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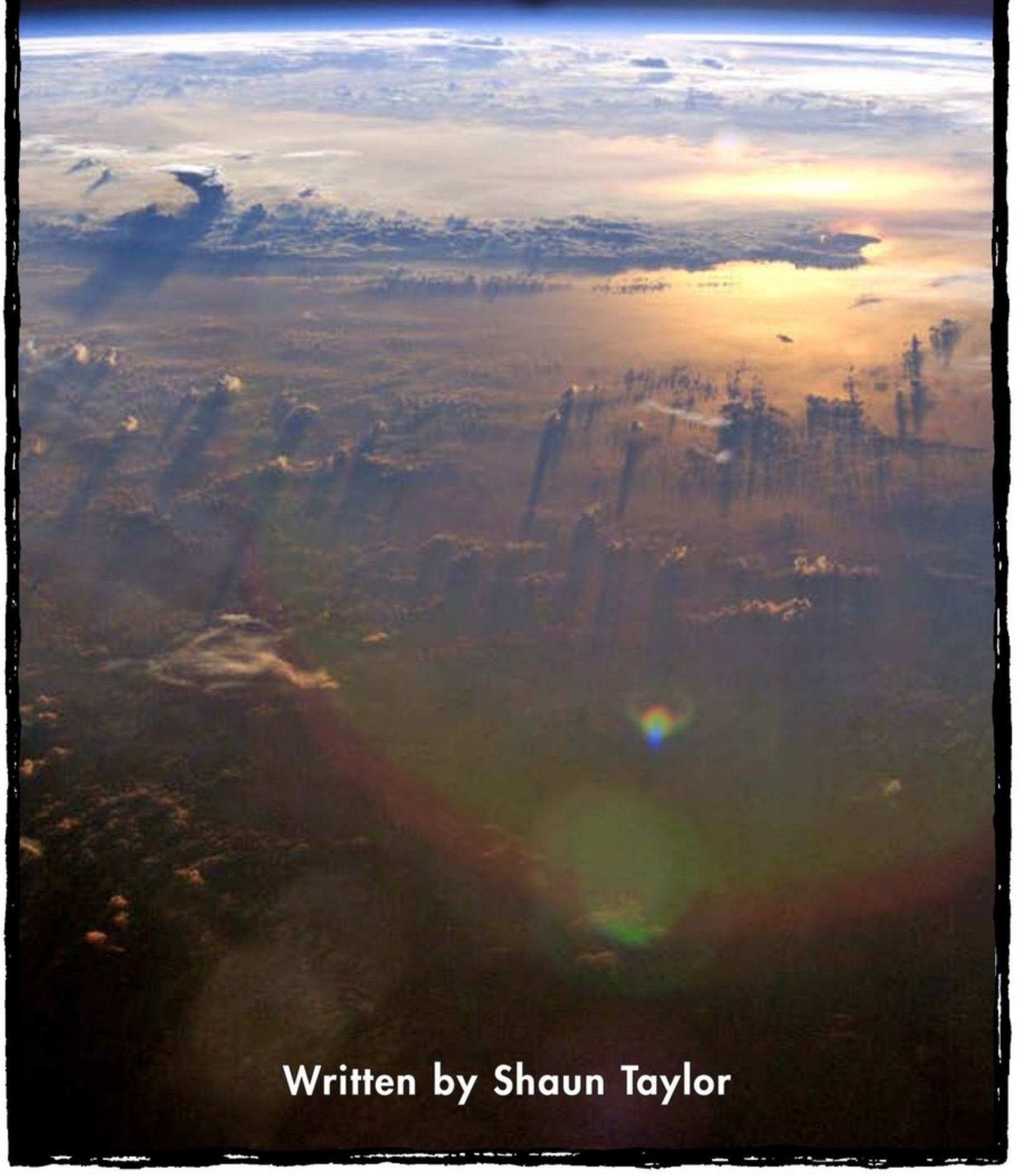
Threats to Our Atmosphere



