BIOLOGY 2e

Chapter 18 EVOLUTION AND ORIGIN OF SPECIES

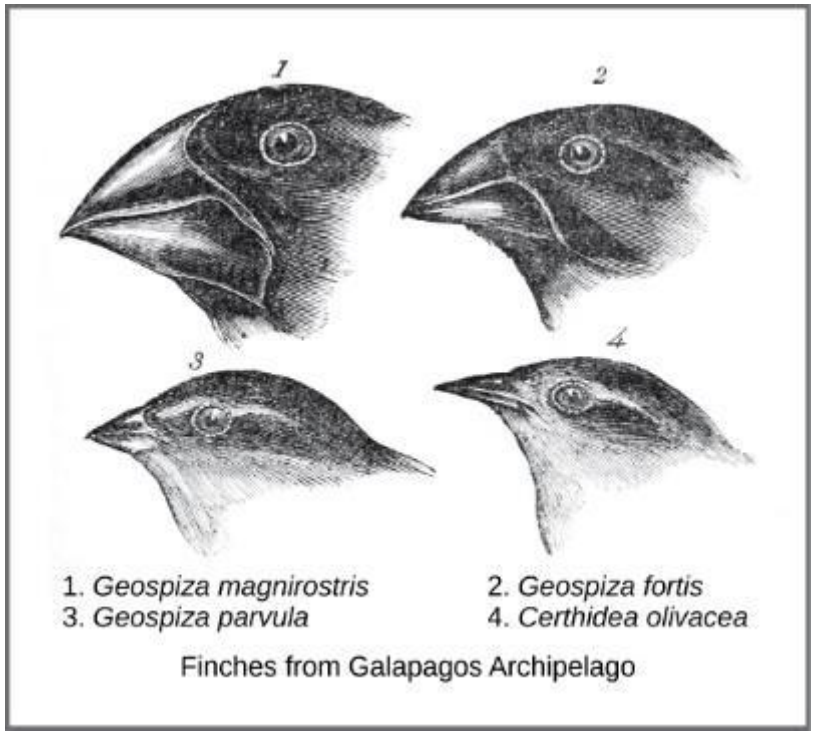
PowerPoint Image Slide Show

FIGURE 18.1

All organisms are products of evolution adapted to their environment. (a) Saguaro (*Carnegiea gigantea*) can soak up 750 liters of water in a single rain storm, enabling these cacti to survive the dry conditions of the Sonora desert in Mexico and the Southwestern United States. (b) The Andean semiaquatic lizard (*Potamites montanicola*) discovered in Peru in 2010 lives between 1,570 to 2,100 meters in elevation, and, unlike most lizards, is nocturnal and swims. Scientists still do no know how these ectotherms, which rely on external sources of body heat, are able to move in the cold (10 to 15°C) temperatures of the Andean night.

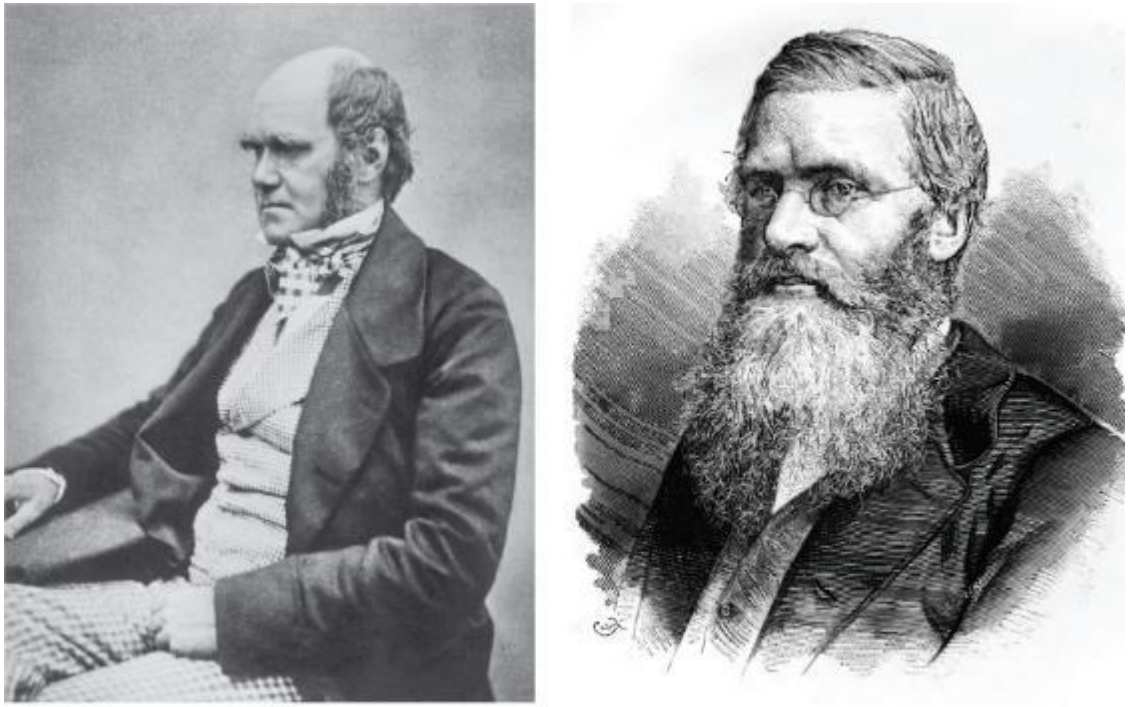
(credit a: modification of work by Gentry George, U.S. Fish and Wildlife Service; credit b: modification of work by Germán Chávez and Diego Vásquez, *ZooKeys*)

