Chapter 52

An Introduction to Ecology and the Biosphere

PowerPoint® Lecture Presentations for

Biology

Eighth Edition

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Lectures by Chris Romero, updated by Erin Barley with contributions from Joan Sharp

Key concepts

1. Ecology is to study “interaction” within, between, and across species, as well as the environment.
2. Ecology is an integrated discipline.

Overview: The Scope of Ecology

- **Ecology** is the scientific study of the interactions between organisms and the environment
- These interactions determine distribution of organisms and their abundance
- Ecology reveals the richness of the biosphere

Fig. 52-1

- **Organismal ecology** studies how an organism's structure, physiology, and (for animals) behavior meet environmental challenges

- A **population** is a group of individuals of the same species living in an area
- **Population ecology** focuses on factors affecting how many individuals of a species live in an area

- A **community** is a group of populations of different species in an area
- **Community ecology** deals with the whole array of interacting species in a community

- An **ecosystem** is the community of organisms in an area and the physical factors with which they interact
- **Ecosystem ecology** emphasizes energy flow and chemical cycling among the various biotic and abiotic components

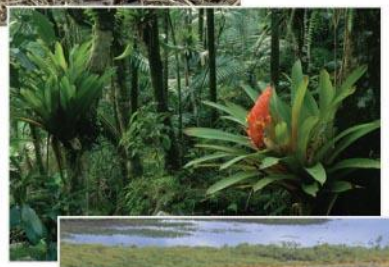
- A **landscape** is a mosaic of connected ecosystems
- **Landscape ecology** deals with arrays of ecosystems and how they are arranged in a geographic region

- The **biosphere** is the global ecosystem, the sum of all the planet's ecosystems
- **Global ecology** examines the influence of energy and materials on organisms across the biosphere

Fig. 52-2

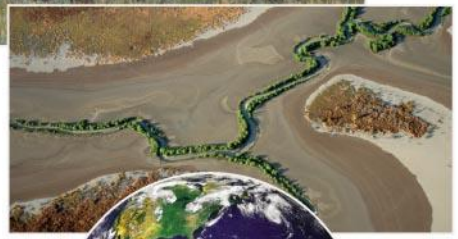
Organismal ecology

Population ecology



Community ecology

Ecosystem ecology



Landscape ecology

Global ecology

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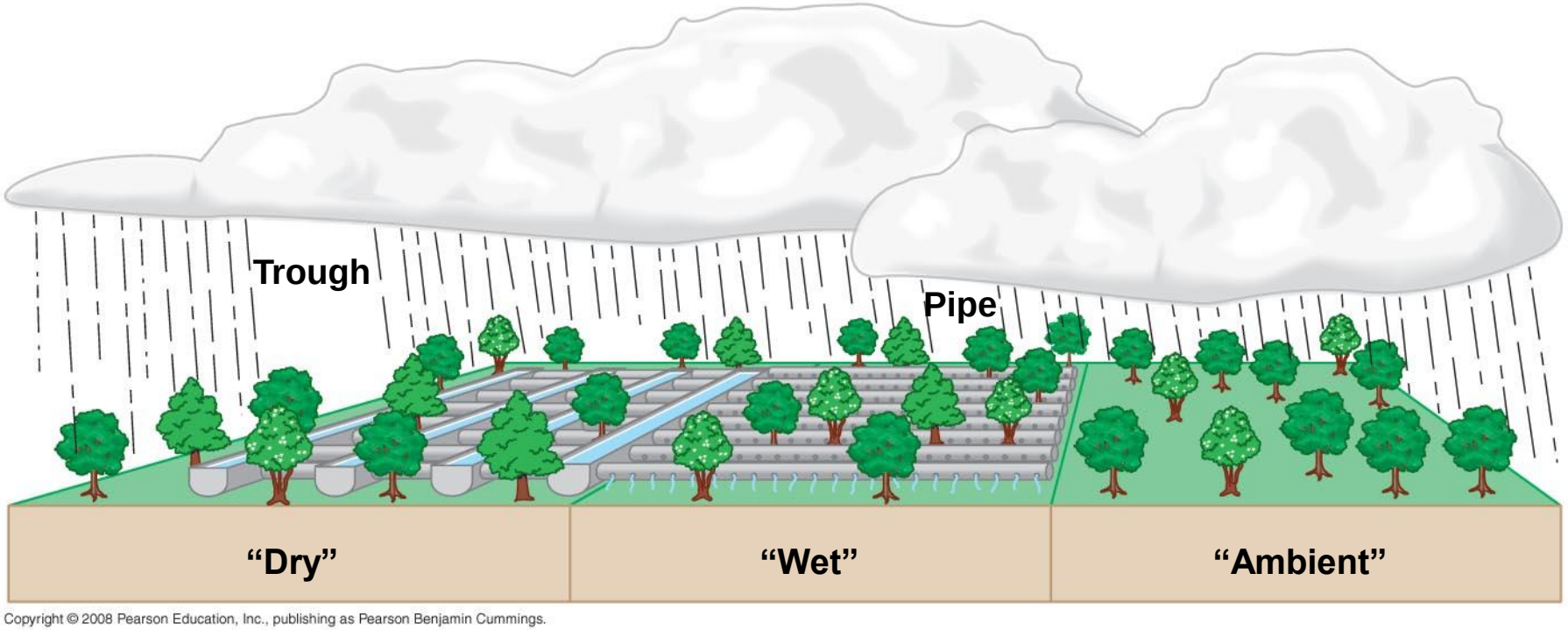
Fig. 52-3

Ecology has a long history as a descriptive science, but it is also a rigorous experimental science



Studying how a forest responds to altered precipitation

Ecology and Environmental Issues

- Ecology
  - Provides the scientific understanding underlying environmental issues
- Rachel Carson

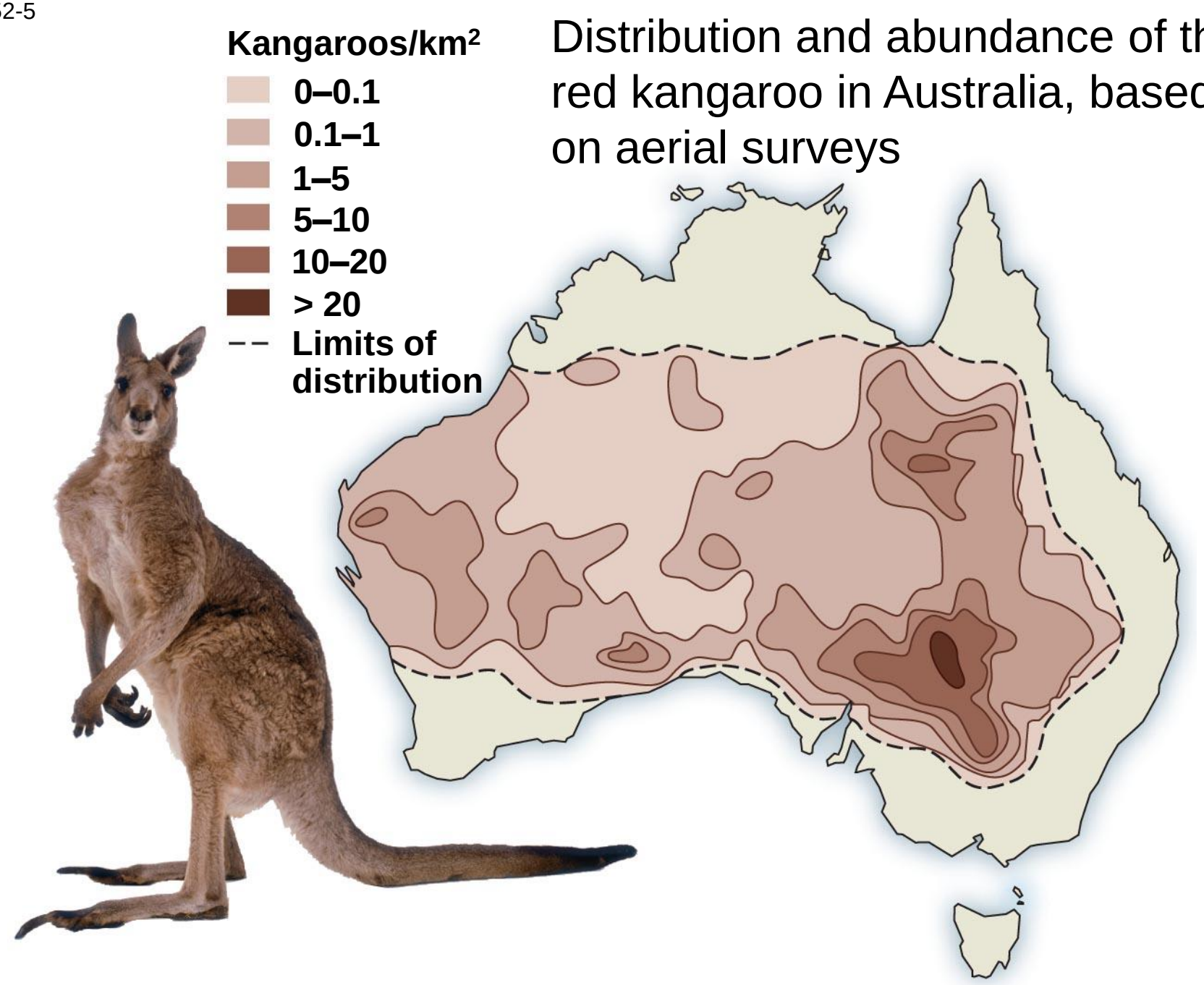
Silent Spring (1962)

"The 'control of nature' is a phrase conceived in arrogance, born of the Neanderthal age of biology and philosophy, when it was supposed that nature exists for the convenience of man."