Written by Shaun Taylor

www.readinga-z.com

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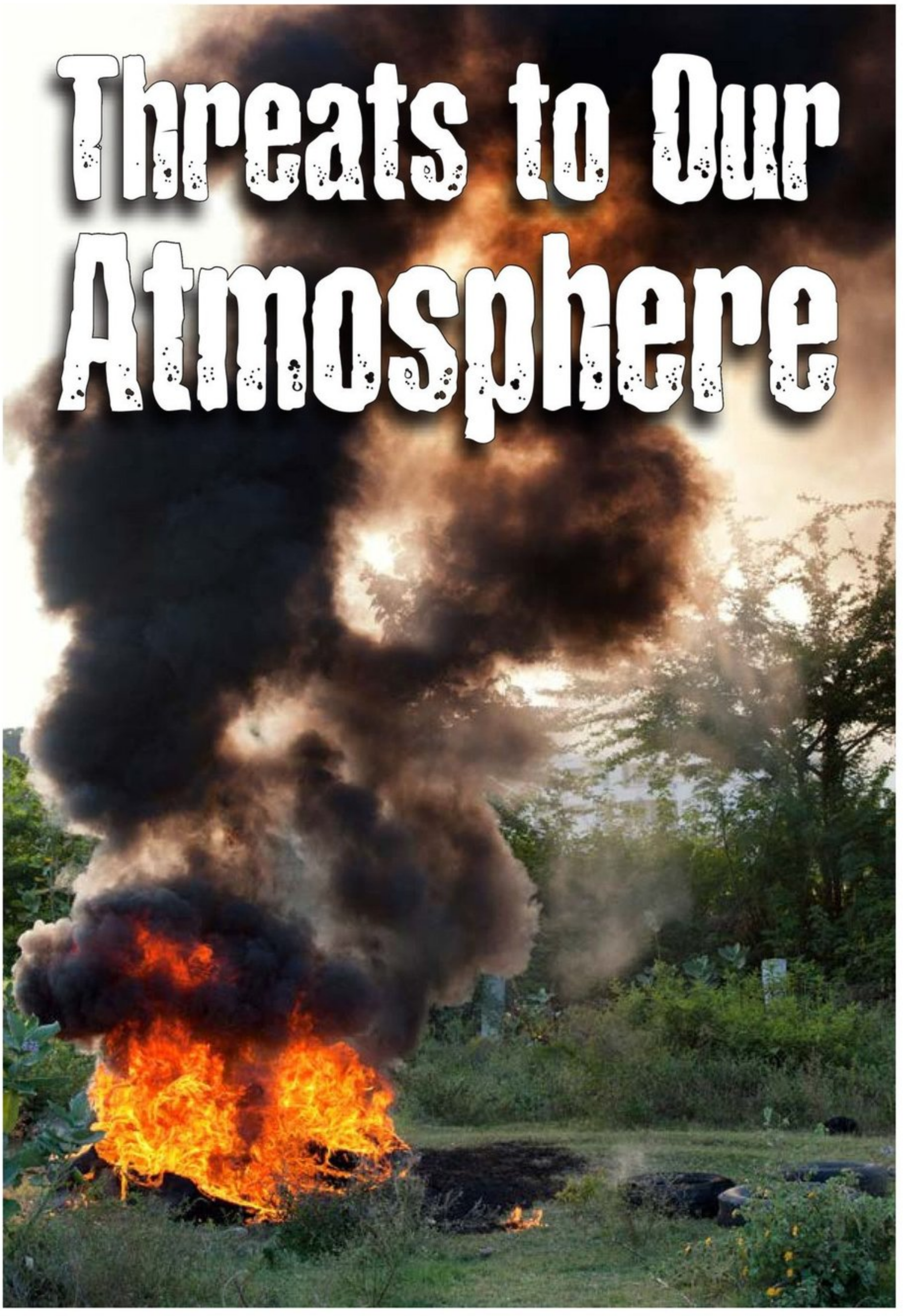