FIGURE 18.2



Darwin observed that beak shape varies among finch species. He postulated that the beak of an ancestral species had adapted over time to equip the finches to acquire different food sources.

FIGURE 18.3



(a) (b)

Both (a) Charles Darwin and (b) Alfred Wallace wrote scientific papers on natural selection that were presented together before the Linnean Society in 1858.

FIGURE 18.4

A field biologist tranquilizes a polar bear for study.

(credit: Karen Rhode)

FIGURE 18.5

(a) (b)

Flowering plants evolved from a common ancestor. Notice that the (a) dense blazing star (*Liatrus spicata*) and the (b) purple coneflower (*Echinacea purpurea*) vary in appearance, yet both share a similar basic morphology.

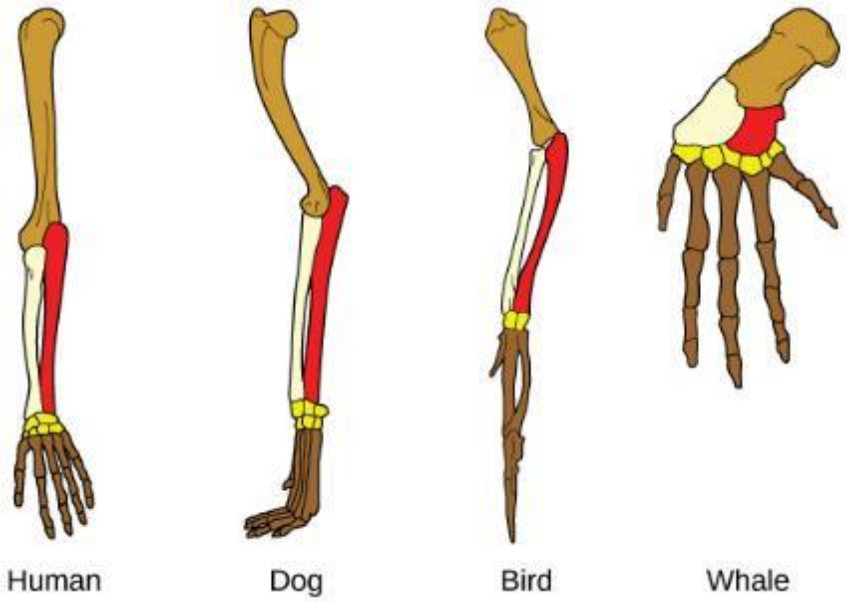
(credit a: modification of work by Drew Avery; credit b: modification of work by Cory Zanker)

FIGURE 18.6

(a) (b)

In this (a) display, fossil hominids are arranged from oldest (bottom) to newest (top). As hominids evolved, the shape of the skull changed. An artist's rendition of (b) extinct species of the genus *Equus* reveals that these ancient species resembled the modern horse (*Equus ferus*) but varied in size.

FIGURE 18.7



The similar construction of these appendages indicates that these organisms share a common ancestor.

FIGURE 18.8

(a) (b)

The white winter coat of the (a) arctic fox and the (b) ptarmigan's plumage are adaptations to their environments.

(credit a: modification of work by Keith Morehouse)

FIGURE 18.9

The (a) poodle and (b) cocker spaniel can reproduce to produce a breed known as (c) the cockapoo.