Concept 52.2: Interactions between organisms and the environment limit the distribution of species

- Ecologists recognize two kinds of factors that determine distribution: **biotic**, or living factors, and **abiotic**, or nonliving factors

Fig. 52-5



Distribution and abundance of the red kangaroo in Australia, based on aerial surveys

Fig. 52-6

Flowchart of factors limiting geographic distribution

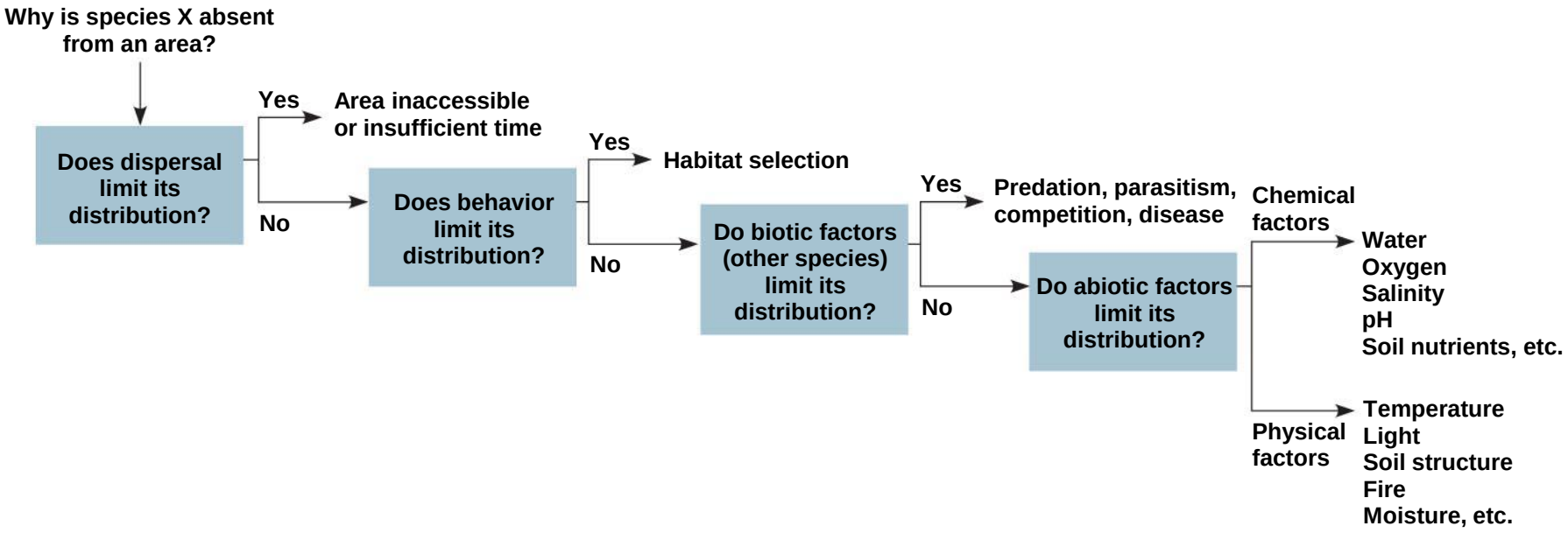


Fig. 52-7

Natural range expansions show the influence of dispersal on distribution

Dispersal of the cattle egret in the Americas

Species Transplants

- Species transplants include organisms that are intentionally or accidentally relocated from their original distribution

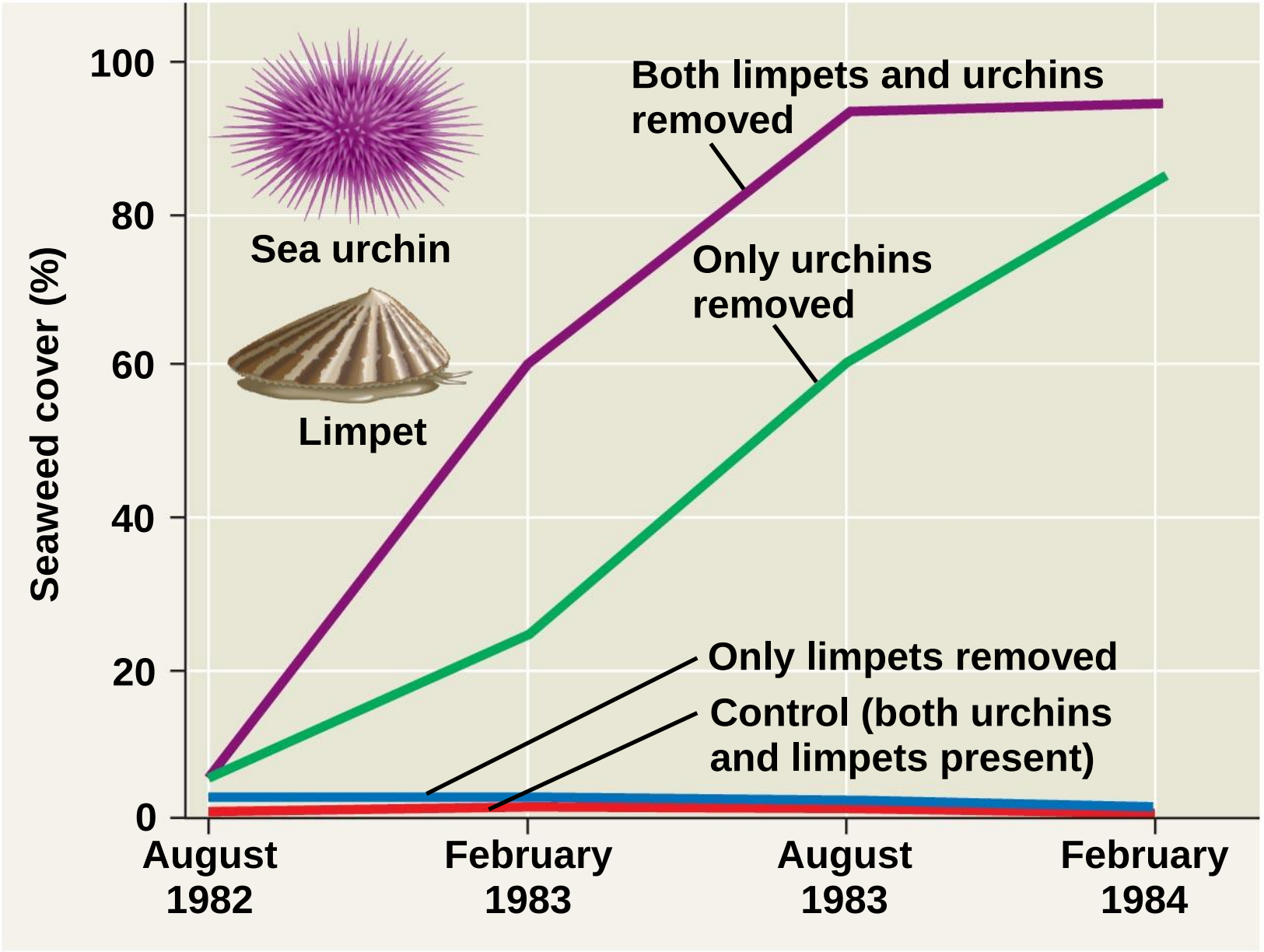
Behavior and Habitat Selection

- Some organisms do not occupy all of their potential range
- Species distribution may be limited by habitat selection behavior

Fig. 52-8

RESULTS

Does feeding by sea urchins limit seaweed distribution?



Biotic Factors

- Biotic factors that affect the distribution of organisms may include:
  - Interactions with other species
  - Predation
  - Competition

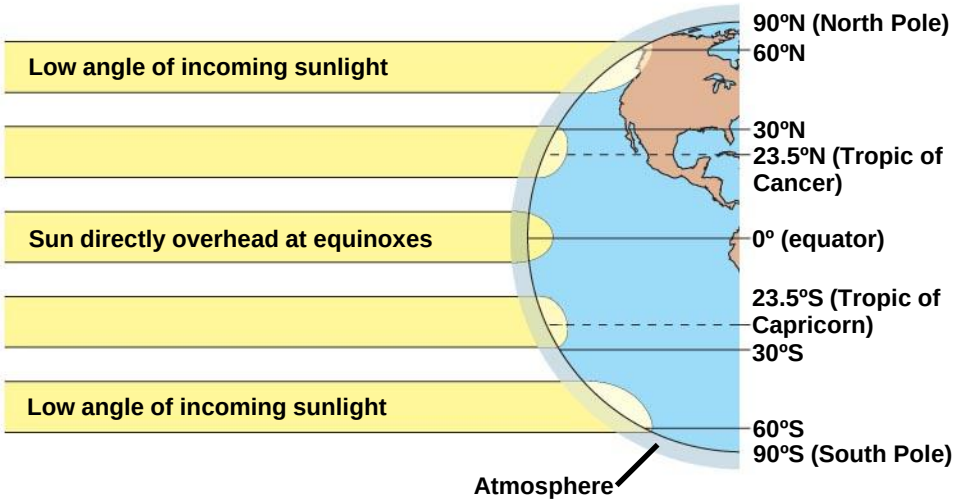
Abiotic Factors

- Abiotic factors affecting distribution of organisms include:
  - Temperature
  - Water
  - Sunlight
  - Wind
  - Rocks and soil
- Most abiotic factors vary in space and time

