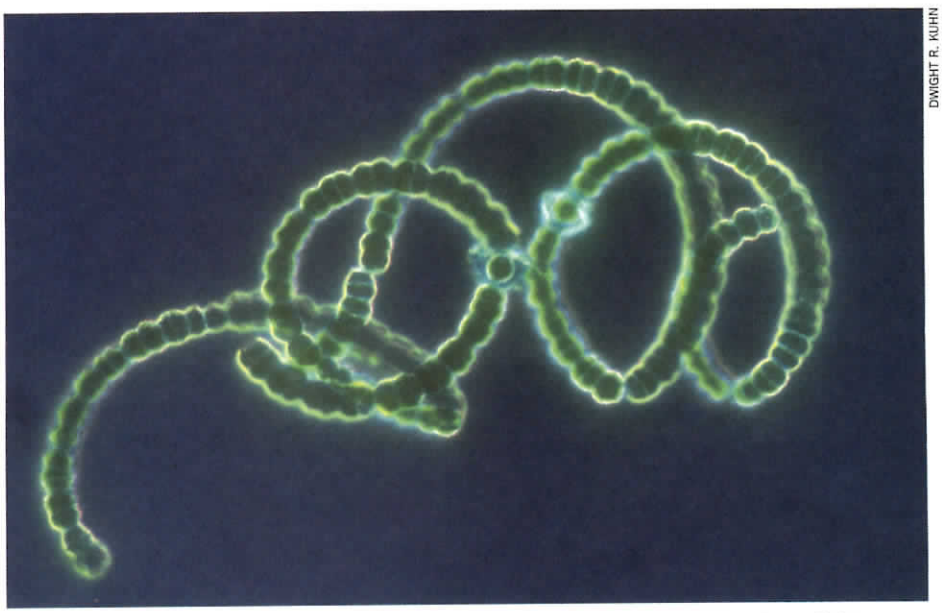
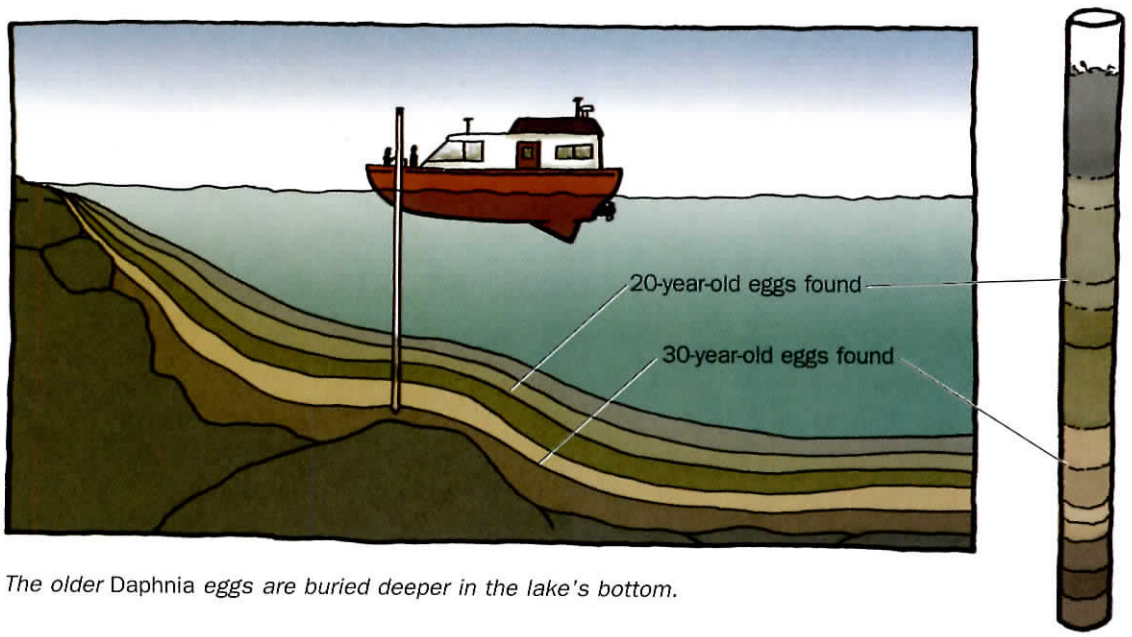
DWIGHT R. KUHN

Daphnia *illuminated in a drop of water swimming among the algal filaments*



DWIGHT R. KUHN

This harmless-looking organism, a type of Cyanobacteria, *can be very harmful to most* Daphnia.



The older Daphnia *eggs are buried deeper in the lake's bottom.*

to their offspring. If there had been no *Daphnia* with this tolerance in Lake Constance, their species in the lake would have perished.

New *Daphnia* From Old Eggs

How do scientists know that *Daphnia* have evolved? Through an amazing bit of detective work.

Scientists knew that each year, after *Daphnia* laid their eggs, some of the eggs became buried at the bottom of Lake Constance. Year after year, the sediment covered more and more eggs. So the deeper the eggs are buried, the older they are.

