48

THE BIOSPHERE

Introduction

This chapter takes a big-picture look at the biosphere, or Earth. Starting with an explanation of how climate is influenced by air and ocean currents, and land formations such as mountains, the chapter progresses to a discussion of the primary surface biomes. The study of water-based biomes follows, from freshwater streams and lakes to the deep ocean. Throughout the chapter you should focus on the key characteristics of each of the biomes.

Focal Points

- Sections 48.1 and 48.3 explain how climate is influenced by three major factors: air currents [pp.868–869,873], ocean currents [p.872], and mountain ranges [p.873].
- Figure 48.24 [p.885] outlines the interrelatedness of many of the challenges facing the biosphere.

Interactive Exercises

Surfers, Seals, and the Sea [pp.866–867]

48.1. GLOBAL AIR CIRCULATION PATTERNS [pp.868–869]

48.2. CIRCULATING AIRBORNE POLLUTANTS [pp.870–871]

48.3. THE OCEANS, LANDFORMS, AND CLIMATES [pp.872–873]

Selected Words: *hydrosphere* [p.867], *lithosphere* [p.867], *atmosphere* [p.867], *net* [p.869], *solar–hydrogen energy* [p.869], "wind farms" [p.869], "ozone hole" [p.870], *thermal inversion* [p.870], *industrial* smog [p.870], *photochemical* smog [p.871], ocean currents [p.872], *topography* [p.873], *leeward* [p.873], *windward* [p.873]

Boldfaced, Page-Referenced Terms

[p.867] biogeography _____

_____

[p.867] biosphere _____

_____

[p.868] climate _____

_____

[p.869] temperature zones _____

_____

[p.870] pollutants _____

_____

[p.870] ozone thinning _____

_____

[p.870] smog _____

_____

[p.871] acid rain _____

_____

[p.872] ocean _____

_____

[p.873] rain shadow _____

_____

[p.873] monsoons _____

_____

Matching

Choose the most appropriate statement for each term.

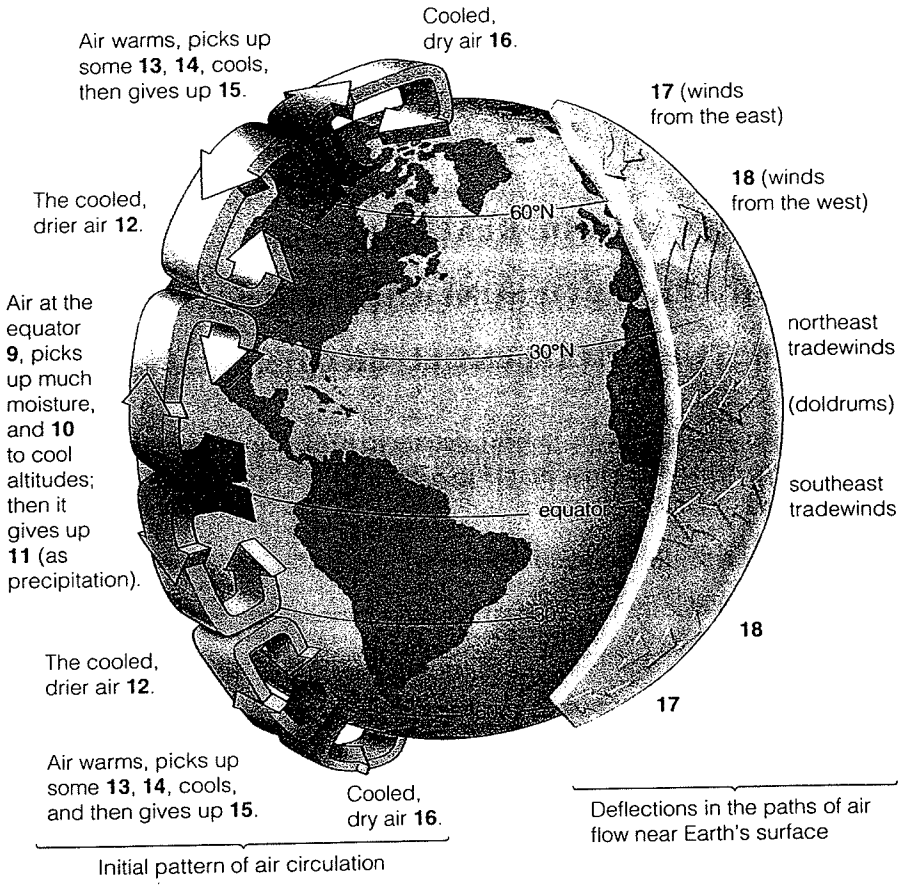
1. ____ biogeography [p.867]
2. ____ biosphere [p.867]
3. ____ hydrosphere [p.867]
4. ____ lithosphere [p.867]
5. ____ atmosphere [p.867]
6. ____ climate [p.868]
7. ____ solar–hydrogen energy [p.869]
8. ____ temperature zones [p.869]