Fig. 52-9

Fig. 52-10a

Latitudinal Variation in Sunlight Intensity



Seasonal Variation in Sunlight Intensity

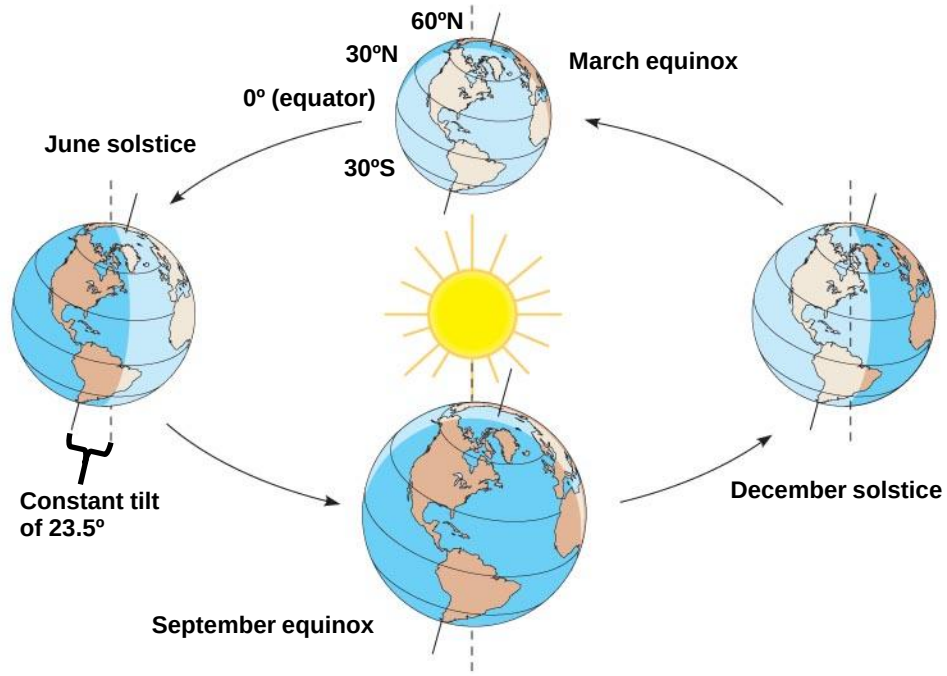
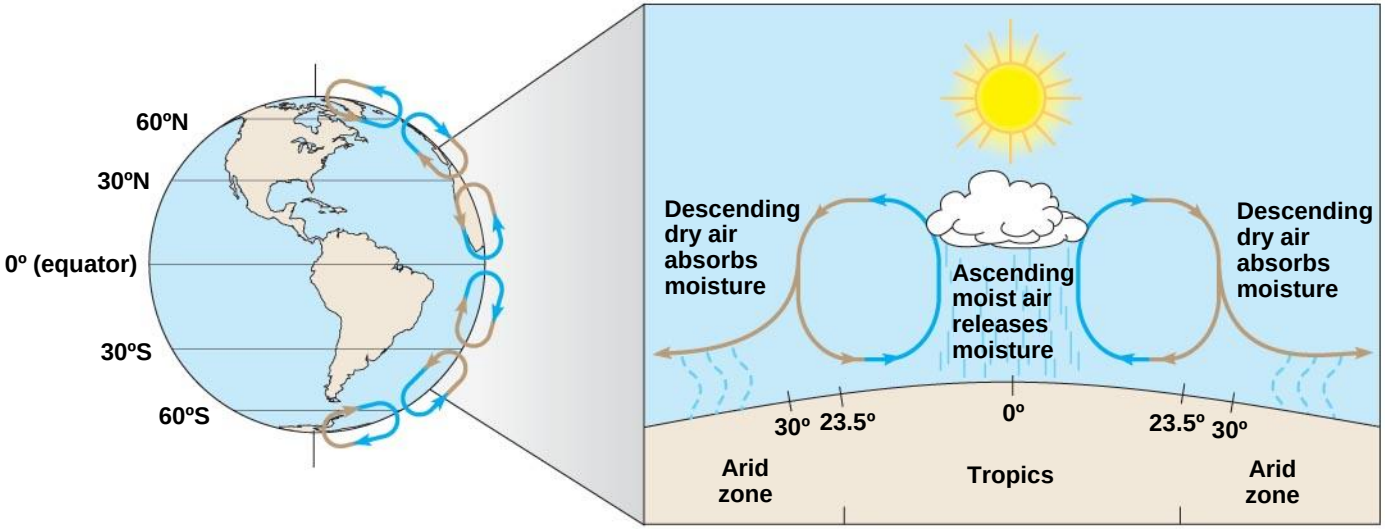