(credit a: modification of work by Sally Eller, Tom Reese; credit b: modification of work by Jeremy McWilliams; credit c: modification of work by Kathleen Conklin)

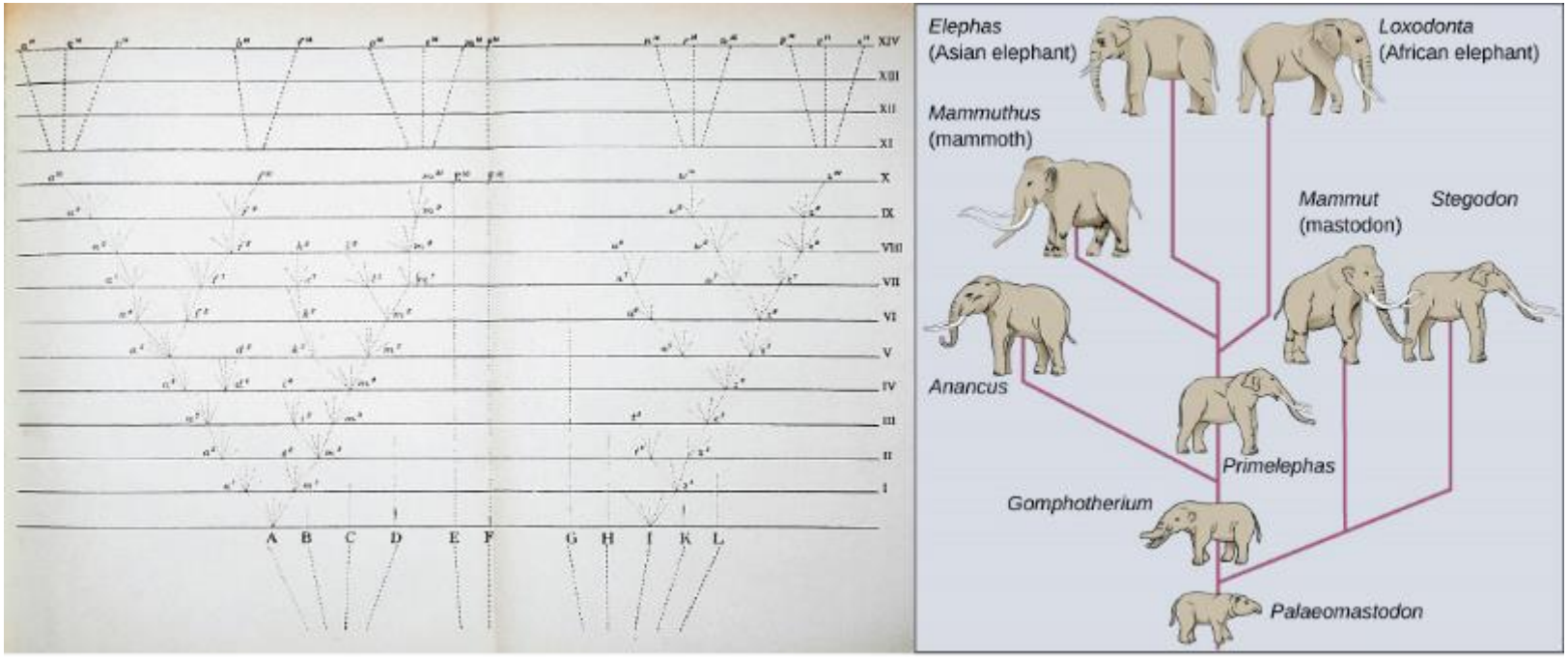
FIGURE 18.10

(a) (b)

The (a) African fish eagle is similar in appearance to the (b) bald eagle, but the two birds are members of different species.

(credit a: modification of work by Nigel Wedge; credit b: modification of work by U.S. Fish and Wildlife Service)

FIGURE 18.11



(a) (b)

