Chapter 14

CRITICAL THINKING • Air

Protecting the Ozone Layer

Scientists fear that the holes in the ozone layer that have occurred over Antarctica and the North Pole in the 1980s might be the beginning of the destruction of this protective shield. The exact consequences of the removal of the ozone layer aren't known, but the chief destroyer of the ozone layer is known—chlorofluorocarbons (CFCs). These human-made gases are stable and therefore do not break down easily. This means that when they're released into the atmosphere, they can destroy ozone molecules for years and years.

CFCs are used in many products, including the bubbles in foam products, refrigerants in refrigerators and air conditioners, propellants in aerosols, and solvents used in cleaning. Car air conditioners are responsible for the greatest amount of CFC emissions. CFCs sometimes leak from other air-conditioning systems. In 1978, the United States and Canada banned the use of CFCs in aerosols, but they're still used in other countries. The first step toward worldwide restrictions took place in 1987. The Montreal Protocol was an international agreement that required industrialized nations to cut their production of CFCs in half by 1998; less industrialized countries still continue to use CFCs. In 1990, an updated proposal called for banning the production of CFCs completely by the year 2000 in more industrialized countries.

Many substitutes for CFCs already exist. Efforts are being made to find more substitutes and to construct equipment that doesn't rely on CFCs. In Arizona, scientists are working on an air conditioner that uses fresh water and salt water as its working fluids. A company has developed gas-fired absorption air conditioners that don't use CFCs. The automotive industry has the challenge of designing a car air conditioner that not only doesn't use CFCs but also maintains fuel efficiency. In one version, tetrafluoroethane is used instead of CFC. The entire air-conditioning system has to be redesigned to fit the characteristics of tetrafluoroethane. It will probably be used along with other cooling devices, such as solar-powered fans and heat-absorbing or heat-reflecting glass.

In refrigerators, CFCs circulate in pipes inside the refrigerator and also are part of the foam insulation used in the outside shell. Manufacturers are interested in tetrafluoroethane and other substitutes for CFCs, but they will need more than CFC replacements to meet efficiency requirements. New insulation ideas include using silica gels, silica powders, stainless-steel sheets with glass beads between them welded together by a laser, and microfiberglass.

These and many other inventions will have to be developed and tested. Scientists hope that somewhere among them are the methods that will protect the ozone layer and ensure that it continues to protect us.

Applying Critical Thinking Skills

1. When CFCs were no longer allowed to be used in items such as hair sprays and furniture polish, some people complained. They said they only used one small spray can every few weeks. How would you respond to their complaints?

2. The Montreal Protocol was partly based on the assumption that industrialized nations produced a much greater amount of CFCs than less industrialized nations. That was one of the reasons the agreement required industrialized nations to cut their production of hydrocarbons in half, but it didn't require less industrialized nations to limit their production. Do you think that was a good agreement? Explain.

3. Suppose you're an engineer with an idea for a new air conditioner. What kinds of factors should you consider when developing and testing your idea?