A. Sediments, soils, and Earth's outer rocky layer
B. The use of photovoltaic cells to generate hydrogen gas for use as fuel
C. Temperature gradients from Earth's poles to the equator
D. The study of factors that give rise to patterns in the distribution of organisms
E. Average weather conditions over time
F. The gases and airborne particles that envelop Earth
G. All bodies of water, liquid and frozen, on the planet
H. The sum of all places where we find life on Earth

Labeling

Several terms in the accompanying diagram have been replaced by numbers. Identify each of the missing terms. [p.868]

9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____



Matching

Match each of the following definitions to the correct term. [pp.870–871]

19. _____ Seasonal declines in ozone concentration above the Earth's poles.
20. _____ This is caused by the release of smoke, soot, and sulfur dioxides into the atmosphere.
21. _____ This is caused by sulfur dioxides and nitrogen oxides in the atmosphere.
22. _____ This is caused by the interaction of nitric oxide with sunlight in the atmosphere.
23. _____ Weather conditions that trap a layer of cool, dense air under a warm air layer.

A. industrial smog
B. photochemical smog
C. ozone thinning
D. acid rain
E. thermal inversion

Matching

Match each of the following terms with the appropriate statement. [pp.872–873]

24. ____ monsoons
25. ____ rain shadow
26. ____ leeward
27. ____ windward
28. ____ ocean currents

A. Air circulation patterns caused by the interaction of the equatorial sun with trade winds
B. The side facing away from the wind
C. The side facing toward the wind
D. An arid region located leeward of high mountains
E. Large volumes of water responding to trade winds and westerlies

48.4. BIOGEOGRAPHIC REALMS [pp.874–875]

48.5. AVAILABILITY OF SUNLIGHT, SOILS, AND MOISTURE [pp.876–877]

48.6. MOISTURE-CHALLENGED BIOMES [pp.878–879]

Selected Words: *soil profile* [p.876], *deserts* [p.878], *dry shrublands* [p.878], *dry woodlands* [p.878], *grasslands* [p.878], "the Dust Bowl" [p.878]

Boldfaced, Page-Referenced Terms

[p.874] biogeographic realms _____

_____

[p.874] biome _____

_____

[p.875] hot spots _____

_____

[p.876] soils _____

_____

Matching

Choose the most appropriate answer for each term.

1. ____ biogeographic realms [p.874]
2. ____ biome [p.874]
3. ____ soils [p.876]
4. ____ deserts [p.878]
5. ____ savannas [p.878]
6. ____ dry shrublands [p.878]
7. ____ soil profile [p.876]

A. Mixtures of mineral particles and variable amounts of decomposing organic material (humus)
B. Areas susceptible to wind-driven firestorms and receiving from 60 to less than 25 centimeters of rain per year
C. Portions of biomes and ecoregions that are richest in biodiversity and most vulnerable to species losses
D. The interior of continents between deserts and temperate forests; warm summers and cold winters
E. Areas of annual rainfall between 40 and 100 centimeters; dominant trees can be tall but do not form a dense, continuous canopy
F. Subdivision of a biogeographic realm
G. Areas where annual rainfall is less than 10 centimeters; evaporation rates are high

8. _____ dry woodlands [p.878]
9. _____ grasslands [p.878]
10. _____ hot spots [p.875]

H. Six vast land areas on Earth, each with distinguishing plants and animals
I. Broad belts of grasslands with a smattering of shrubs or trees; rainfall averages 90 to 150 centimeters a year with prolonged seasonal droughts common
J. The layered structure of soils

Matching

Choose the most appropriate description for each soil type. [pp.876–877]

11. _____ grassland soil
12. _____ coniferous forest soil
13. _____ tropical rain forest soil
14. _____ deciduous forest soil
15. _____ desert soil

A. A horizon: alkaline, deep, rich in humus
B. O horizon: scattered litter; A horizon: rich in organic matter above humus layer unmixed with minerals
C. O horizon: sparse litter; A–E horizons: continually leached
D. O horizon: pebbles, little organic matter; A horizon: shallow, poor soil
E. O horizon: well-defined, compacted mat of organic deposits resulting mainly from activity of fungal decomposers

48.7. MORE RAIN, BROADLEAF FORESTS [p.880]

48.8. YOU AND THE TROPICAL FORESTS [p.881]

48.9. WET SUMMERS, COLD WINTERS, AND CONIFERS [p.882]

48.10. BRIEF SUMMERS AND LONG, ICY WINTERS [p.883]

Selected Words: *evergreen broadleaf* forests [p.880], *semi-evergreen forests* [p.880], *broadleaf deciduous forests* [p.880], *coniferous* forests [p.882], *taigas* [p.882], "swamp forests" [p.882], *arctic tundra* [p.883], *alpine tundra* [p.883]

Boldfaced, Page-Referenced Term

[p.883] permafrost _____

_____

Matching

Match each of the following to the correct statement.