Fig. 52-10d

Global Air Circulation and Precipitation Patterns



Global Wind Patterns

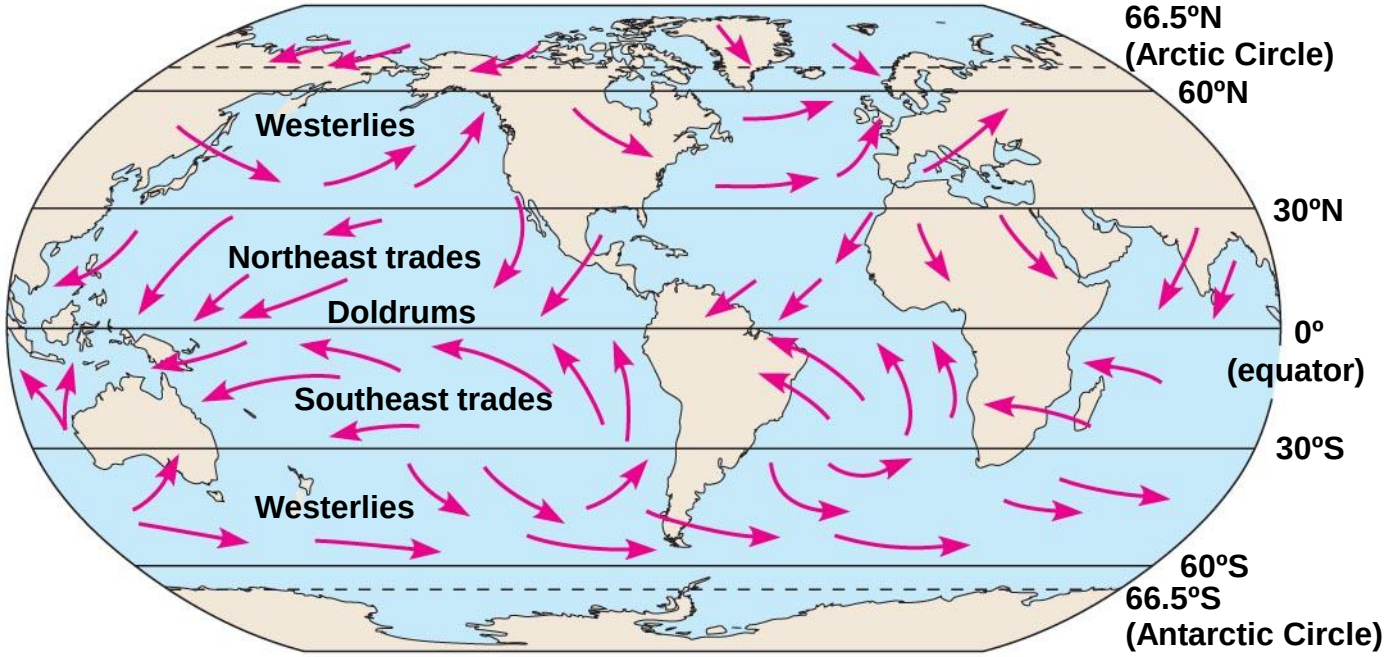


Fig. 52-11

The great ocean conveyor belt

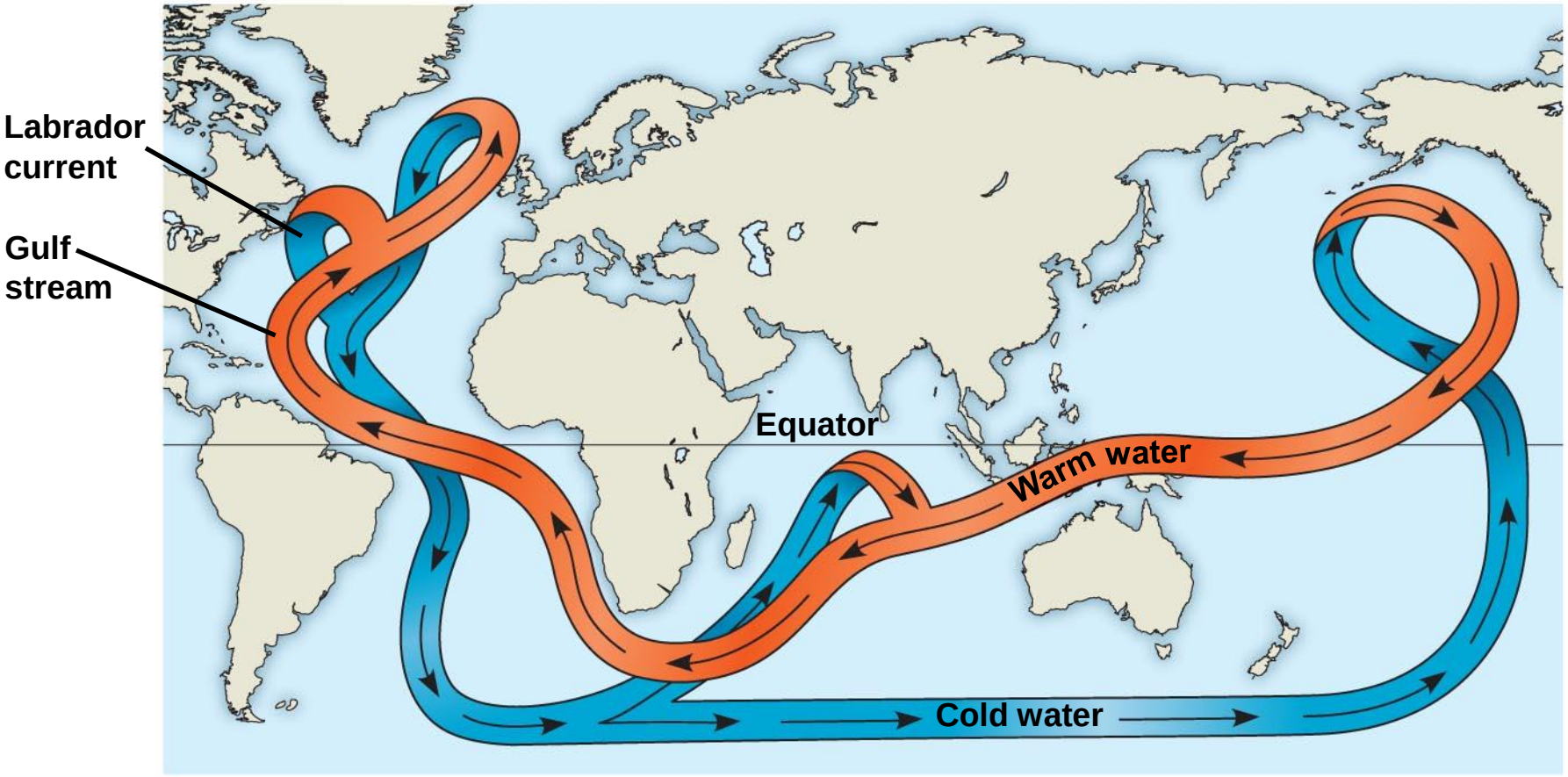


Fig. 52-12

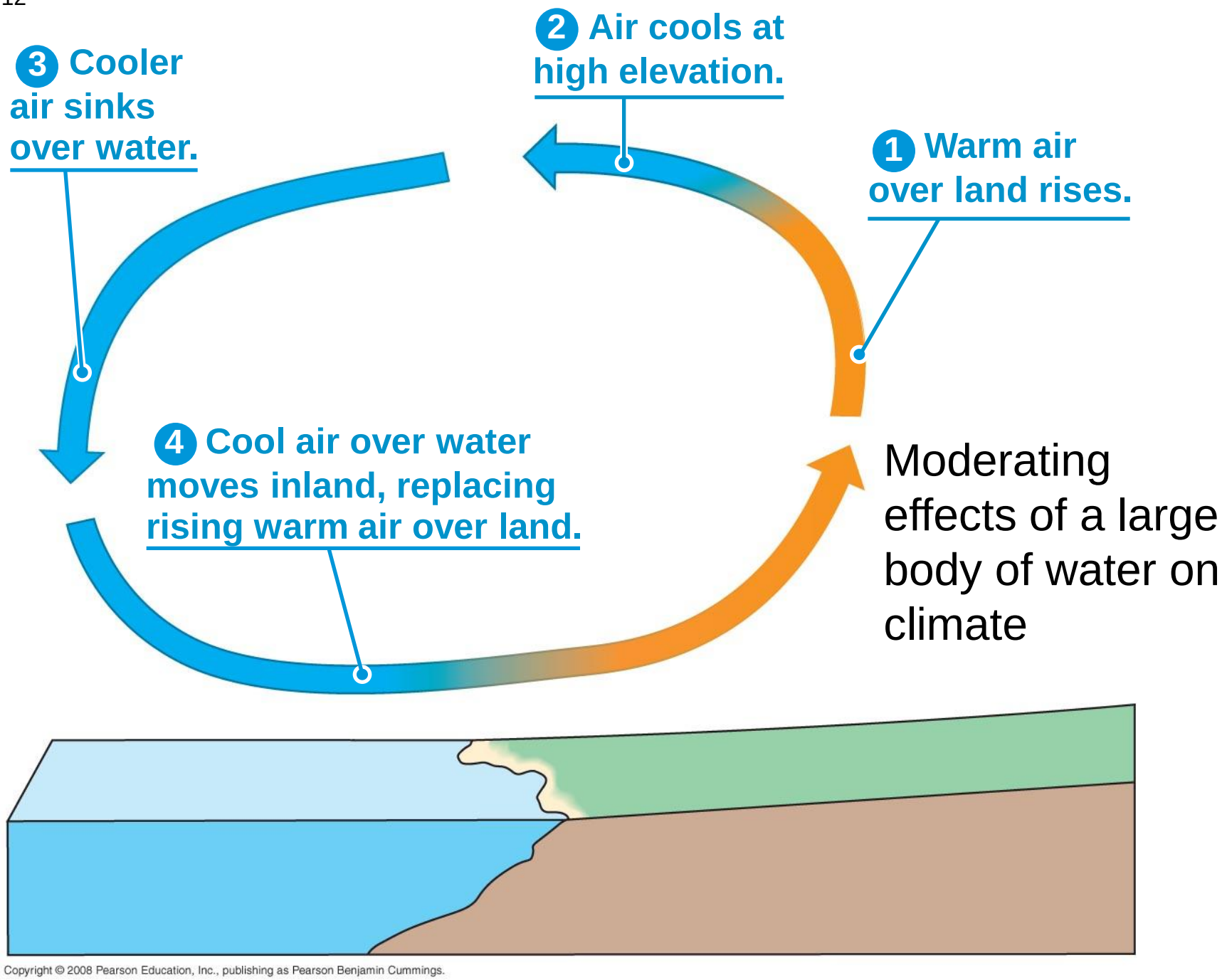
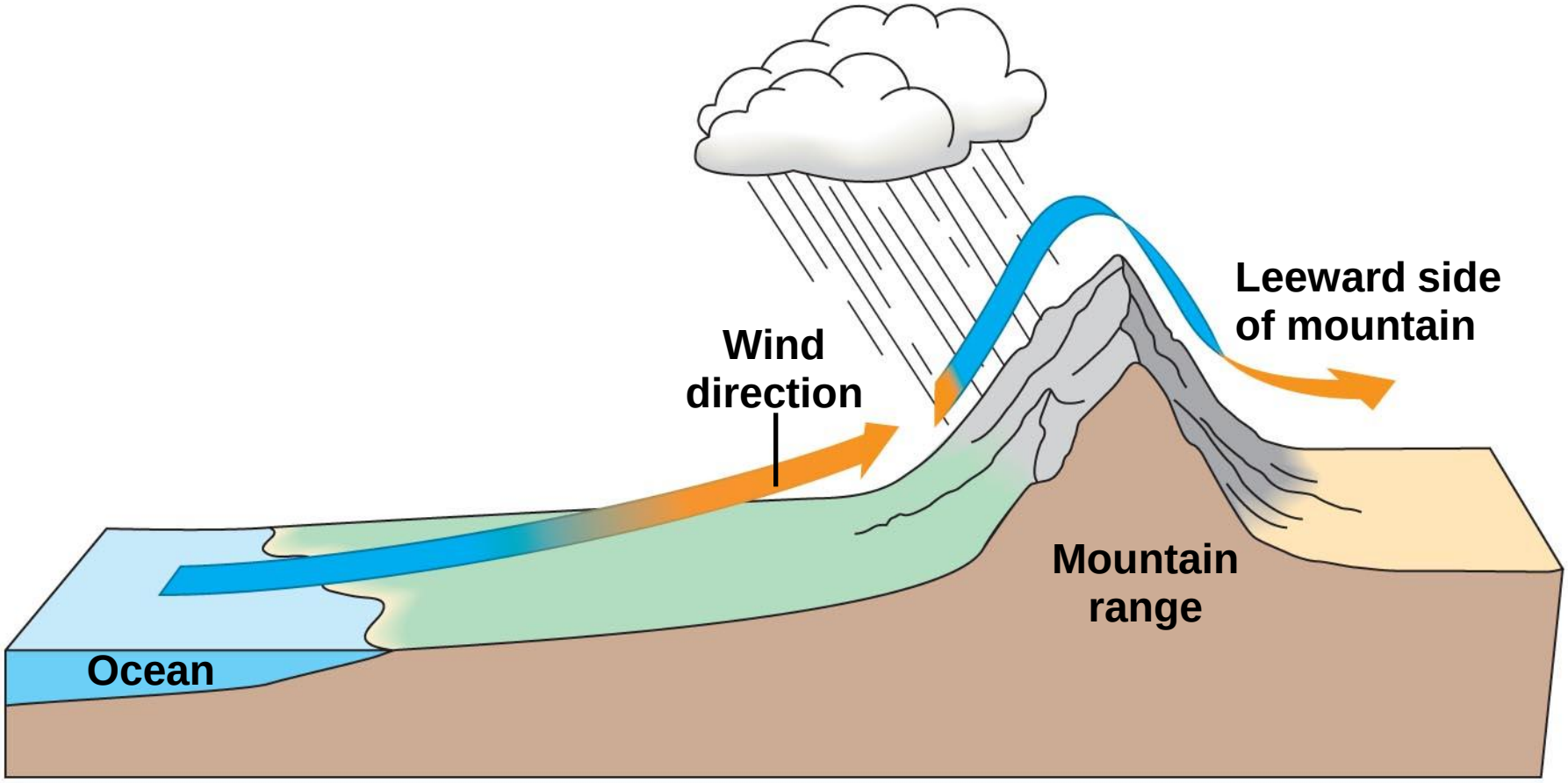
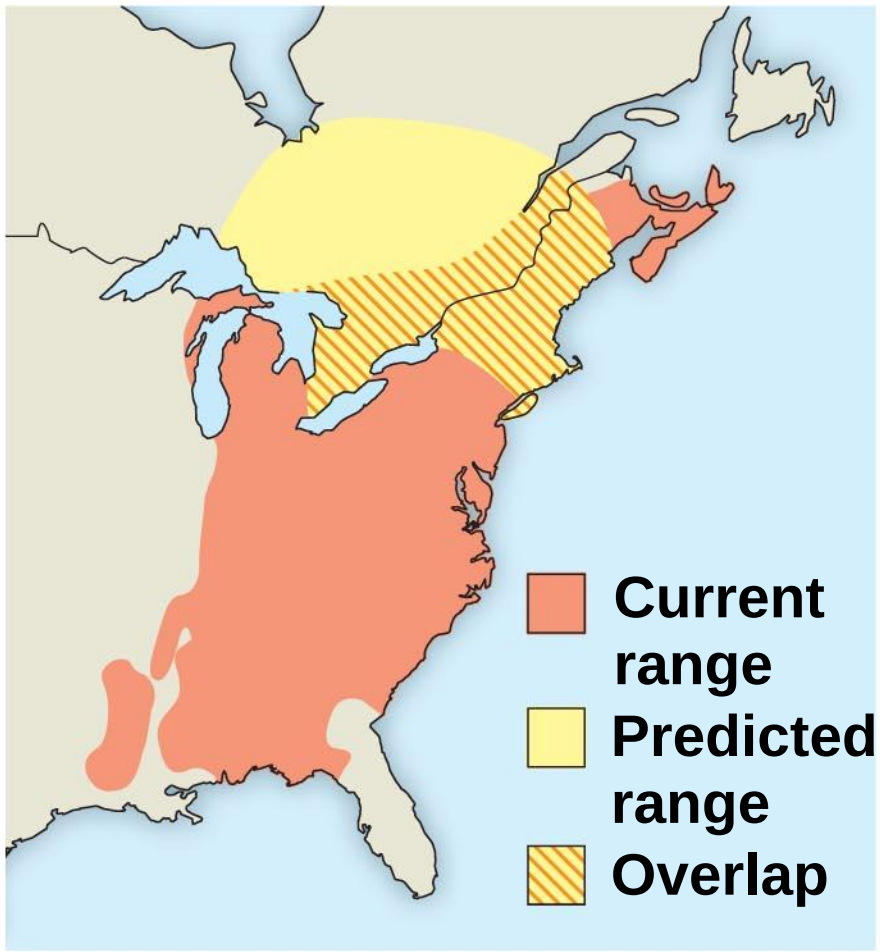