A group of scientists decided to dig up some eggs that had been buried about 30 years ago, before the lake became polluted, as well as some eggs that were buried about 20 years ago. Then the scientists brought the eggs to the laboratory, where, incredibly, the 30-year-old eggs were still able to hatch! They raised the newly hatched *Daphnia* in the laboratory, feeding deadly *Cyanobacteria* to both the pre- and post-pollution creatures.

What did the scientists discover? *Daphnia* from the older eggs couldn't eat *Cyanobacteria* and survive. Their diet evidently had been the green algae, and they couldn't "stomach" the blue-green stuff. And—you guessed it—*Daphnia* hatched from 20-year-old eggs ate the toxic blue-green algae without a problem!

The scientists were surprised. *Daphnia* had evolved in only about 10 years. In the process, the species had survived in the lake, and, by consuming the poisonous *Cyanobacteria*, had helped make Lake Constance safe for humans again. □

Habitats

This fungus lives very comfortably on and within this tree.

A habitat is any place where a plant or animal lives. A habitat can be a desert for a cactus or a rattlesnake, an ocean for a whale or a sea turtle, a grassland for a bison or a gazelle, or a rainforest for a monkey or a rubber tree. A habitat can be an animal's intestine, as it is for some parasitic worms. A habitat can be a single tree, as it is for some species of fungi.

The concept of a habitat is quite simple. It is an organism's home. It is a place that supplies an organism with all it needs—food, water, shelter, and a place to bear and raise its young.

The reality of habitats, however, is not so simple. Consider the sea turtle, for example. Females of the world's seven sea turtle species all come to shore to nest and lay their eggs. When the babies hatch, they rush to the sea, which becomes their habitat. But for a very brief time in the female sea turtle's life, the ocean shore becomes its habitat. Male sea turtles never

(continued)

need to return to land. So for adult males, the ocean becomes their only habitat.

Within the vast ocean, sea turtles find different types of habitats. Some leatherback sea turtles spend part of the year in Alaskan waters, feeding on jellyfish. Hawksbill turtles feed along tropical coral reefs, while young Kemp's Ridley sea turtles mature in the reefs of the Sargasso Sea.

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Of all the hatchlings that now call the ocean their home, only the females eventually will return to land to lay their eggs.

Salmon alternate between two different habitats and, like the female sea turtle, must have both for their species to survive. Salmon hatch in freshwater streams and migrate to the sea, where they live for a few years before swimming back up the streams of their birth to lay eggs and die.

Through the process of evolution, many plants and animals change in ways that make certain habitats threatening to their survival. Some species have adapted to very specific food requirements and therefore are limited to habitats where that food is available. Australia's koala bear, for example, feeds only on the leaves of a few species of eucalyptus trees, making it highly specialized. Species like the koala are often very vulnerable to changes in their habitat. If disease were to kill off Australia's

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These salmon struggle to swim upstream to their spawning grounds.

eucalyptus trees, for example, the koala in that area would soon perish. By contrast, for their survival, cabbage white butterflies depend on plants in the mustard family, which include more than 3000 species in over 300 genera. Therefore, the cabbage white may inhabit the many places in the world in which varieties of mustard plants are found.

Vertebrates in two classes, mammals and birds, are warm-blooded. This means that they maintain a constant body temperature. The other three classes of vertebrates—reptiles, amphibians, and fish—consist of animals that are cold-blooded, meaning that they take on the temperature of their surroundings. Because they can maintain a constant body temperature, mammals and birds are generally able to adapt to a wider range of temperatures and thus a wider range of habitats.

It is important to understand that evolution of a species happens entirely by chance. Evolution does not occur in order to help organisms adapt to a habitat. If a species cannot adapt to protect itself in some way from changes that occur within its habitat, it is left with two alternatives. It may move to a more suitable habitat, or it may become extinct. And finding a suitable habitat isn't always easy. In fact, scientists estimate that more than 99 percent of all the species of organisms that have ever lived are now extinct.

Some organisms, such as certain species of mammals, birds, and fish, migrate to other areas during certain times of the year to follow the food supply, to seek more suitable temperatures, to reproduce, or for a combination of these reasons. As a result, their habitats temporarily change. Other organisms have avoidance strategies to cope with changes in their environment. For example, some microorganisms form spores or cysts, encasing themselves within thick, durable coverings to protect themselves from the elements. Seeds may go into periods of rest, or dormancy. The cabbage white butterfly larva forms a protective chrysalis, a stage of metamorphosis in which it may exist until conditions are favorable for it to emerge as an adult.

A habitat may be as tiny as a drop of water or a pinch of soil or as large as an ocean or a forest as long as it provides an organism those things it needs for its survival—food, shelter, and a place to reproduce. □

This koala is resting comfortably on the branches of a eucalyptus tree, the leaves of which are its main diet.