1. _____ alpine tundra [p.883]
2. _____ arctic tundra [p.883]
3. _____ taigas [p.882]
4. _____ coniferous forest [p.882]
5. _____ evergreen broadleaf forests [p.880]
6. _____ semi-evergreen forests [p.880]
7. _____ broadleaf deciduous forests [p.880]

A. Characterized by an abundance of cone-bearing trees.
B. Characterized by low rainfall (less than 25 centimeters per year), permafrost, and fast plant growth during a brief growing season.
C. Also called "swamp forests," these are the boreal forests found in glaciated regions.
D. This develops in the high mountain regions of the world; no permafrost.
E. Characterized by high rainfall (more than 130 centimeters per year) and high humidity and temperature.
F. Characterized by high rainfall, but longer dry seasons and slower decomposition rates than tropical rain forests.
G. Characterized by a six-month growing season and approximately 50–150 centimeters of rainfall per year.

48.11. CONVERTING MARGINAL LAND FOR AGRICULTURE [pp.884–885]

48.12. STANDING FRESHWATER ECOSYSTEMS [pp.886–887]

48.13. FLOWING FRESHWATER ECOSYSTEMS [pp.888–889]

Selected Words: *green revolution* [p.884], *phyto*plankton [p.886], *zoo*plankton [p.886], *thermocline* [p.886], *oligotrophic* lakes [p.887], *eutrophic* lakes [p.887], *riffles* [p.888], *pools* [p.888], *runs* [p.888], *wastewater treatment* [p.889]

Boldfaced, Page-Referenced Terms

[p.884] desertification _____

_____

[p.886] spring overturn _____

_____

[p.886] fall overturn _____

_____

[p.887] eutrophication _____

_____

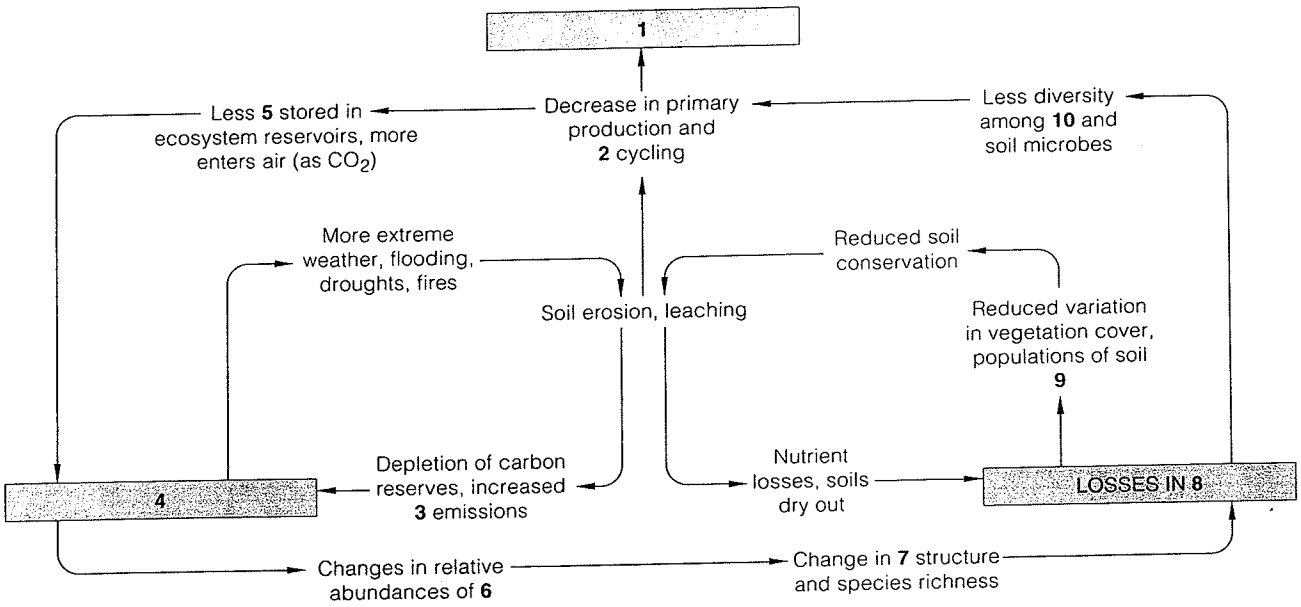
[p.888] streams _____

_____

Labeling

Provide the missing terms for the indicated blanks in the following diagram. [p.885]

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____



Matching

Match each of the following terms to the appropriate statement.

