Chapter 52: An Introduction to Ecology and the Biosphere

52.1 Describe key factors that affect Earth's climate and explain how they influence climate patterns at different scales.

52.2 Identify terrestrial biomes and how their location and characteristics are influenced by climate and disturbance.

52.3 Identify the dominant zones and biomes in aquatic systems and their principal biological attributes.

52.4 Explain how the distribution of species is limited by biotic and abiotic factors.

52.5 Describe how ecological change and evolution affect one another over short and long periods of time.

What determines which organisms will be found in an area? In this chapter, you will learn about the role of climate, light and nutrient availability, dispersal, and species interactions in affecting this distribution.

Study Tip: Figure 52.1 in your text gives you a visual overview of factors that strongly affect species distribution. Notice that the factors that have the strongest effect on terrestrial systems are different from the ones affecting aquatic systems. Create a flow chart that shows these differences and then bring the chart to a common end with dispersal and interactions. Then, for any of the four communities represented (tropical forest, desert, coral reef, or deep-sea vent), describe all the factors that work together to determine the location of a single species found in that community.

Concept 52.1 Earth's climate varies by latitude and season and is changing rapidly

LO 52.1 Describe key factors that affect Earth's climate and explain how they influence climate patterns at different scales.

Overview

1. What is *ecology*?

2. Study Figure 52.2 in your text. It shows the different levels of the biological hierarchy studied by ecologists. Notice also the different types of questions that might be studied by an ecologist at each level of study. Use this figure to develop a flowchart of the hierarchy from least to most inclusive.

3. What is climate? What four factors are the key components of climate?

4. Study Figures 52.3 and 52.4 in your text, which summarize Earth's climate patterns and how they are formed. Explain how Earth's curvature and axis of rotation influence the amount of sunlight reaching a given area—for our purposes Miami and Chicago—and how these factors influence the temperature, precipitation, and levels of photosynthesis in that area.

5. Use the global circulation of surface water in the oceans to explain why the California coast is cooler than expected but England is warmer than expected.

6. Explain the "rain shadow" effect.

7. What effect does elevation have on climate? Why do we say that hiking from Gatlinburg, Tennessee, at 393 m of elevation in the Smoky Mountains, to the top of Mount LeConte, at 2,010 m, is like traveling to Canada?

8. Every environment on Earth is characterized by _____, or nonliving, factors and _____, or living, factors.

9. Explain why the climate becomes hotter and drier in regions where large-scale deforestation has occurred.

10. What is the difference between *macroclimate* and *microclimate*?

11. Climate and weather are not the same! Explain how they differ.

12. Use the example of the beech tree to explain how global climate change can alter the current range of a species.

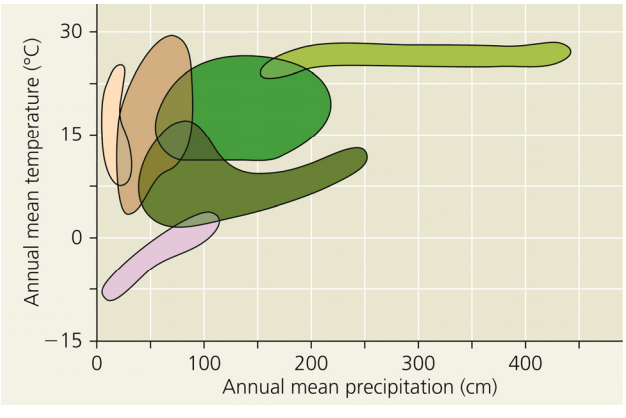
Concept 52.2 The distribution of terrestrial biomes is controlled by climate and disturbance

LO 52.2 Identify terrestrial biomes and how their location and characteristics are influenced by climate and disturbance.

13. What is a *biome*?

14. Figure 52.11 in your text shows a *climograph* for some major biomes in North America. You will also find this figure below. What two abiotic factors shown here are most important in determining the distribution of the biome?

15. Identify each biome shown in Figure 52.11. Try to do this based on your understanding of the figure, and then use the text to check your answers. You will use these biomes: *temperate grassland, temperate broadleaf forest, tropical forest, northern coniferous forest, desert,* and *tundra*.



16. What is an ecotone? Using the climograph, give an example of where an ecotone would be expected and label it on the figure.

17. The energy budget of a biome is set by its level of photosynthesis. In general, warm temperatures and abundant rainfall translate to high levels of photosynthesis and biomes with high energy budgets. Use your labeled climograph to answer the following questions.

    a. Which biome has the highest energy budget and, consequently, the greatest species diversity?

    b. Which biome would you predict has the lowest energy budget?

    c. What effect would you expect global warming to have on the total area of the northern coniferous forest?