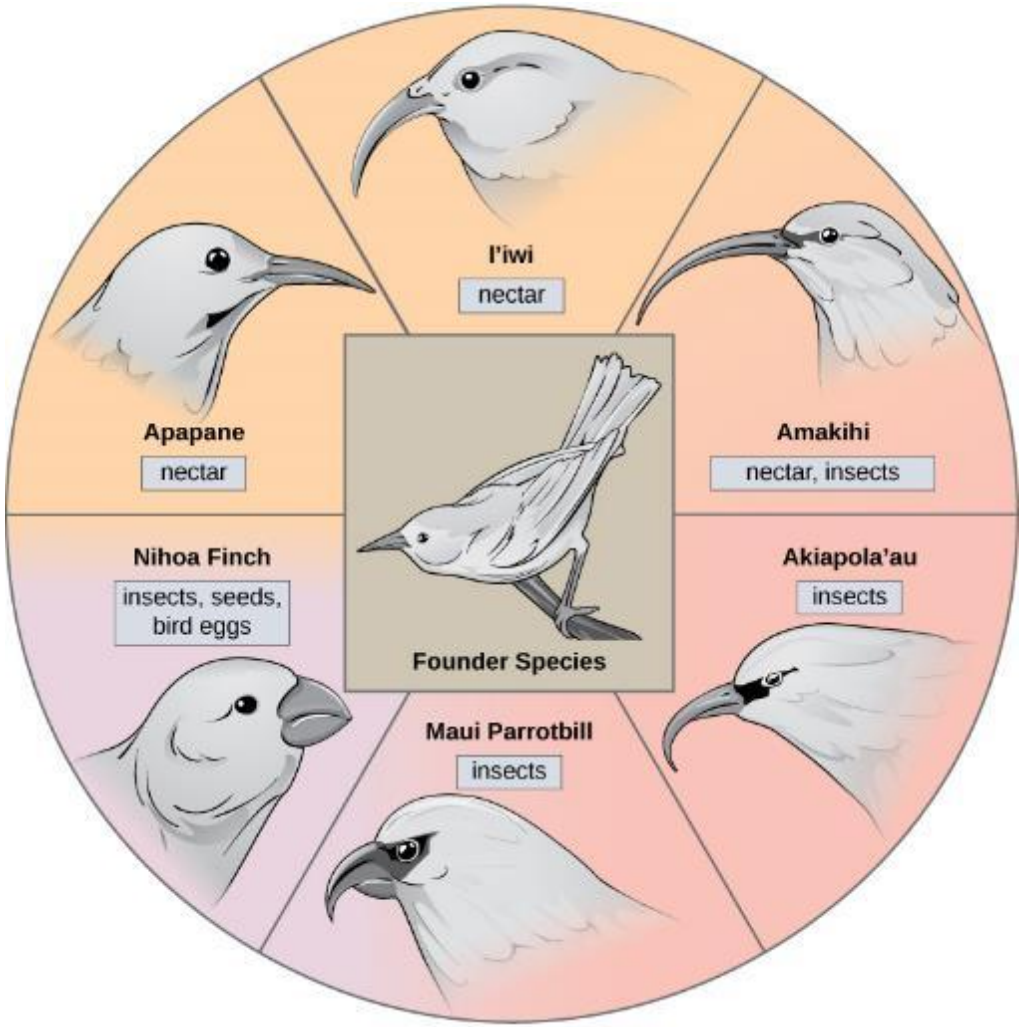
The only illustration in Darwin's *On the Origin of Species* is (a) a diagram showing speciation events leading to biological diversity. The diagram shows similarities to phylogenetic charts that today illustrate the relationships of species. (b) Modern elephants evolved from the *Palaeomastodon*, a species that lived in Egypt 35–50 million years ago.

FIGURE 18.12

The northern spotted owl and the Mexican spotted owl inhabit geographically separate locations with different climates and ecosystems. The owl is an example of allopatric speciation.

