

COMPELLING QUESTIONS

In this chapter, you will explore the following questions:

- What are the sources of carbon on Earth?
- How does carbon move between reservoirs, and how do scientists measure this?
- What are “greenhouse gases,” and what are their positive and negative effects?
- What are the global consequences of climate change?
- How do our current climate trends differ from the past?
- How can my daily actions affect the global environment?

Your Turn 4.54**Group Activity: The “Big Question” Revisited**

Form a group and answer these questions based on your current knowledge.

- a. Do you feel the greenhouse effect and warming of the atmosphere is good or bad?
Why or why not?
- b. Where does the carbon dioxide in the air come from?
- c. What is climate change?
- d. Is climate change occurring? Why or why not?

Compare your answers to those from the start of the chapter. How have your answers changed?

Conclusion



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This group of chimpanzees contributed minimally, or not at all, to global climate change and likely are not discussing the issue. However, they must adapt to the changes that will occur. Unlike humans, chimpanzees, along with plants and other animals, don't argue with each other about whether climate is changing. They just attempt to adapt to the ever-changing world, which can affect their way of life including their access to food, water, and habitat. For example, as the climate changes, food availability shifts, thus forcing animals such as the chimpanzee to adapt in order to obtain enough calories to survive. The changes also affect their habitat, with variations due to differing weather patterns.

Like much of the planet, the salt water in the oceans has no voice, but it still responds to climate change and has a story to tell. In colder climates, it quietly freezes to form sea ice when temperatures drop. And perhaps more noisily, this ice breaks up with the return of warmer temperatures in the spring. This freeze–thaw cycle has been occurring for thousands of years, gradually shifting to form more or less ice as the temperatures on Earth have shifted. In recent years, however, the freeze–thaw cycle has been more pronounced and the waters in the Arctic have been free of ice for longer periods of time. Might carbon dioxide be the culprit of changes witnessed in the Arctic? As a greenhouse gas, carbon dioxide plays a role in keeping our planet comfortably warm and able to support life, but there can be too much of a good thing. John Holdren has said several times, “Global warming is a misnomer, because it implies something that is gradual, something that is uniform, something that is quite possibly benign. What we are experiencing with climate change is none of those things.”

The first assertion is that global warming isn't gradual. By this he means that in comparison with the past, the climate changes we are seeing today are occurring much more rapidly. Natural climate changes are part of our planet's history. Glaciers, for example, have advanced and retreated numerous times, and global temperatures have been both much higher and much lower than the temperatures we currently experience. But the geologic evidence indicates these past changes occurred over millennia, not decades as they occur today. So Holdren is correct. Global warming is not gradual, at least not in comparison with the geologic time frames of the past.

Second, he asserts that global warming does not occur uniformly across the globe. Holdren is right again. To date, the most dramatic effects have been observed at the poles. These include quickly receding glaciers, shrinking sea ice, and melting permafrost. So far, the more densely populated lower latitudes have experienced far smaller effects from climate change.

His third assertion, that global warming might not be benign, is the most difficult to assess. The issue is complicated in part because we cannot predict with certainty which aspects of our planet global warming will affect and to what degree. It is further complicated because we cannot easily understand why only a few degrees of warming might be catastrophic.

As evidenced by Holdren's points, global climate change is an extremely complicated phenomenon. Like it or not, we are in the midst of conducting a planetwide experiment, one that will test our ability to sustain both our economic development and our environment.

In the next chapter, you will learn about a chemical that is essential to life on this planet—water. You will understand how our daily actions result in changes to the availability, purity, and properties of water. As we focus on this precious resource, we will continue our discussions related to air quality and climate change, which impact the likelihood of securing suitable water resources for future generations.

LEARNING OUTCOMES

The numbers in parentheses indicate the sections within the chapter where these outcomes were discussed.

Having studied this chapter, you should now be able to:

- illustrate, identify, and predict how carbon from different carbon-containing substances flows among carbon reservoirs in a carbon cycle centered in a specific ecosystem. (4.1, 4.2)
- describe the key characteristics of molecular compounds, including their Lewis structures and molecular shapes. (4.1, 4.7)
- write formulas and names of a variety of ionic compounds made of monoatomic and polyatomic ions that serve as mineral sources in rock and soil forms. (4.1)
- quantify the amount of carbon or other atoms present in substances. (4.3, 4.4)
- distinguish how greenhouse gases affect the temperature of Earth via the greenhouse effect. (4.5, 4.6)

- critique how electromagnetic radiation, specifically UV, IR, and microwaves, affects the movement of molecules and molecular bonds differently, and how the stretching and bending of bonds in a molecule can ultimately influence Earth's temperature. (4.7, 4.8)
- explain the process for collecting historical and current climate data, such as how an analysis of isotopes allows scientists to determine past trends, then defend the reliability of the data by describing how our climate trends differ from the past. (4.9, 4.10)
- evaluate the possible global consequences of climate change and describe factors that can mitigate the severity of these potential consequences. (4.11)
- predict how changes in individual carbon footprints (daily actions) and, more broadly, how cities and nations can mitigate climate change consequences. (4.12)

Questions

Emphasizing Essentials

1. The chapter concluded with a quote from John Holdren: "Global warming is a misnomer, because it implies something that is gradual, something that is uniform, something that is quite possibly benign. What we are experiencing with climate change is none of those things." Use examples to:

- a. explain why climate change is not uniform.
 - b. explain why it is not gradual, at least in comparison to how quickly social and environmental systems can adjust.
 - c. explain why it probably will not be benign.
2. The surface temperatures of both Venus and Earth are warmer than would be expected on the basis