Fig. 52-13

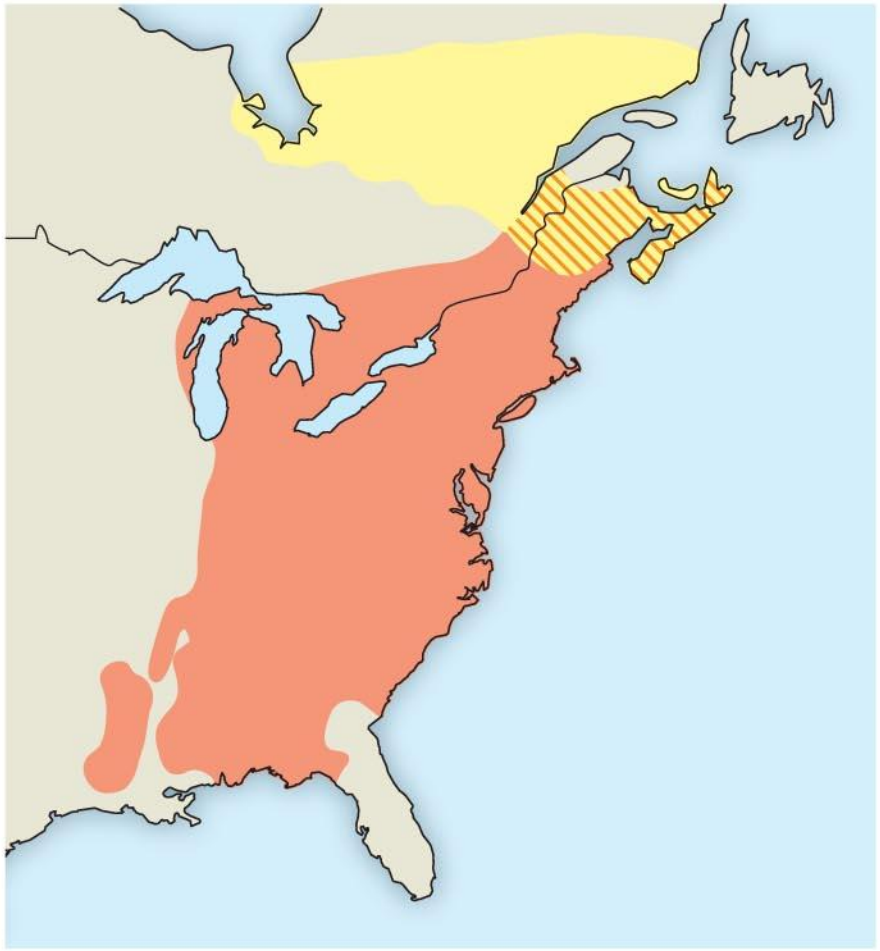
How mountains affect rainfall



Current range and predicted range for the American beech (*Fagus grandifolia*) under two scenarios of climate change



(a) 4.5ºC warming over next century



(b) 6.5ºC warming over next century

Concept 52.3: Aquatic biomes are diverse and dynamic systems that cover most of Earth

- **Biomes** are the major ecological associations that occupy broad geographic regions of land or water
- Varying combinations of biotic and abiotic factors determine the nature of biomes

Fig. 52-15

The distribution of major aquatic biomes

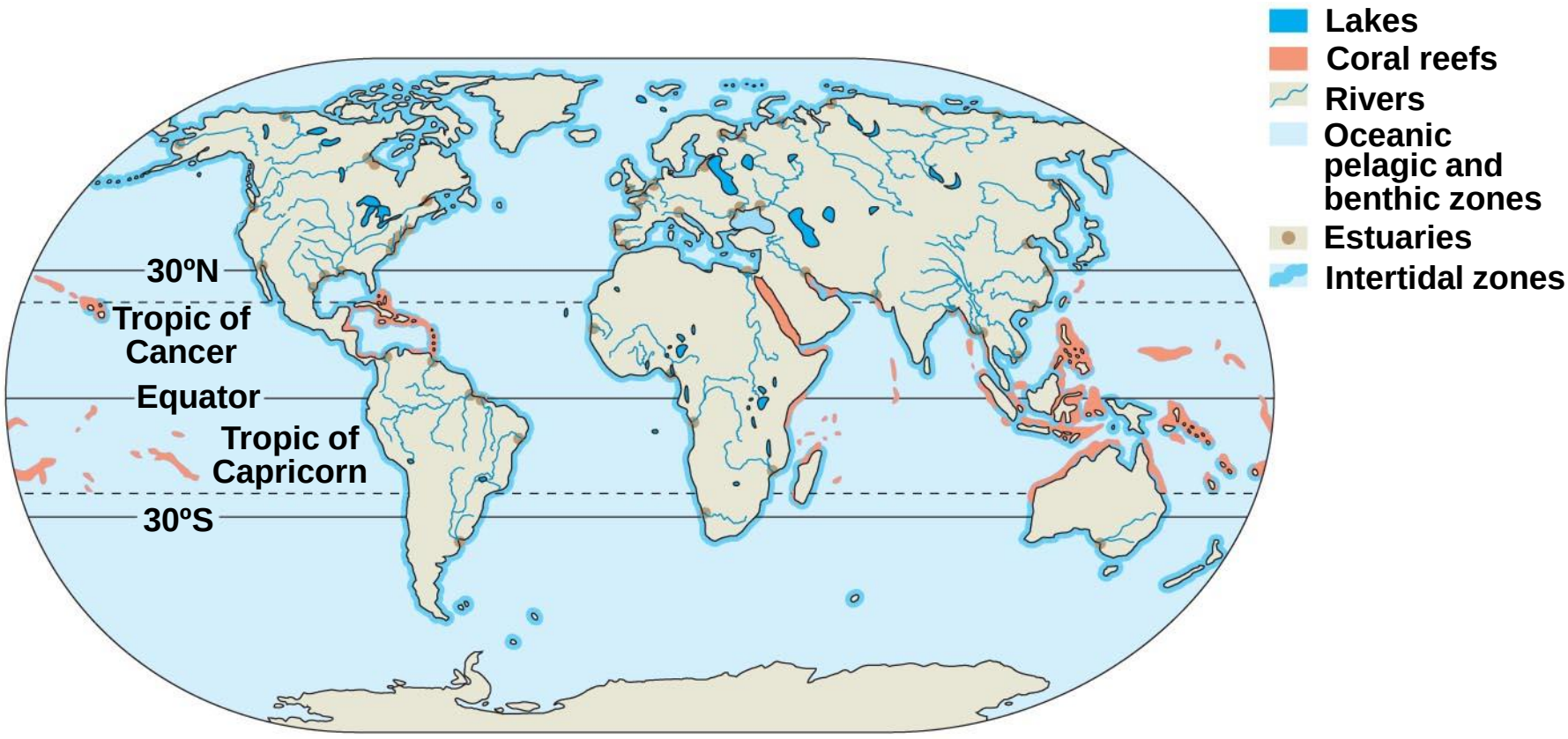
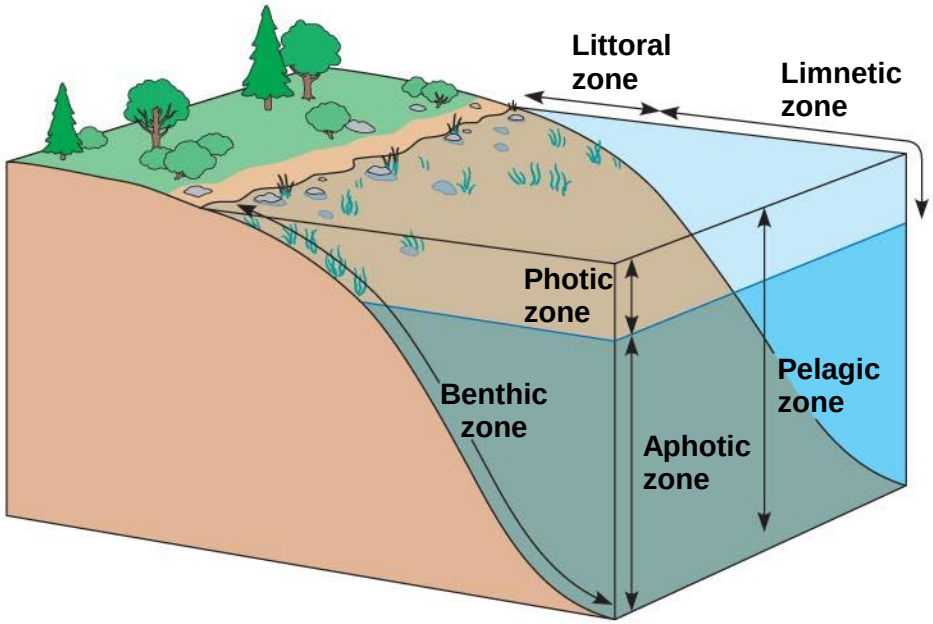
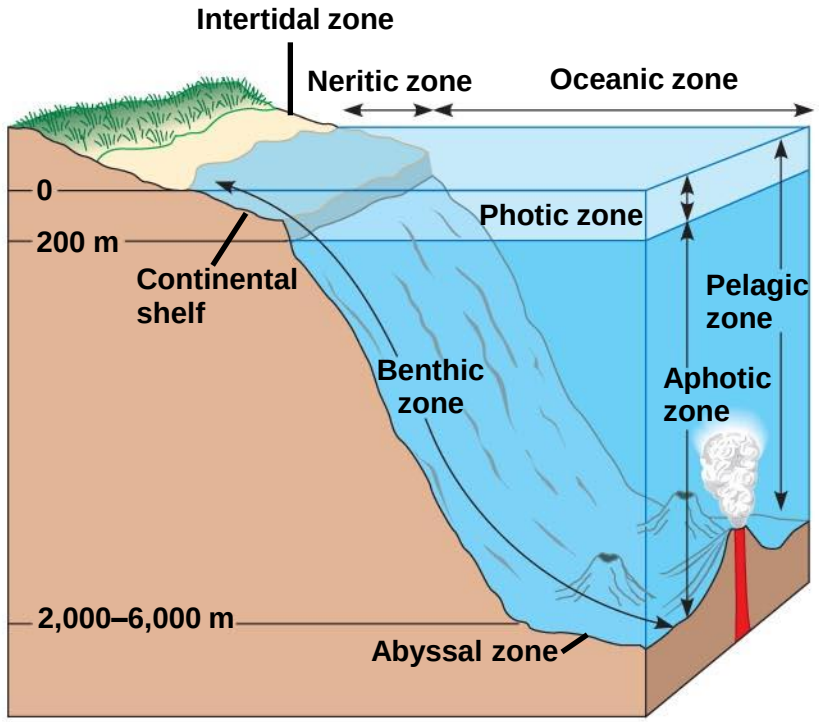