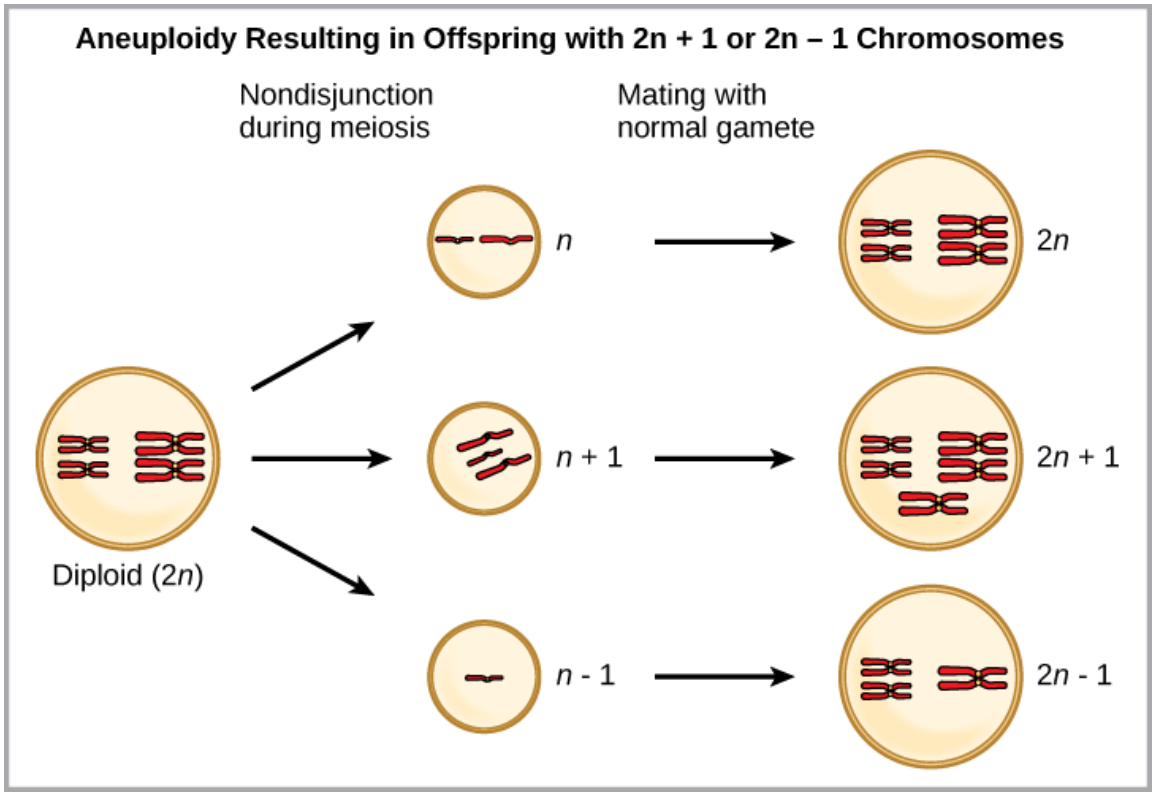
(credit "northern spotted owl": modification of work by John and Karen Hollingsworth; credit "Mexican spotted owl": modification of work by Bill Radke)

FIGURE 18.13



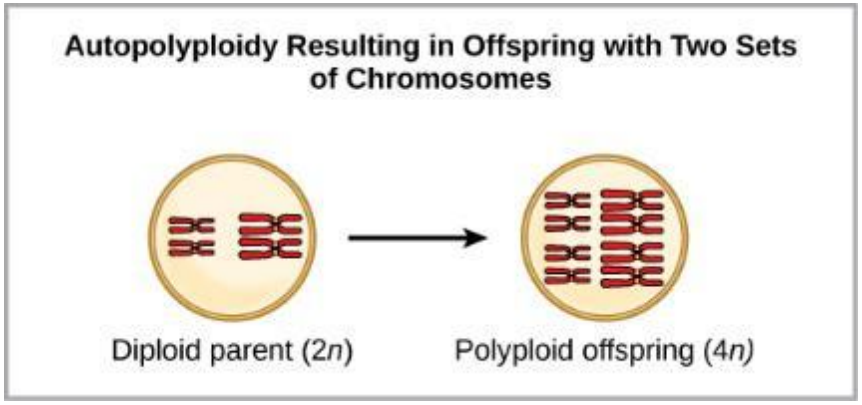
The honeycreeper birds illustrate adaptive radiation. From one original species of bird, multiple others evolved, each with its own distinctive characteristics.