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Layers of Earth's atmosphere as seen from a satellite

Introduction

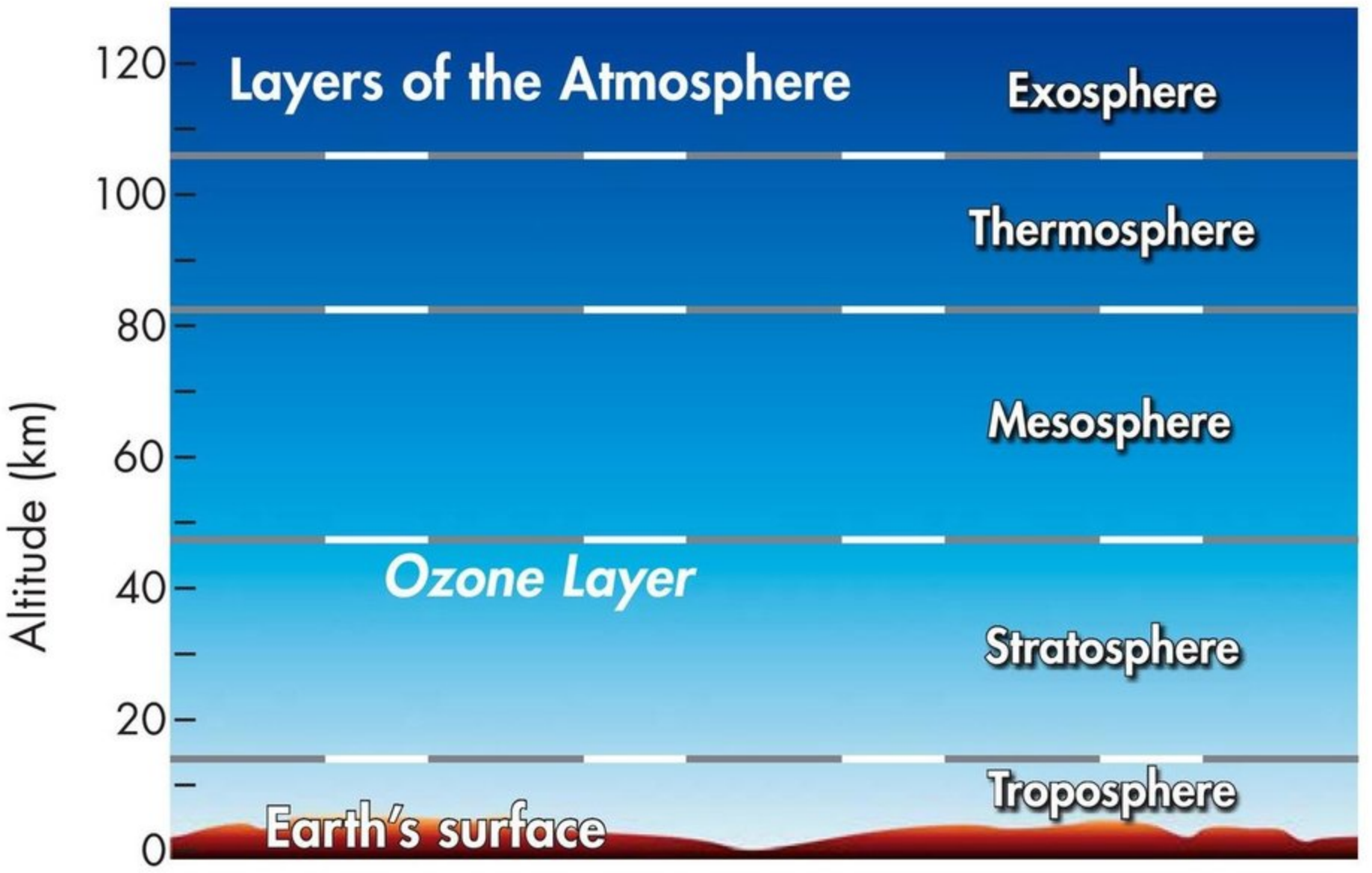
There is a protective blanket around Earth called the **atmosphere**. The atmosphere is a mixture of many gases. The three most important are nitrogen, oxygen, and carbon dioxide. Living things need these gases in order to survive. Earth's atmosphere filters out the Sun's harmful rays and prevents heat from escaping too rapidly into space.