Fig. 52-16

Zonation in aquatic environments



(a) Zonation in a lake



(b) Marine zonation

Fig. 52-17-5

Seasonal turnover in lakes with winter ice cover

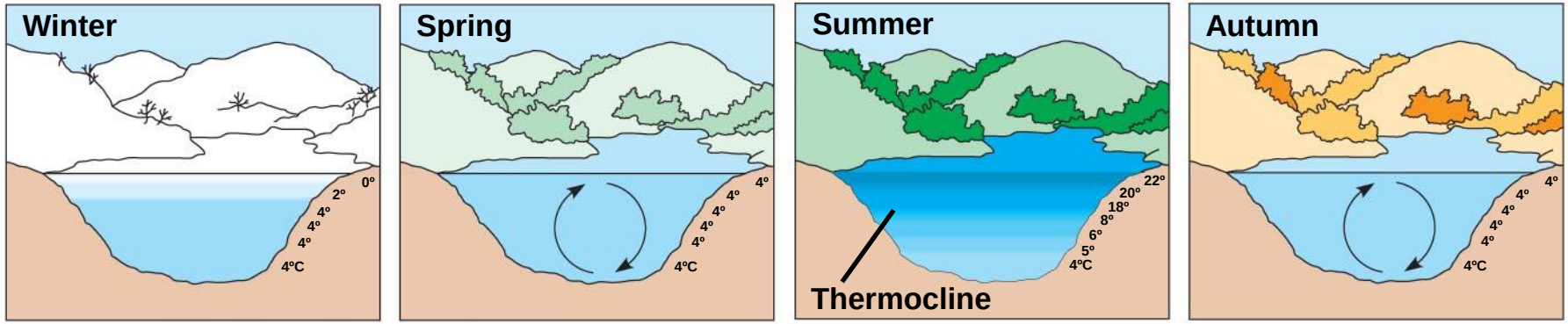
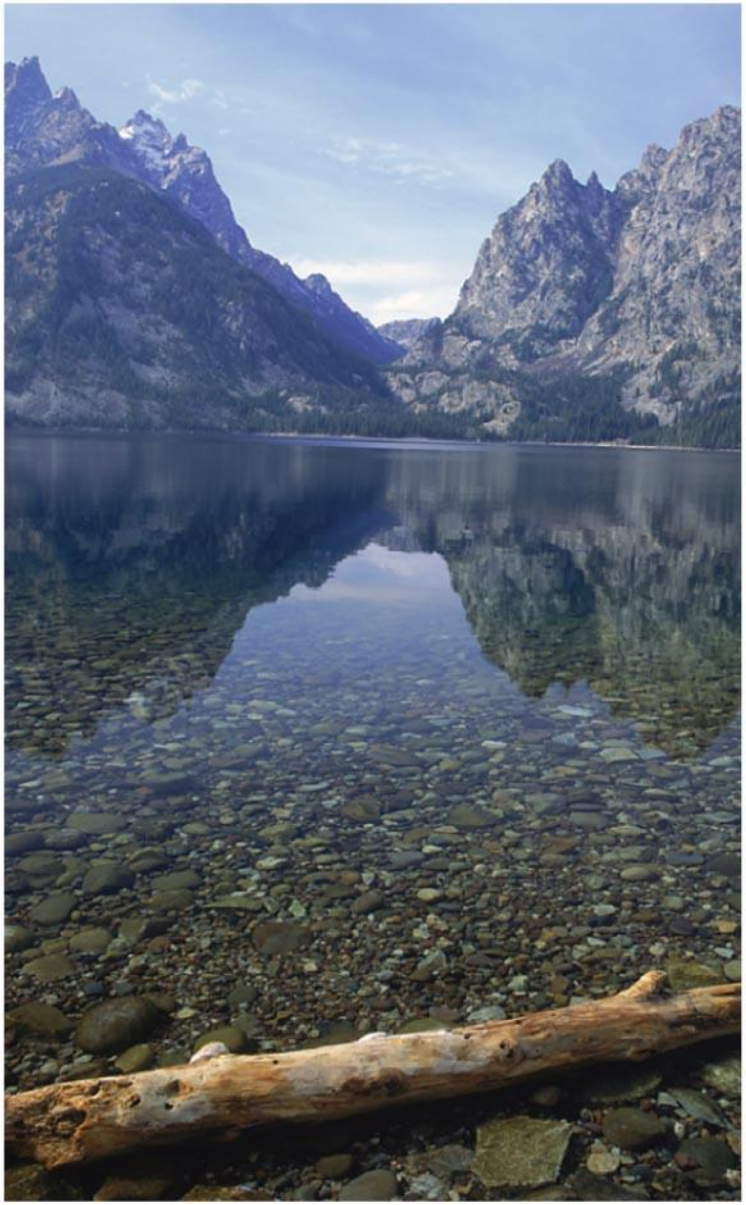


