Case Study #1: Atmospheric Ozone

Between 20 and 50 kilometers above Earth's surface, the atmosphere contains a relatively high concentration of ozone called the **ozone layer.** This natural ozone layer absorbs harmful ultraviolet (UV) radiation from sunlight, so it acts like a global sunscreen. Overexposure to UV radiation causes sunburn, and can also cause cancer, damage eyes, and lower resistance to disease. UV can also damage plants and algae. The scientific study and world-wide response to a problem with the ozone layer led to one of the first effective and workable responses by the international community to an ecological challenge involving a global commons.

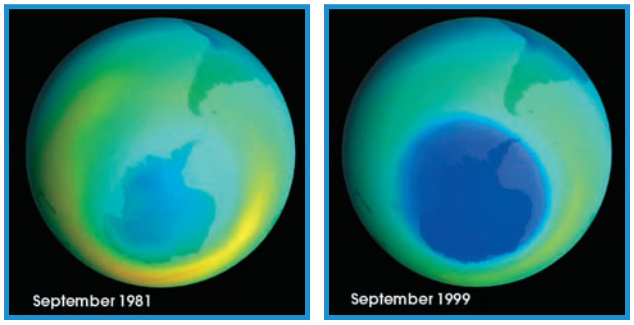

FIGURE 6–24 The Disappearing Ozone

FIGURE 6–25 CFC-Containing Refrigerators

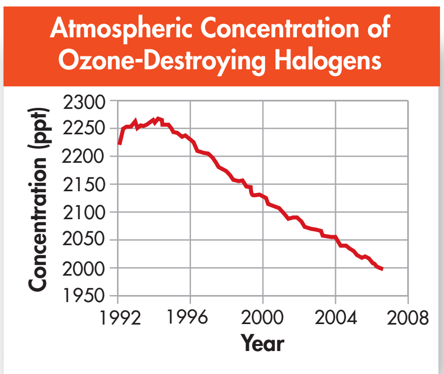

FIGURE 6–26 The Decline of CFCs

1 Recognizing a Problem: "Hole" in the Ozone Layer Beginning in the 1970s, satellite data revealed that the ozone concentration over Antarctica was decreasing during the southern winter. This area of lower ozone concentration was called an "ozone hole." It isn't really a "hole" in the atmosphere, of course, but an area where ozone concentration is unusually low. For several years after the hole was discovered, ozone concentrations continued to drop, and the hole grew larger and lasted longer each year. **Figure 6–24** shows the progression from 1981 to 1999. The darker blue color in the later image indicates that the ozone layer had thinned since 1981.

2 Researching the Cause: CFCs In 1974 a research team led by Mario Molina, F. Sherwood Rowland, and Paul J. Crutzen demonstrated that gases called chlorofluorocarbons (CFCs) could act as catalysts to destroy ozone molecules under conditions in the upper atmosphere. This research earned a Nobel Prize in 1995. CFCs were once widely-used as propellants in aerosol cans; as coolant in refrigerators, freezers, and air conditioners; and in the production of plastic foams.

3 Changing Behavior: Regulation of CFCs Once CFC research was published and accepted by the scientific community, the rest was up to policymakers and industry. In this case, their response was positive and effective. Following researchers' recommendations, 191 countries signed the Montreal Protocol, an agreement that banned most uses of CFCs. Manufacturers found alternatives to CFCs for most purposes. Because CFCs remain in the atmosphere for a long time, their effects on the ozone layer are still apparent. But ozone-destroying halogens from CFCs have been steadily decreasing since about 1994, as shown in **Figure 6–26.** These data show that the CFC ban has positive long-term effects. In fact, current data predict that the ozone hole will fluctuate in size from year to year, but should disappear around the middle of this century.