11. ____ fall overturn [p.886]
12. ____ eutrophic lakes [p.887]
13. ____ riffles [p.888]
14. ____ spring overturn [p.886]
15. ____ oligotrophic lakes [p.887]
16. ____ thermocline [p.886]
17. ____ pools [p.888]
18. ____ runs [p.888]

A. Newly formed lakes; deep, clear, and nutrient-poor.
B. Older, shallower, nutrient-rich lakes.
C. Winds moving across a lake cause vertical movements of dissolved oxygen and nutrients.
D. Cooling of the upper layer of a lake causes vertical movements of dissolved oxygen and nutrients.
E. Deeper water of streams; flows over smooth, sandy, or muddy bottoms.
F. Smooth-surfaced, rapidly flowing stretches of a stream; usually over bedrock or rock and sand.
G. Thermal stratification of a lake.
H. Shallow, turbulent stretches of stream.

48.14. LIFE AT LAND'S END [pp.890–891]

48.15. THE OPEN OCEAN [pp.892–893]

48.16. RITA IN THE TIME OF CHOLERA [pp.894–895]

Selected Words: *mangrove wetlands* [p.890], *rocky* shores [p.890], *upper* littoral zone [p.890], *mid*littoral zone [p.890], *lower* littoral zone [p.891], *sandy* and *muddy* shores [p.891], *coral reefs* [p.891], "pastures" [p.892], *seamounts* [p.892], *hydrothermal vents* [p.892], "southern oscillation" [p.894], *cholera* [p.894], Vibrio cholerae [p.894]

Boldfaced, Page-Referenced Terms

[p.890] estuaries _____

[p.892] marine snow _____

[p.893] upwelling _____

[p.893] downwelling _____

[p.893] El Niño _____

[p.894] ENSO _____

[p.894] La Niña _____

Matching

Match each of the following terms to the appropriate statement.

1. ____ cholera [p.894]
2. ____ ENSO [p.894]
3. ____ upwelling [p.893]
4. ____ downwelling [p.893]
5. ____ marine snow [p.892]
6. ____ seamounts [p.892]
7. ____ hydrothermal vents [p.892]
8. ____ coral reefs [p.891]
9. ____ mangrove wetlands [p.890]
10. ____ estuaries [p.890]
11. ____ rocky shores [p.890]

A. Forests of salt-tolerant plants that provide nutrients for neighboring estuarine ecosystems
B. A wave-resistant formation of the slowly accumulated remains of marine organisms
C. Tiny bits of organic matter that form the basis of deep-water food webs
D. The location of superheated, mineral-rich water
E. The vertical movement of cold, deep, nutrient-rich water
F. The southern oscillation marked by increases in sea surface temperatures and changes in air circulation patterns
G. A disease caused by the bacteria *Vibrio cholerae*
H. The location where seawater mixes with nutrient-rich fresh water
I. Extinct, underwater volcanoes
J. Caused by water piling into a coastline
K. Is subdivided into upper, mid-, and lower littoral zones

Labeling and Matching

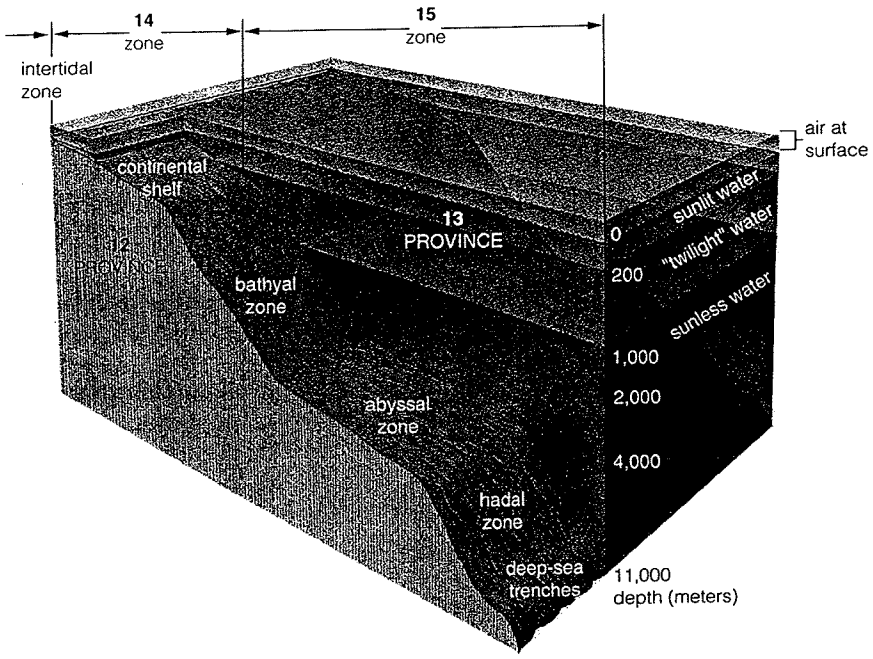
Label each numbered item in the accompanying illustration. [p.892]