Living things on Earth survive within a narrow range of conditions. All living things need the right amount of gases, the right range of temperature, and the right balance of sunlight. The atmosphere helps to maintain proper conditions for life on Earth.

Earth's Atmosphere

Earth's atmosphere is divided into five layers. As you move up through the layers, conditions change. The atmosphere gets colder and thinner as you move away from Earth's surface.

The closest layer to the ground is the *troposphere*. This is where clouds form and **precipitation** occurs. The next layer is the *stratosphere*. It extends about 50 kilometers (30 mi) above the ground. Commercial airliners fly about 11 kilometers (6.84 mi) into the calmer, lower layers of the stratosphere. Next are the *mesosphere* and *thermosphere*, which are from 50 kilometers to more than 90 kilometers (30–56 mi) above Earth's surface. The very thin, outermost layer of Earth's atmosphere is the *exosphere*.



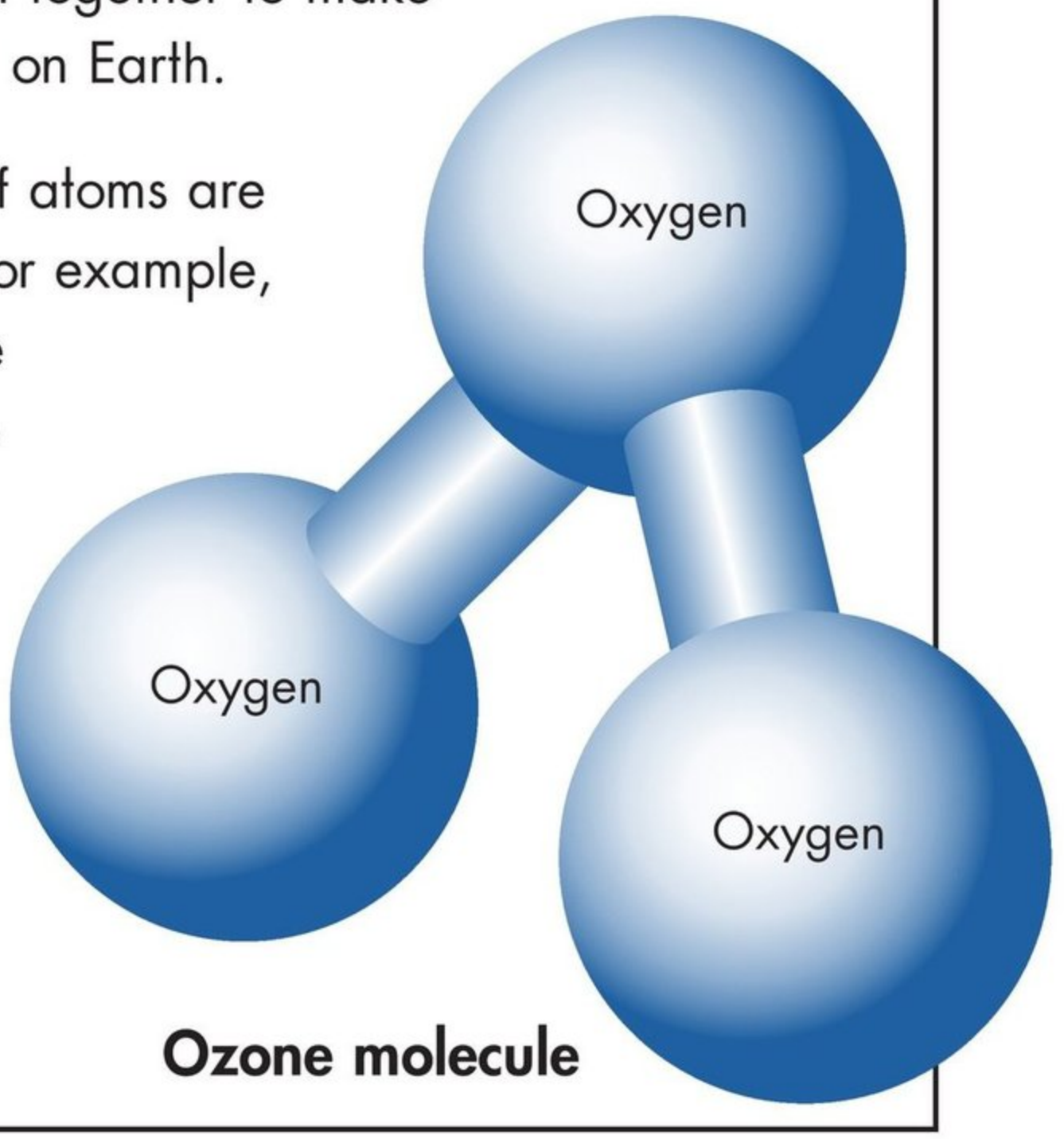
The Ozone Layer

Ozone is a special form of oxygen gas. Different amounts of ozone are found in each of the five layers of Earth's atmosphere. A lot of ozone is in the upper part of the stratosphere, so it is considered a sublayer called the *ozone layer.* This sublayer, which absorbs harmful **ultraviolet** rays from the Sun, is called "good ozone" because it protects us.

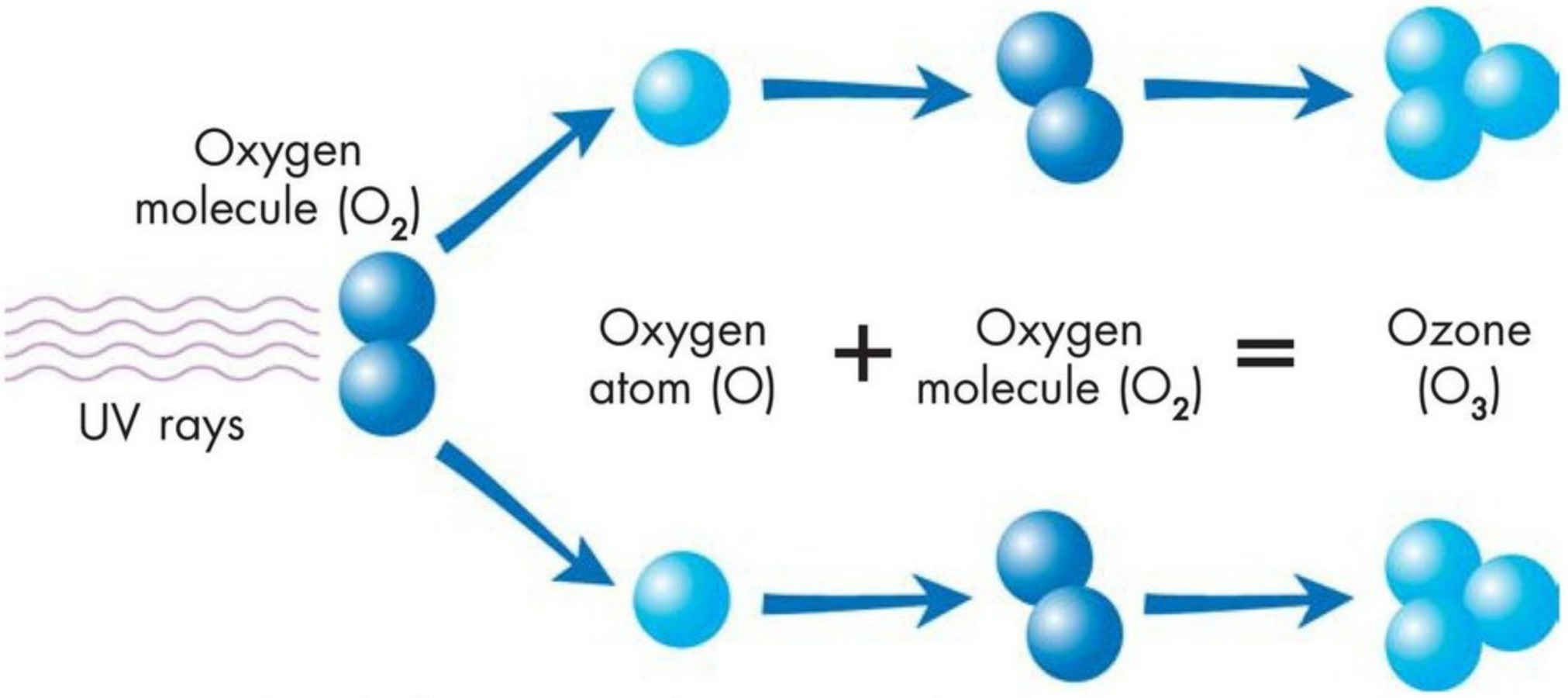
Do You Know?