FIGURE 18.14



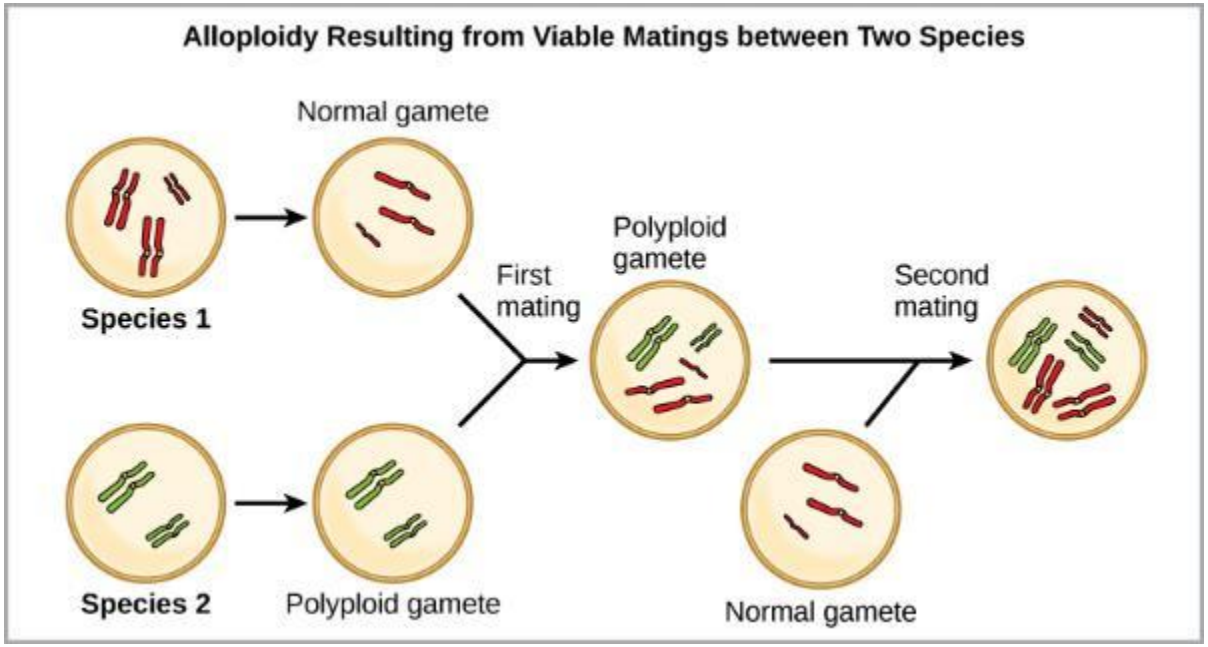
Aneuploidy results when the gametes have too many or too few chromosomes due to nondisjunction during meiosis. In the example shown here, the resulting offspring will have 2*n*+1 or 2*n*-1 chromosomes.

FIGURE 18.15



Autopolyploidy results when mitosis is not followed by cytokinesis.

FIGURE 18.16



Alloploidy results when two species mate to produce viable offspring. In the example shown, a normal gamete from one species fuses with a polyploidy gamete from another. Two matings are necessary to produce viable offspring.

FIGURE 18.17

(a) (b)

These two related frog species exhibit temporal reproductive isolation. (a) *Rana aurora* breeds earlier in the year than (b) *Rana boylii*.

(credit a: modification of work by Mark R. Jennings, USFWS; credit b: modification of work by Alessandro Catenazzi)

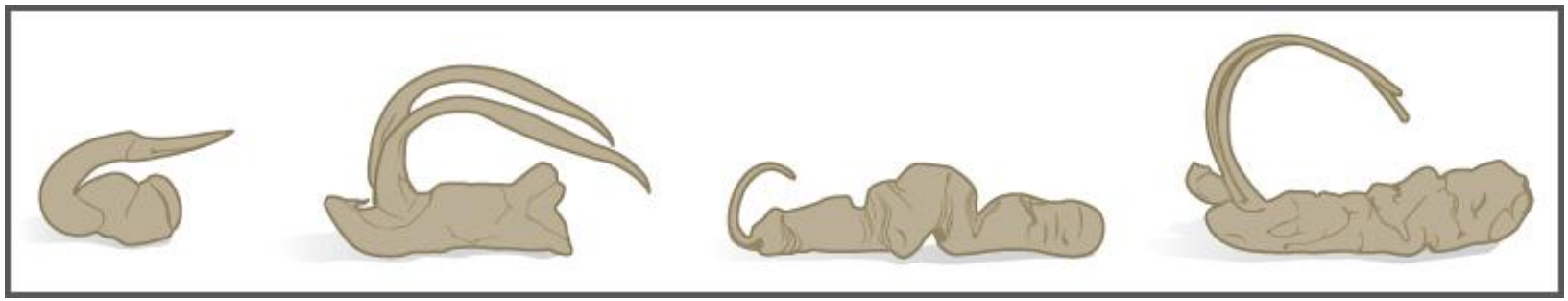
FIGURE 18.18

(a) *Gryllus pennsylvanicus* prefers sandy soil.

(b) *Gryllus firmus* prefers loamy soil.

Speciation can occur when two populations occupy different habitats. The habitats need not be far apart. The cricket (a) *Gryllus pennsylvanicus* prefers sandy soil, and the cricket (b) *Gryllus firmus* prefers loamy soil. The two species can live in close proximity, but because of their different soil preferences, they became genetically isolated.

FIGURE 18.19



The shape of the male reproductive organ varies among male damselfly species, and is only compatible with the female of the same species. Reproductive organ incompatibility keeps each species reproductively isolated.