Fig. 52-18a



An oligotrophic lake in Grand Teton National Park, Wyoming

Fig. 52-18b

A eutrophic lake in the Okavango Delta, Botswana

Fig. 52-18c

Okefenokee National Wetland Reserve in Georgia

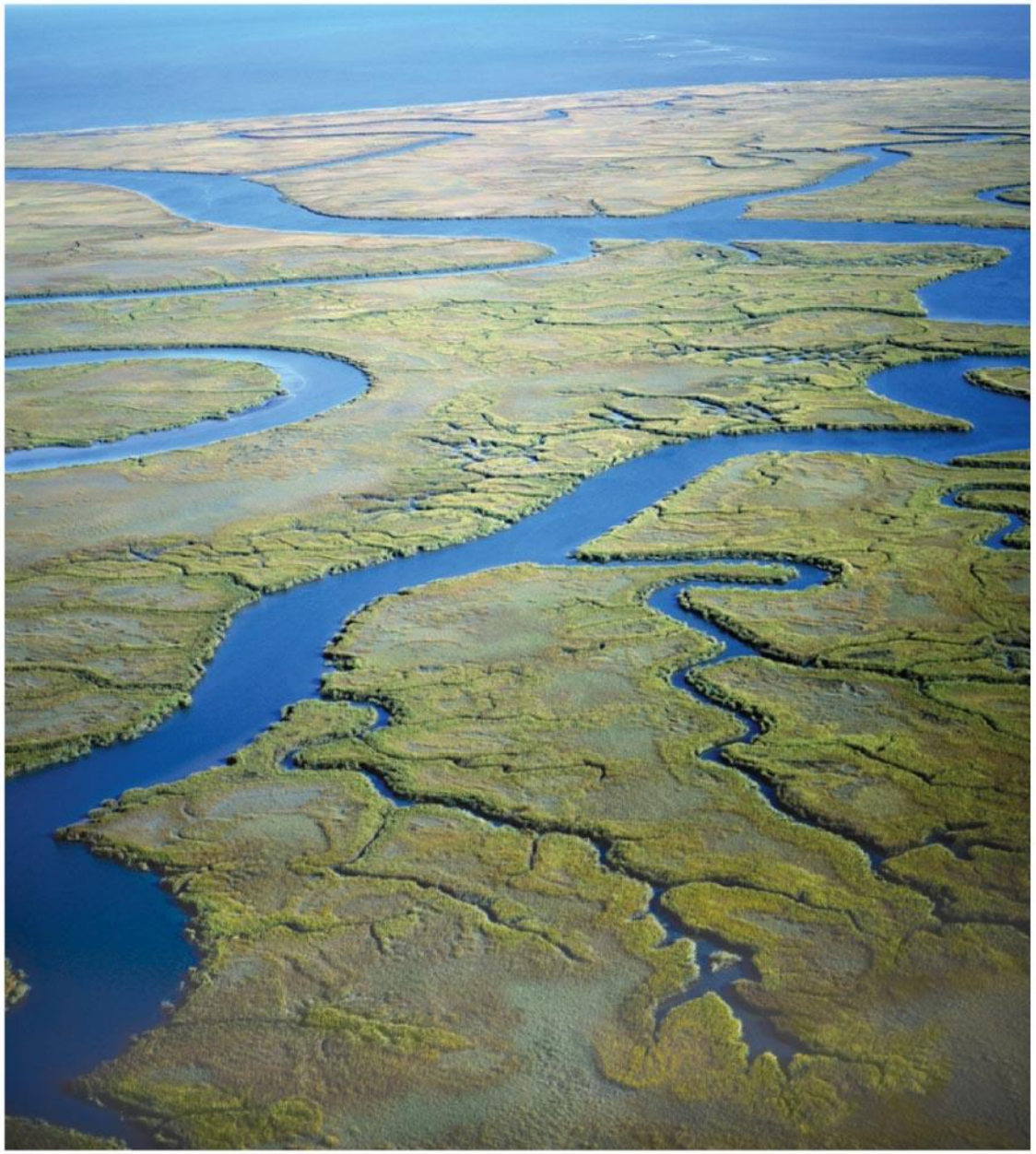
Fig. 52-18d

A headwater stream in the Great Smoky Mountains

Fig. 52-18e

The Mississippi River far from its headwaters

Fig. 52-18f



An estuary in a low coastal plain of Georgia

Fig. 52-18g

Rocky intertidal zone on the Oregon coast

Fig. 52-18h

Open ocean off the island of Hawaii

Fig. 52-18i

A coral reef in the Red Sea

Fig. 52-18j

A deep-sea hydrothermal vent community

Fig. 52-19

The distribution of major terrestrial biomes

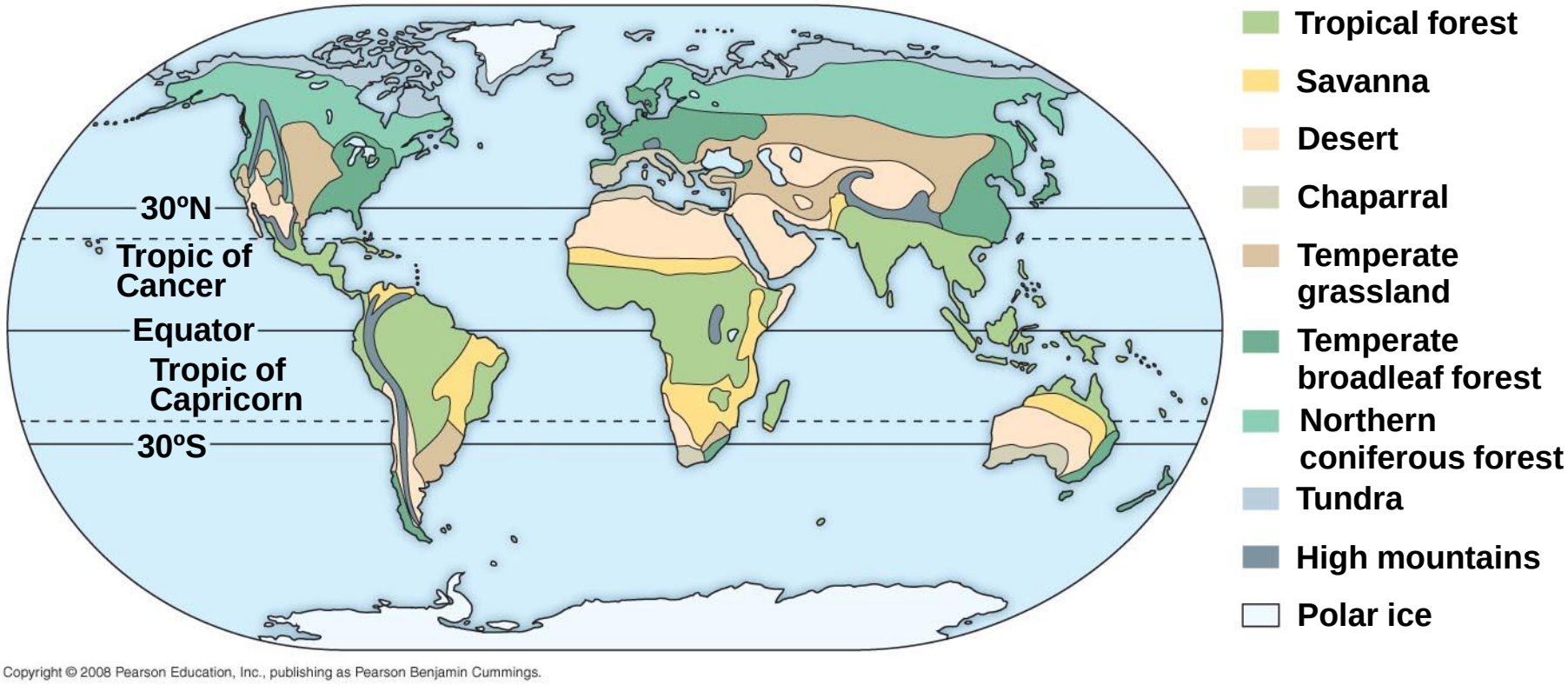
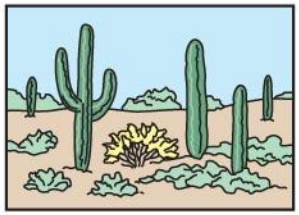


Fig. 52-20

Climograph



Desert

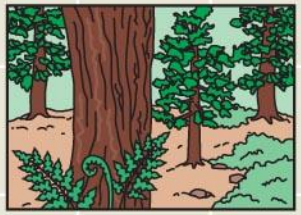
Temperate grassland

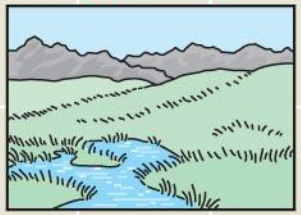
Tropical forest

Temperate broadleaf forest

Northern coniferous forest

Arctic and alpine tundra





Annual mean temperature (°C)

30

15

0

–15

0

100

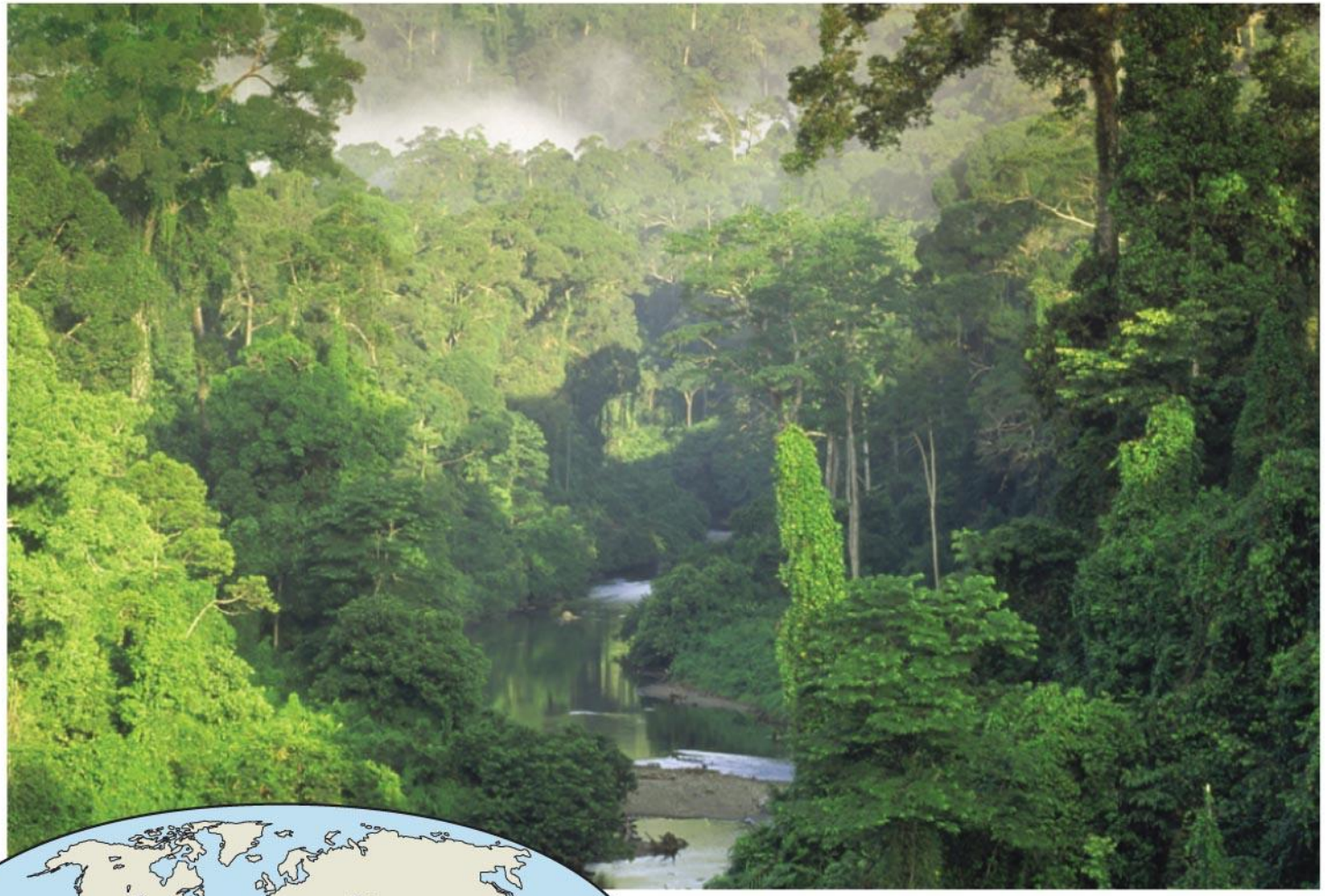
200

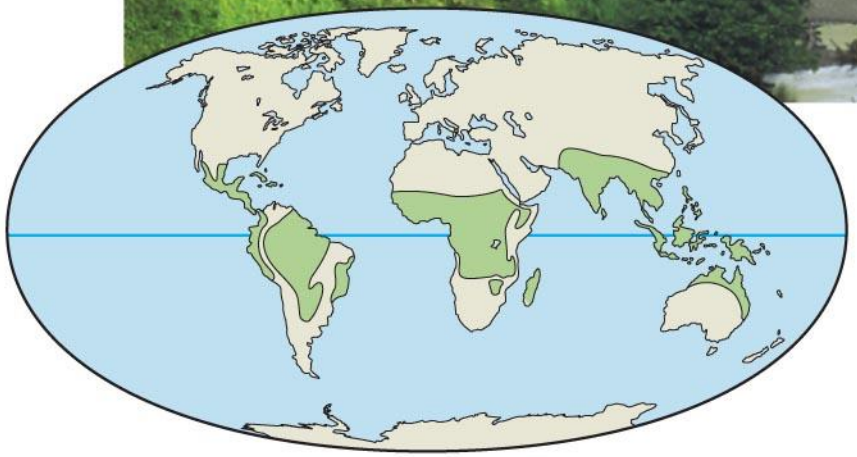
300

400

Annual mean precipitation (cm)