Atoms are the tiny particles that make up all matter in the universe. There are ninety-four natural substances on Earth, called *elements*. Each element has its own type of atom. Atoms join together to make all the things found on Earth.

Combinations of atoms are called *molecules*. For example, one molecule of the oxygen we breathe is made up of two atoms of oxygen, or O_2. Ozone is an oxygen molecule made of three atoms of oxygen, or O_3.



Ozone molecule



UV rays break down normal oxygen molecules into two separate atoms. These atoms then combine with other oxygen molecules to make ozone.

Ozone in the ozone layer is continually created and destroyed. Under normal conditions, the amount of ozone remains fairly **constant**, which means that the balance does not shift too greatly one way or the other.

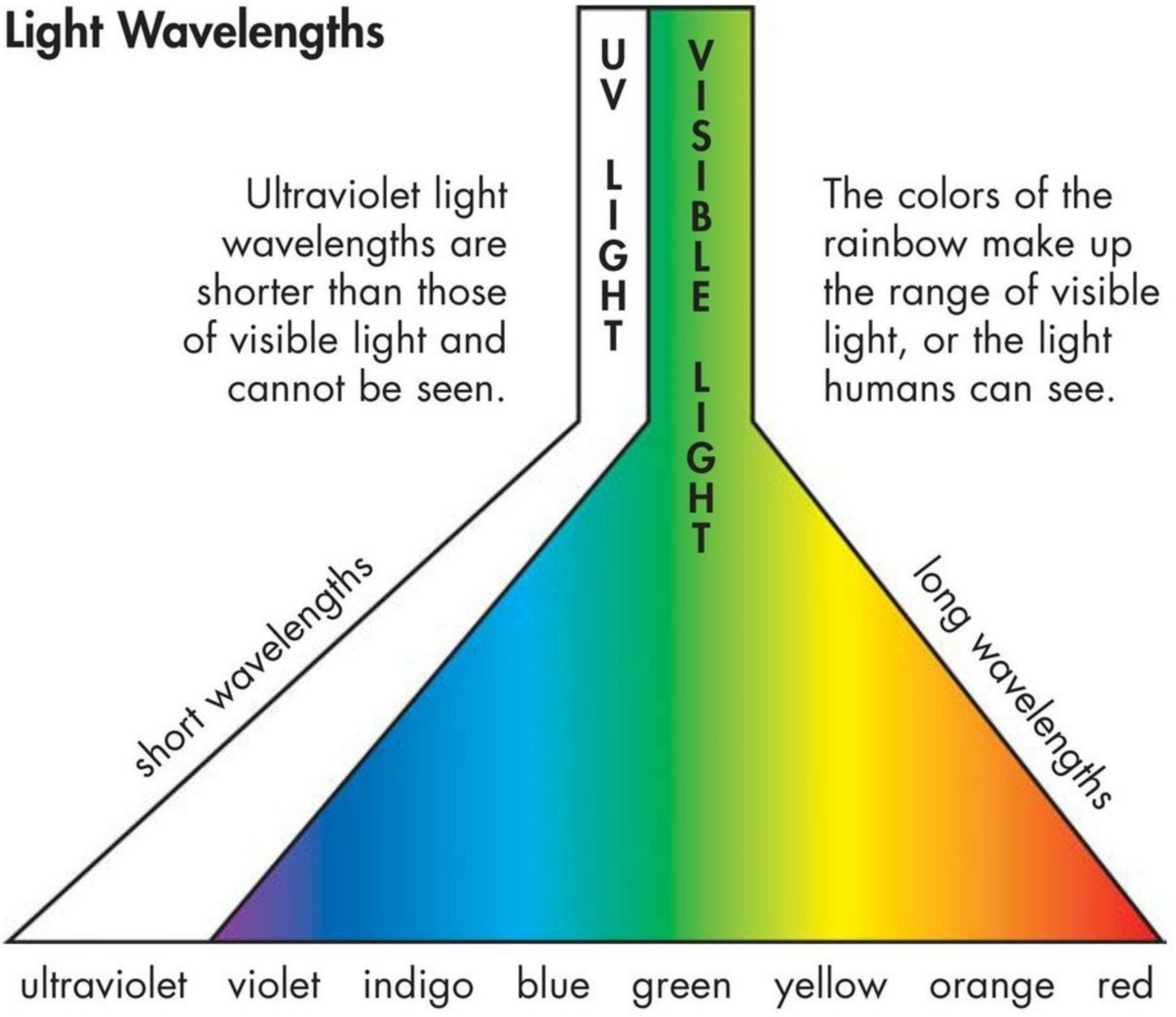
The part of sunlight known as ultraviolet (UV) light is responsible for both creating and destroying ozone. UV light creates ozone by splitting **molecules** of oxygen gas (O_2) into two individual oxygen **atoms** (O). If one of these oxygen atoms joins with a molecule of oxygen gas, a three-atom ozone molecule forms. UV light can also change an existing ozone molecule by removing one of its oxygen atoms. The freed oxygen atom then reacts with an ozone molecule (O_3), causing it to split into two oxygen molecules ($O_2 + O_2$).

Do You Know?

Sunlight is actually a mixture of visible and invisible light of various wavelengths. The visible light is made of different colors from red to violet. Long wavelengths, which are less powerful, produce red light. Shorter wavelengths, which are more powerful, produce blue and violet light. Light eventually becomes invisible as the wavelengths decrease.

Powerful ultraviolet light, which is invisible, can cause skin cancer, damage the eyes and plants, and kill ocean life. Some biologists believe that increased ultraviolet light is bleaching the color out of corals around the world.

Light Wavelengths



This continual creation and destruction of ozone keeps the amount of ozone in the ozone layer fairly constant. The layer of ozone created keeps harmful UV light from reaching Earth's surface.

Ozone also forms near the ground. This ozone is harmful to plants and animals, and is called "bad ozone." It forms when cars and factories release **chemicals** called **pollutants** into the air. On hot days, sunlight starts a reaction between the pollutants and oxygen, causing the formation of harmful ground-level ozone.

When air becomes polluted, outdoor activities might be limited.

If levels of ground-level ozone rise to dangerously high levels, a warning is sent out. People with breathing problems are told to stay inside.