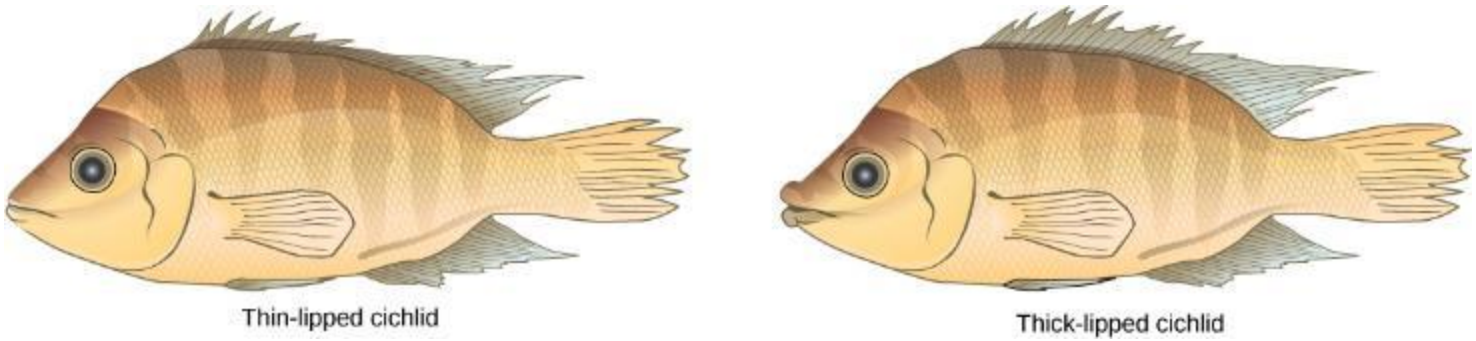
FIGURE 18.20

(a) Honeybee drinking nectar from a foxglove flower

(b) Ruby-throated hummingbird drinking nectar from a trumpet creeper flower

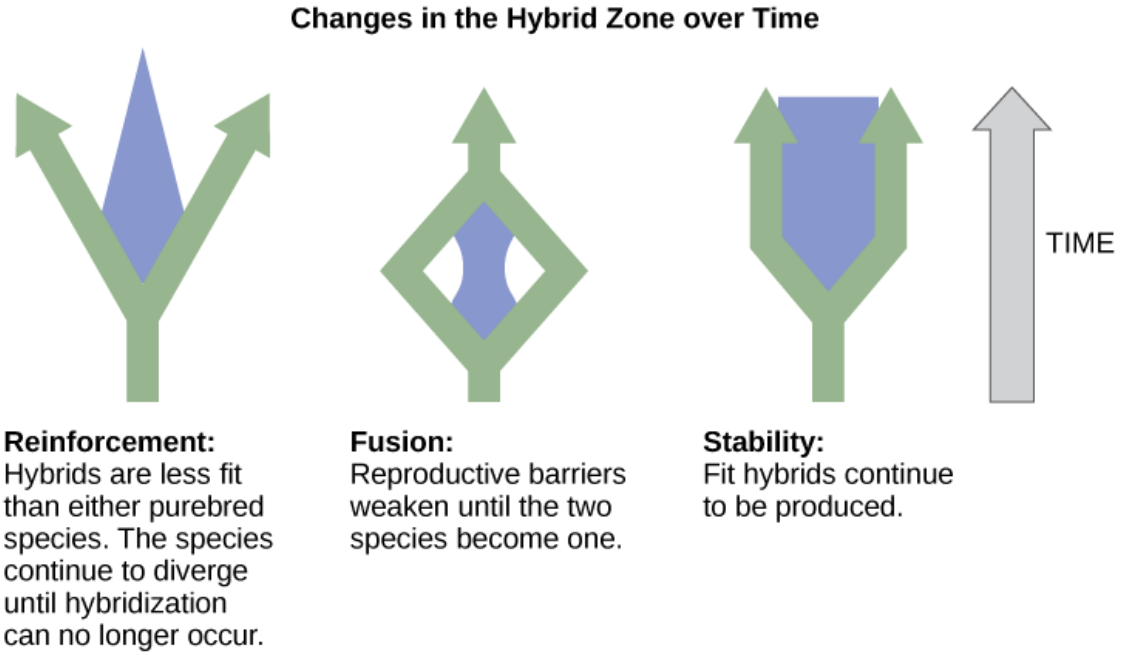
Some flowers have evolved to attract certain pollinators. The (a) wide foxglove flower is adapted for pollination by bees, while the (b) long, tube-shaped trumpet creeper flower is adapted for pollination by hummingbirds.