12. _____ province

13. _____ province

14. _____ zone

15. _____ zone



Self-Quiz

_____ 1. The form of pollution that is the result of the interaction of nitric oxide and sunlight is called _____. [p.871]
   a. photochemical smog
   b. industrial smog
   c. acid rain
   d. ozone thinning
   e. none of the above

_____ 2. In a(n) _____, nutrient-rich fresh water draining from the land mixes with seawater carried in on tides. [p.890]
   a. pelagic province
   b. rift zone
   c. upwelling
   d. estuary

_____ 3. A biome with broad belts of grasslands and scattered trees adapted to prolonged dry spells is known as a _____. [p.878]
   a. warm desert
   b. savanna
   c. tundra
   d. taiga

_____ 4. The _____ biome is located at latitudes of about 30° north and south, has limited vegetation, and has rapid surface cooling at night. [p.878]
   a. shrublands
   b. savanna
   c. taiga
   d. desert

_____ 5. In evergreen broadleaf forests, _____. [p.880]
a. productivity is high
b. litter does not accumulate
c. soils are weathered and humus-poor, and have poor nutrient reservoirs
d. decomposition and mineral cycling are extremely rapid
e. all of the above

_____ 6. Permafrost would be found in which of the following? [p.883]
a. alpine tundra
b. arctic tundra
c. savannas
d. grasslands
e. boreal forests

_____ 7. The lake's upper layer cools, the thermocline vanishes, lake water mixes vertically, and once again dissolved oxygen moves down and nutrients move up. This describes the _____. [p.886]
a. spring overturn
b. summer overturn
c. fall overturn
d. winter overturn

_____ 8. Rain shadows are located on the _____ side of high mountain ranges. [p.873]
a. windward
b. leeward
c. both windward and leeward

_____ 9. _____ are air circulation patterns that influence the continents north or south of warm oceans; low pressure causes moisture-laden air above the neighboring ocean to move inland, resulting in heavy rains. [p.873]
a. Geothermal ecosystems
b. Upwelling
c. Taigas
d. Monsoons

_____ 10. All the water above the continental shelves is in the _____. [p.892]
a. neritic zone of the benthic province
b. oceanic zone of the pelagic province
c. neritic zone of the pelagic province
d. oceanic zone of the benthic province

_____ 11. Complex forests of ash, beech, birch, chestnut, elm, and oaks are found in the _____. [p.880]
a. semi-evergreen forest
b. coniferous forest
c. broadleaf deciduous forest
d. evergreen broadleaf forest

_____ 12. Chemoautotrophic prokaryotes are the starting point for _____. [p.892]
a. hydrothermal vent communities
b. desert communities
c. lake communities
d. coniferous forest communities

Chapter Objectives/Review Questions

1. Define the terms *biogeography* and *biosphere.* [p.867]
2. Explain the factors that contribute to climate. [p.868]
3. Describe the causes of ozone thinning, industrial smog, photochemical smog, and acid rain. [p.870–871]
4. Explain how ocean currents and mountain ranges influence climate. [pp.872–873]
5. Distinguish between a biogeographic realm and a biome. [pp.874–875]
6. Understand the structure of soil and what is meant by a soil profile. [pp.876–877]
7. Give the basic characteristics of a desert, dry shrubland, dry woodland, grassland, and savanna. [p.878]
8. Give the basic characteristics of the following forest types: evergreen broadleaf, semi-evergreen, and broadleaf deciduous. [p.880]
9. Give the general characteristics of a coniferous forest. [p.882]
10. Distinguish between an arctic tundra and an alpine tundra. [p.883]
11. Explain how desertification occurs and the impact on both humans and biodiversity. [p.884]
12. Explain why spring and fall overturns are important for lakes. [p.886]