Introduction: *Life from Top to Bottom*

- **Ecology** is the study of the interactions of organisms with their environments.

- The **biosphere** is composed of living communities and nonliving physical and chemical factors.

- **Aquatic biomes** are defined as fresh water and marine.

- **Terrestrial biomes** are categorized by climate and plant life.
THE BIOSPHERE
34.1 Ecologists study how organisms interact with their environment at several levels

- Ecologists study environmental interactions at the levels of the
  - Organism
  - Population
  - Community
  - Ecosystem
34.1 Ecologists study how organisms interact with their environment at several levels

- The global ecosystem is called the biosphere
  - It is the sum of all the Earth’s ecosystems
  - The biosphere is the most complex level in ecology
34.1 Ecologists study how organisms interact with their environment at several levels

- Ecosystem interactions involve living (biotic) communities and nonliving (abiotic) components
  - Biotic components include all organisms
  - Abiotic components include atmospheric gases, energy, nutrients, and water
    - Organisms are affected by both components of their environment
    - Their presence and activities often change the environment they inhabit
34.2 CONNECTION: The science of ecology provides insight into environmental problems

- Human activities affect all parts of the biosphere
  - Cities, farms, and highways change the landscape
  - The widespread use of chemicals such as fertilizers and pesticides poses problems to people and other organisms
Rachel Carson was one of the first to perceive the global dangers of pesticide abuse

- Carson documented her concerns in the 1962 book *Silent Spring*
- This book played a key role in the awakening of environmental awareness
34.3 Physical and chemical factors influence life in the biosphere

The most important abiotic factors that determine the biosphere’s structure and dynamics include:

- Solar energy
- Temperature
- Water
- Nutrients
- Other aquatic factors
- Other terrestrial factors
The pronghorn is a highly successful herbivorous running mammal of open country

- A pronghorn’s habitat is arid, windswept, and subject to extreme temperature fluctuations
- Pronghorns able to survive and reproduce under these conditions left offspring that carried their alleles into subsequent generations
Climate often determines the distribution of communities.

The Earth’s global climate patterns are largely determined by the input of solar energy and the planet’s movement in space.
34.5 Regional climate influences the distribution of terrestrial communities

- Solar radiation varies with latitude
  - Most climatic variations are due to the uneven heating of Earth’s surface
Low angle of incoming sunlight

Sunlight strikes most directly

Low angle of incoming sunlight

Atmosphere

North Pole
60° N

30° N
Tropic of Cancer

0° (equator)

Tropic of Capricorn
30° S

60° S
South Pole
The Earth’s tilt causes the seasons

- The seasons of the year result from the permanent tilt of the plant on its axis as it orbits the sun
June solstice (Northern Hemisphere tilts toward sun)

March equinox (equator faces sun directly)

Constant tilt of 23.5°

September equinox

December solstice (Northern Hemisphere tilts away from sun)
34.5 Regional climate influences the distribution of terrestrial communities

- Uneven heating causes rain and winds
  - The direct intense solar radiation near the equator has an impact on the global patterns of rainfall and winds
  - The tropics experience the greatest annual input and least seasonal variation in solar radiation
Descending dry air absorbs moisture

Trade winds

Ascending moist air releases moisture

Trade winds

Descending dry air absorbs moisture

Temperate zone

Tropics

Temperate zone

Doldrums

0°
As the air rises, it cools and releases much of its water content

- This results in the abundant precipitation typical of most tropical regions

After losing their moisture over equatorial zones, high altitude air masses spread away from the equator
34.5 Regional climate influences the distribution of terrestrial communities

- Air cools and descends again at latitudes of about 30° north and south

- As the dry air descends, some of it spreads back toward the equator
  - This creates the cooling trade winds that dominate the tropics
34.5 Regional climate influences the distribution of terrestrial communities

- Prevailing wind patterns
  - In the tropics, Earth's rapidly moving surface deflects vertically circulating air, making the winds blow from east to west
  - In temperate zones, the slower-moving surface produces the westerlies, winds that blow from west to east
Atlantic Ocean currents

- **Ocean currents** have a profound effect on regional climates by warming or cooling coastal areas.

- They are created by winds, planet rotation, unequal heating of surface waters, and the locations and shapes of continents.
34.5 Regional climate influences the distribution of terrestrial communities

- Mountains affect rainfall
  - Rainfall is affected by location of mountains, prevailing winds, and ocean current patterns
AQUATIC BIOMES
34.6 Sunlight and substrate are key factors in the distribution of marine organisms

- Oceans cover about 75% of the Earth’s surface
- Light and the availability of nutrients are the major factors that shape aquatic communities
High water

Low water

Intertidal zone

Continental shelf

Pelagic realm

Photic zone

Aphotic zone

200 m

“Twilight”

1,000 to 4,000 m

No light

6,000 to 10,000 m

Oarweed (to 2 m)

Brain coral (to 1.8 m)

Phytoplankton

Zooplankton

Man-of-war (to 50 m)

Turtle (60 to 180 cm)

Blue shark (to 2 m)

Sea pen (to 45 cm)

Sponges (1 cm to 1 m)

Sea spider (1 to 90 cm)

Brittle star (to 60 cm)

Sea cucumber (to 40 cm)

Tripod fish (to 30 cm)

Rat-tail fish (to 80 cm)