FIGURE 18.21



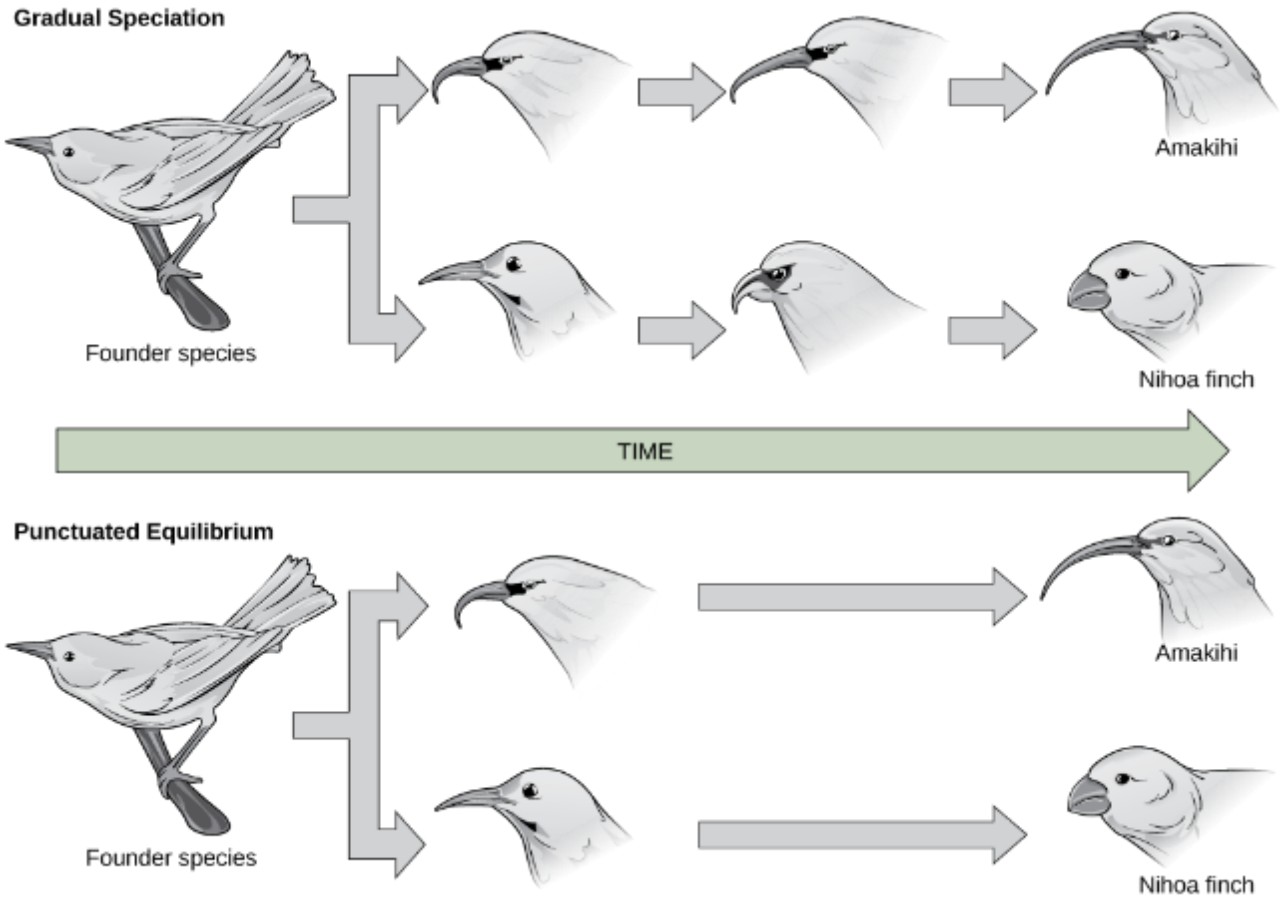
Cichlid fish from Lake Apoyeque, Nicaragua, show evidence of sympatric speciation. Lake Apoyeque, a crater lake, is 1800 years old, but genetic evidence indicates that the lake was populated only 100 years ago by a single population of cichlid fish. Nevertheless, two populations with distinct morphologies and diets now exist in the lake, and scientists believe these populations may be in an early stage of speciation.

FIGURE 18.22



After speciation has occurred, the two separate but closely related species may continue to produce offspring in an area called the hybrid zone. Reinforcement, fusion, or stability may result, depending on reproductive barriers and the relative fitness of the hybrids.

FIGURE 18.23



In gradual speciation (top), species diverge at a slow, steady pace as traits change incrementally. In punctuated equilibrium (bottom), species diverge quickly and then remain unchanged for long periods of time.