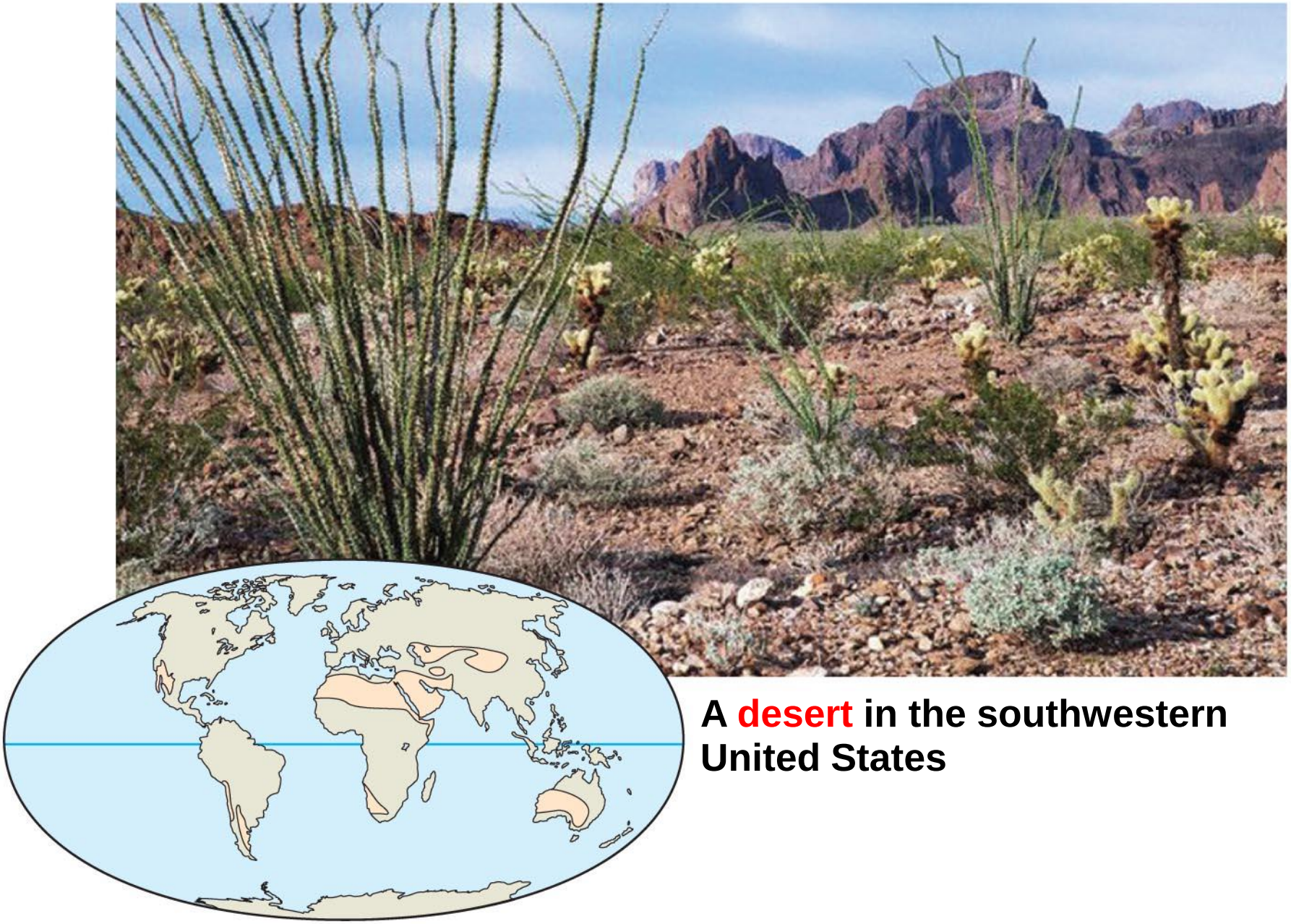
Fig. 52-21a





A tropical rain forest in Borneo

Fig. 52-21b



A desert in the southwestern United States

Fig. 52-21c

A savanna in Kenya

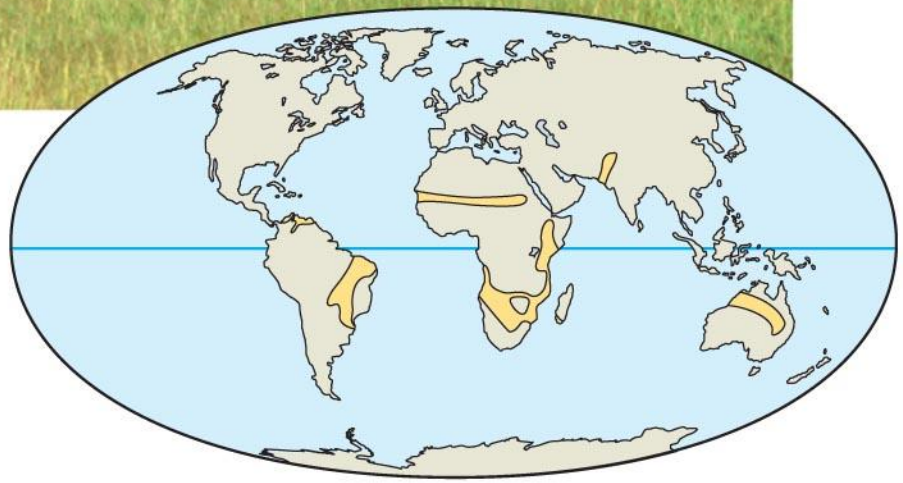
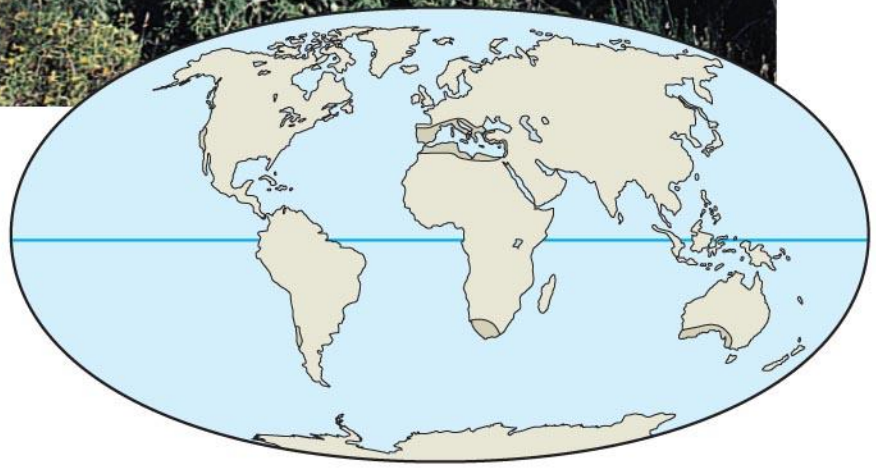
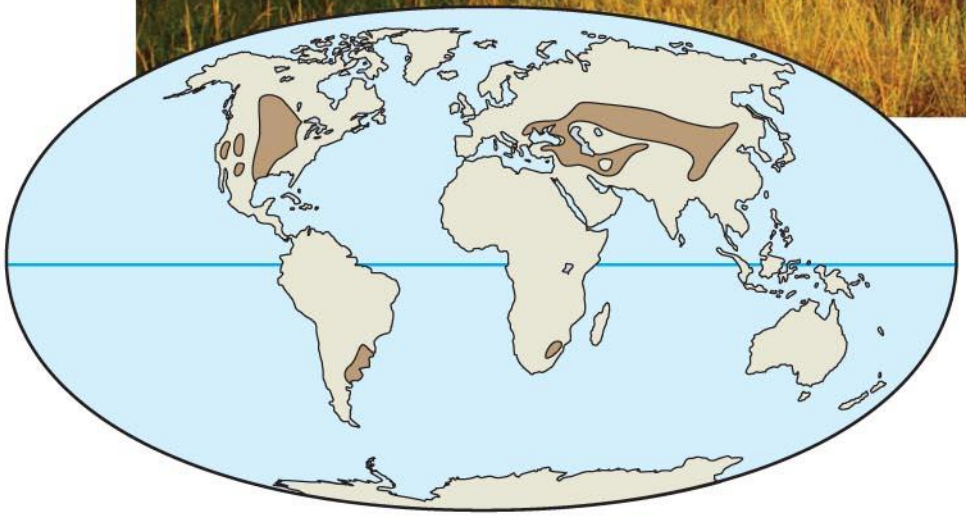


Fig. 52-21d



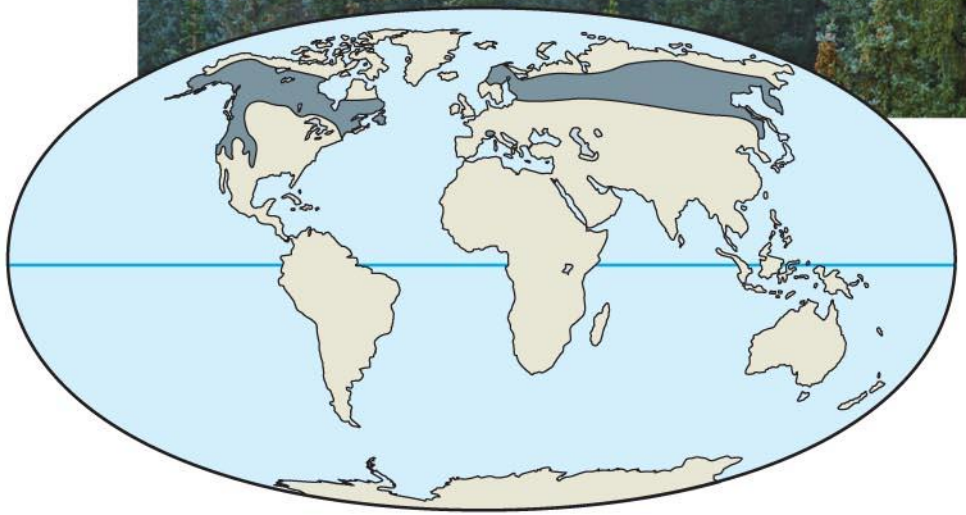
An area of chaparral in California

Fig. 52-21e



Sheyenne National Grassland in North Dakota

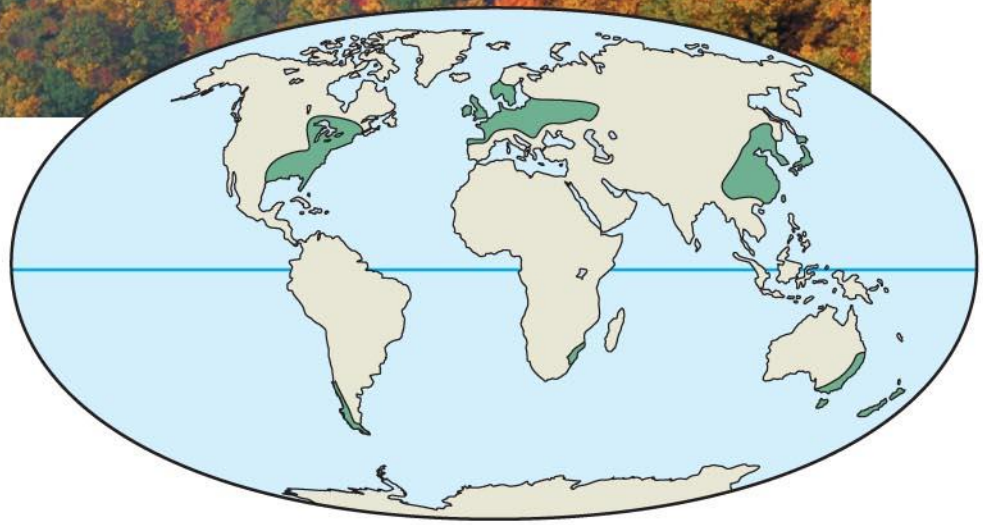
Fig. 52-21f



Rocky Mountain National Park in Colorado

northern coniferous forest

Fig. 52-21g



Great Smoky Mountains National Park in North Carolina

temperate broadleaf forest

Fig. 52-21h

Denali National Park, Alaska, in autumn

tundra

You should now be able to:

1. Distinguish among the following types of ecology: organismal, population, community, ecosystem, and landscape
2. Explain how dispersal may contribute to a species' distribution
3. Distinguish between the following pairs of terms: potential and actual range, biotic and abiotic factors, macroclimate and microclimate patterns

4. Explain how a body of water or mountain range might affect regional climatic conditions

5. Define the following terms: photic zone, aphotic zone, benthic zone, abyssal zone, thermal stratification, thermocline, seasonal turnover, climograph, disturbance

6. List and describe the characteristics of the major aquatic biomes

7. List and describe the characteristics of the major terrestrial biomes

8. Compare the vertical layering of a forest and grassland