18. In ecological terms, what is a *disturbance*? Fire is a disturbance that is controversial in its treatment. How can fire be a normal part of a disturbance pattern in one biome but destructive in another situation?

19. The following table has certain key features completed for each of the terrestrial biomes. Use Figure 52.13 in your text to complete the remaining parts of the table.

Biome	Distribution	Climate	Significant features
		Winters cold, summers hot and humid; precipitation in excess of 70 cm/yr	
		Warm all year; seasonal rains and long dry seasons	Thorny vegetation, large herbivores, fire-adapted species
			Also called *taiga*; largest terrestrial biome; cone-bearing trees are dominant

Tropical Forest			
		May be hot or cold; annual precipitation is low	
	Generally located in the middle latitudes		
Chaparral			
			Permafrost restricts plant growth; most vegetation is herbaceous and dwarfed

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

LO 52.3 Identify the dominant zones and biomes in aquatic systems and their principal biological attributes.

20. What is the largest marine biome, and how much of Earth's surface does it cover?

21. What is the relationship between the depth of the *photic zone* and the energy budget in an aquatic biome?

22. What occurs in *seasonal turnover* in lakes with winter ice cover?

23. As you read this section and study Figure 52.16 in your text, you will encounter a number of new ideas about aquatic biomes. Although it is not necessary to memorize a vast amount of data, a few trends should be part of your general biology knowledge, a knowledge base that will ultimately help you with a wide variety of questions. The following questions will give you a starting outline.

    a. How do *oligotrophic* and *eutrophic* lakes differ?

    b. Why do ecologists consider preservation of wetlands important in maintaining water quality?

    c. Rate the productivity of wetlands relative to other biomes.

    d. What are the two most important physical characteristics of streams and rivers?

    e. What is an *estuary*? What characteristic do they share with *wetlands*?

    f. What is the *intertidal zone*?

    g. How have *coral reefs* been affected by human activities?

    h. What is unique about the producers in deep-sea *hydrothermal vents*? Would you expect these ecosystems to have high or low energy budgets?

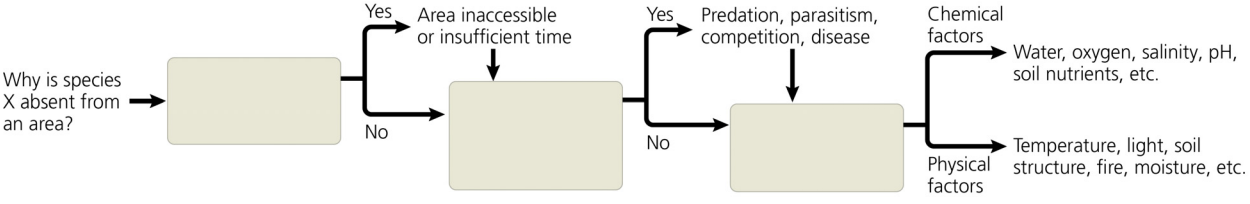
Concept 52.4 Interactions between organisms and the environment limit the distribution of species

LO 52.4 Explain how the distribution of species is limited by biotic and abiotic factors.

24. What two factors determine the distribution of species? Which of these factors explains why kangaroos are found only in Australia?

25. What role does *dispersal* play in the study of the distribution of species?

26. Complete the blanks on the flowchart below, based on Figure 52.18 in your text. Then, replace "species X" with saguaro cactus to model how an ecologist would evaluate the geographic distribution of the saguaro cactus. Circle the yes or no at the junctions, as well as the correct response if given multiple possibilities.



27. Give an example of how one species can affect the distribution of another species.

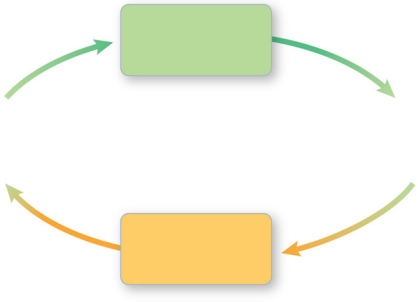
28. List five abiotic factors. Include an example and description of each factor's influence on living organisms.

Abiotic Factor	Example and Description
Temperature	

Concept 52.5 Ecological change and evolution affect one another over long and short periods of time

LO 52.5 Describe how ecological change and evolution affect one another over short and long periods of time.

29. What are "reciprocal effects"? Label the reciprocal effects of evolutionary and ecological change on the figure below.



30. Describe a scenario showing how ecological change and evolution can affect one another.

Test Your Understanding, p. 1188

Now you should be ready to test your knowledge. Place your answers here:

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____