Gulper eel (to 180 cm)

Glass sponge (to 1.8 m)

Octopus (to 10 m)

Hatchet fish (2 to 60 cm)

Sperm whale (10 to 20 m)

Hatchet fish (45 cm to 2 m)

Anglerfish

Man-of-war

Sea spider

Sea cucumber

Sea pen

Sponges

Phytoplankton

Zooplankton

Oarweed

Brain coral

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Estuaries are productive areas where rivers meet the ocean

- The saltiness of estuaries ranges from less than 1% to 3%
- They provide nursery areas for oysters, crabs, and many fishes
- They are often bordered by extensive coastal wetlands
34.6 Sunlight and substrate are key factors in the distribution of marine organisms

- The **intertidal zone** is the wetland at the edge of an estuary or ocean, where water meets land
  - Salt marshes, sand, rocky beaches, and tide pools are part of the intertidal zone
  - It is often flooded by high tides and then left dry during low tides
34.6 Sunlight and substrate are key factors in the distribution of marine organisms

- The **pelagic zone** is the open ocean
  - It supports highly motile animals such as fishes, squids, and marine mammals
  - **Phytoplankton** and **zooplankton** drift in the pelagic zone

- The **benthic zone** is the ocean bottom
  - It supports a variety of organisms based upon water depth and light penetration
The **photic zone** is the portion of the ocean into which light penetrates

- Photosynthesis occurs here

The **aphotic zone** is a vast, dark region of the ocean

- It is the most extensive part of the biosphere
- Although there is no light, a diverse and dense population inhabits this zone
Coral reefs are found in warm tropical waters above the **continental shelf**

- They support a huge diversity of invertebrates and fishes

Coral reefs are easily degraded by

- Pollution
- Native and introduced predators
- Human souvenir hunters
34.7 Current, sunlight, and nutrients are important abiotic factors in freshwater ecosystems

- Freshwater biomes include lakes, ponds, rivers, streams, and wetlands

Video: Flapping Geese

Video: Swans Taking Flight
TERRESTRIAL BIOMES
34.8 Terrestrial biomes reflect regional variations in climate

- Terrestrial ecosystems are grouped into eight major types of biomes
- Biomes are distinguished primarily by their predominant vegetation
- If the climate in two geographically separate areas is similar, the same type of biome may occur in both places
Tropic of Cancer

Equator

Tropic of Capricorn

30° N

Arctic circle

60° N

30° S

Tropical forest

Savanna

Desert

Chaparral

Temperate grassland

Temperate broadleaf forest

Coniferous forest

Tundra

High mountains

Polar ice
Several types of tropical forests occur in the warm, moist belt along the equator.

- The tropical rain forest is the most diverse ecosystem on Earth.
- Large-scale human destruction of tropical rain forests continues to endanger many species.
  - It may also alter world climate.
Drier, tropical areas and some nontropical areas are characterized by the savanna.
34.11 Deserts are defined by their dryness

- **Deserts** are the driest of all terrestrial biomes
  - They are characterized by low and unpredictable rainfall
  - **Desertification** is a significant environmental problem
34.12 Spiny shrubs dominate the chaparral

- The **chaparral** biome is a shrubland with cool, rainy winters and dry, hot summers
  - Chaparral vegetation is adapted to periodic fires
34.13 Temperate grasslands include the North American prairie

- **Temperate grasslands** are found in the interiors of the continents, where winters are cold
  
  - Drought, fires, and grazing animals prevent trees from growing
  
  - Farms have replaced most of North America’s temperate grasslands
34.14 Broadleaf trees dominate temperate forests

- **Temperate broadleaf forests** grow where there is sufficient moisture to support the growth of large trees
  - Nearly all of the original broadleaf forests in North America have been drastically altered by agriculture and urban development
34.15 Coniferous forests are often dominated by a few species of trees

- The **northern coniferous forest**, or taiga, is the largest terrestrial biome on Earth
  - The taiga is characterized by long, cold winters and short, wet summers
34.16 Long, bitter-cold winters characterize the tundra

- The **arctic tundra** lies between the taiga and the permanently frozen polar regions
  - It is a treeless biome characterized by extreme cold, wind, and permafrost
  - **Permafrost** is continuously frozen subsoil
34.17 The global water cycle connects aquatic and terrestrial biomes

- Just as the water draining from your shower carries dead skin cells from your body along with the day’s grime, the water washing over and through the ground carries traces of the land and its history
Solar heat

Water vapor over the sea

Net movement of water vapor by wind

Water vapor over the land

Evaporation from the sea

Evaporation and transpiration

Precipitation over the sea

Evaporation from the sea

Evaporation and transpiration

Surface water and groundwater

Flow of water from land to sea

Precipitation over the land

Oceans

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March equinox

June solstice

Constant tilt of 23.5°

September equinox

December solstice

March equinox
Mean annual precipitation (cm)

Mean annual temperature (°C)

Mean annual precipitation (cm)

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You should now be able to

1. Describe the chemical and physical factors that affect the biosphere
2. Discuss the role of abiotic and biotic factors in the survival of an organism
3. Describe the characteristics of aquatic biomes
4. Explain the factors contributing to the characteristics of terrestrial biomes
5. Describe the eight major terrestrial biomes
6. Explain how the water cycle connects aquatic and terrestrial biomes