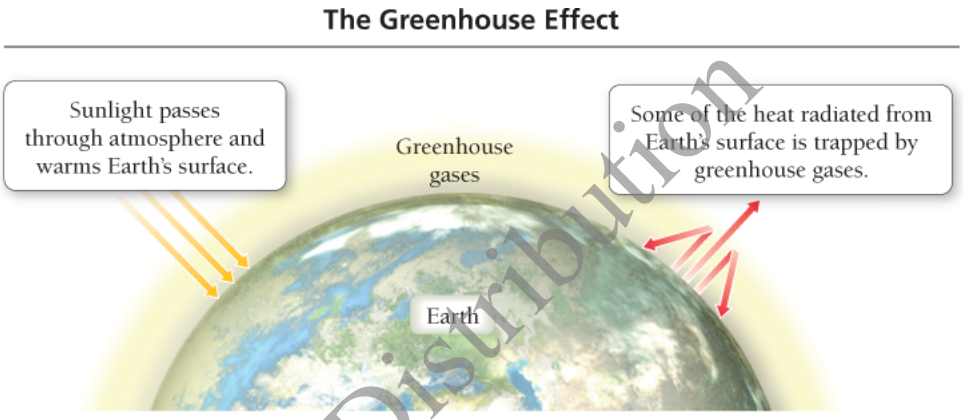
Pearson

7.1: Climate Change and the Combustion of Fossil Fuels

The temperature outside my office today is a cool 48 °F, lower than normal for this time of year on the California coast. However, today's "chill" pales in comparison with how cold it would be without the presence of *greenhouse gases* in the atmosphere. These gases act like the glass of a greenhouse, allowing sunlight to enter the atmosphere and warm Earth's surface, but preventing some of the heat generated by the sunlight from escaping, as shown in Figure 7.1. The balance between incoming and outgoing energy from the sun determines Earth's average temperature.

Figure 7.1 The Greenhouse Effect

Greenhouse gases in the atmosphere act as a one-way filter. They allow visible light to pass through and warm Earth's surface, but they prevent heat energy from radiating back out into space.

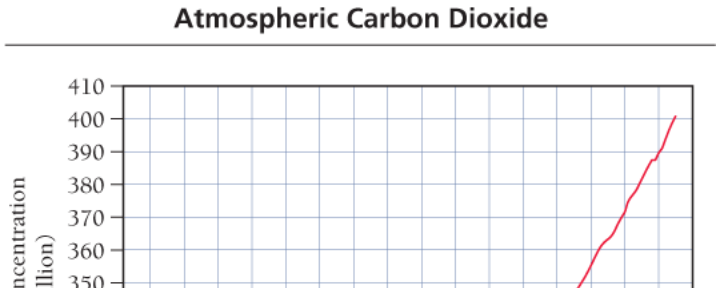


If the greenhouse gases in the atmosphere were not present, more heat energy would escape, and Earth's average temperature would be about 60 °F colder. The temperature outside of my office today would be below 0 °F, and even the sunniest U.S. cities would most likely be covered with snow. However, if the concentration of greenhouse gases in the atmosphere were to increase, Earth's average temperature would rise.

In recent years scientists have become increasingly concerned because the quantity of atmospheric carbon dioxide (CO_2)—Earth's most significant greenhouse gas—is rising. More CO_2 enhances the atmosphere's ability to hold heat and is believed to lead to *global warming*, an increase in Earth's average temperature. Since 1860, atmospheric CO_2 levels have risen by 38% (Figure 7.2), and Earth's average temperature has risen by 0.8 °C (about 1.4 °F), as shown in Figure 7.3.

Figure 7.2 Carbon Dioxide Concentrations in the Atmosphere

The rise in carbon dioxide levels is due largely to fossil fuel combustion.



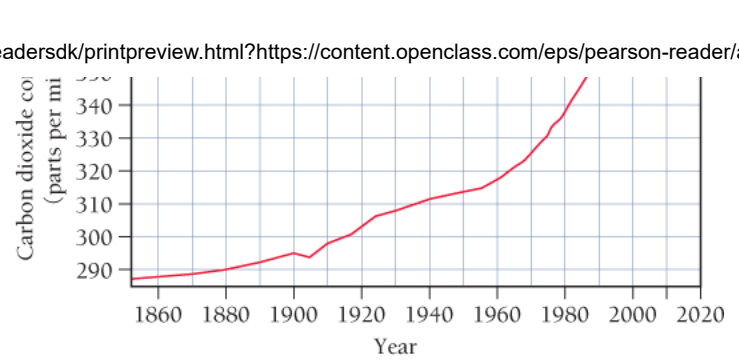
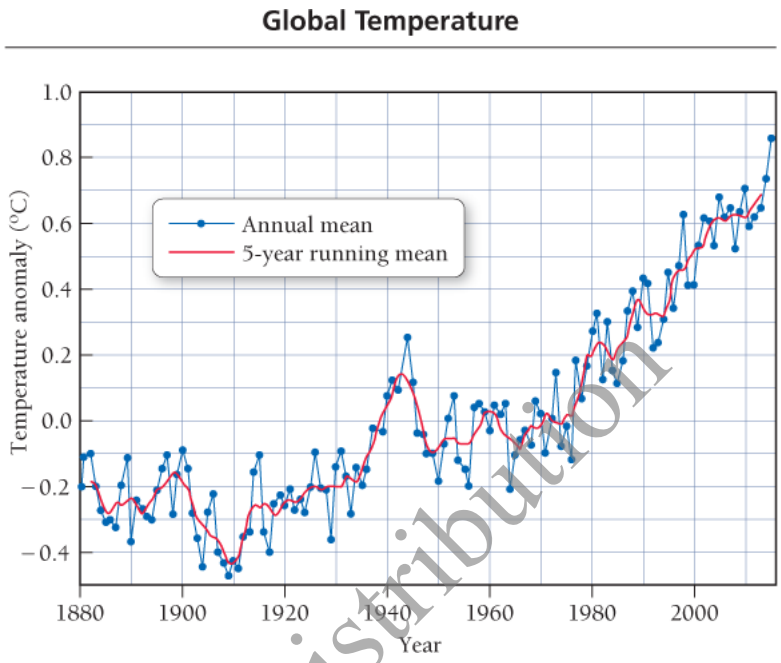


Figure 7.3 Global Temperature

Average temperatures worldwide have risen by about 0.8 °C since 1880.



Most climate scientists assert that the primary cause of rising atmospheric CO_2 concentration is the burning of fossil fuels (natural gas, petroleum, and coal), which provide about 82% of our society's energy. The burning of fossil fuels is a *chemical reaction*, the subject of this chapter. Some people, however, counter that fossil fuel combustion does not significantly contribute to global warming and climate change. They argue that the amount of carbon dioxide emitted into the atmosphere by natural sources, such as volcanic eruptions, far exceeds that from fossil fuel combustion.

Which group is right? We can judge the validity of the naysayers' argument by examining the combustion reaction that forms carbon dioxide. Governments keep records on the amount of fossil fuel that is burned. By understanding the combustion reaction by which fossil fuels burn, we can calculate the amount of carbon dioxide that is formed. We can then compare that amount to the amount released by volcanic eruptions. In this chapter, we first look at chemical changes in general, and then turn to examine this debate.