Discovery of the Ozone Hole

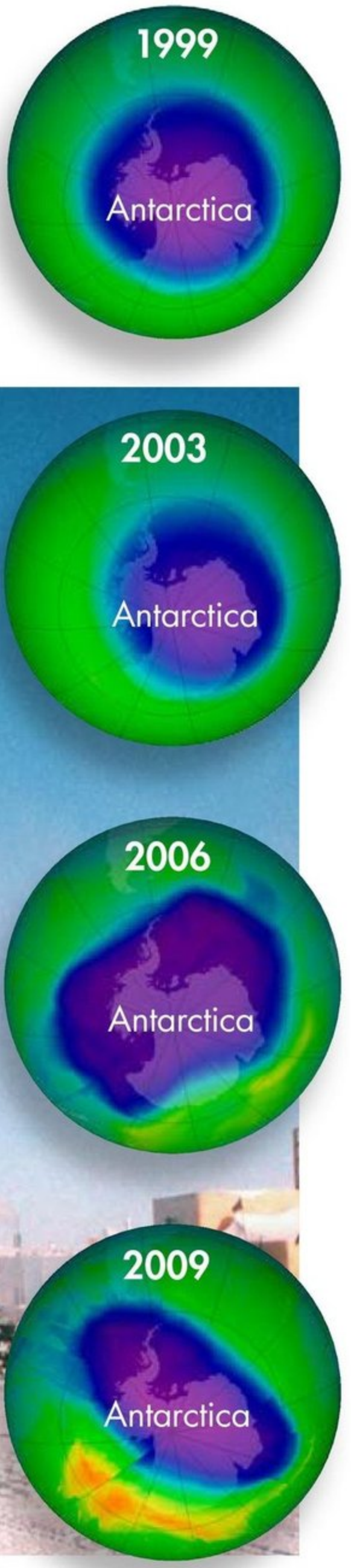
In the 1970s, scientists in Antarctica measured an increase in the ultraviolet (UV) light reaching Earth. Later, satellites confirmed that UV light in some areas was not being absorbed by the ozone layer as much as it had been in previous years. From the satellite data, scientists made maps that showed a hole in the ozone layer over the South Pole.

By 1994, the ozone level had dropped to one-half of what it was in the 1970s. There were signs that the ozone hole discovered above Antarctica was expanding past the polar region toward the equator, where more people lived. The ozone hole was becoming a threat to people and the environment.

Math Minute

A one-percent decrease in ozone in the stratosphere will cause a two-percent increase in UV-B light that reaches the ground. If ozone in the stratosphere decreases by ten percent, what is the increase in the percentage of UV-B light reaching the ground?

Ozone destruction is greatest around the North and South Poles during winter, due to the winds and low temperatures common to polar regions. The ozone layer rebuilds during warmer months. (Winter in Antarctica, or the South Pole, occurs during summer in the Arctic, or North Pole.)



Scientists in Antarctica launch an instrument that will measure the ozone layer. NASA ozone charts record the amount of ozone on a daily basis. The lowest ozone level ever recorded was in 2006.

Chemical Causes of the Ozone Hole

Scientists searched for causes of the changing ozone levels. They discovered that some factories release chemicals called CFCs, or chlorofluorocarbons, that could destroy ozone. The element *chlorine* in CFCs was the main problem. Since CFCs were used in air conditioners, insulating foams, and spray paint, large amounts of chlorine were regularly released into the atmosphere.

Scientists also learned that another chemical, *bromine*, could destroy ozone. Bromine is found in substances that are known as ODCs, or Ozone Depleting Chemicals. Bromine can destroy forty-five times more ozone than an equal amount of chlorine found in CFCs (chlorofluorocarbons). ODCs are frequently found in chemicals used to control fires.

Planes are used to drop fire retardant chemicals on forest fires.

Erupting volcanoes are one natural source of harmful chemicals that destroy ozone.

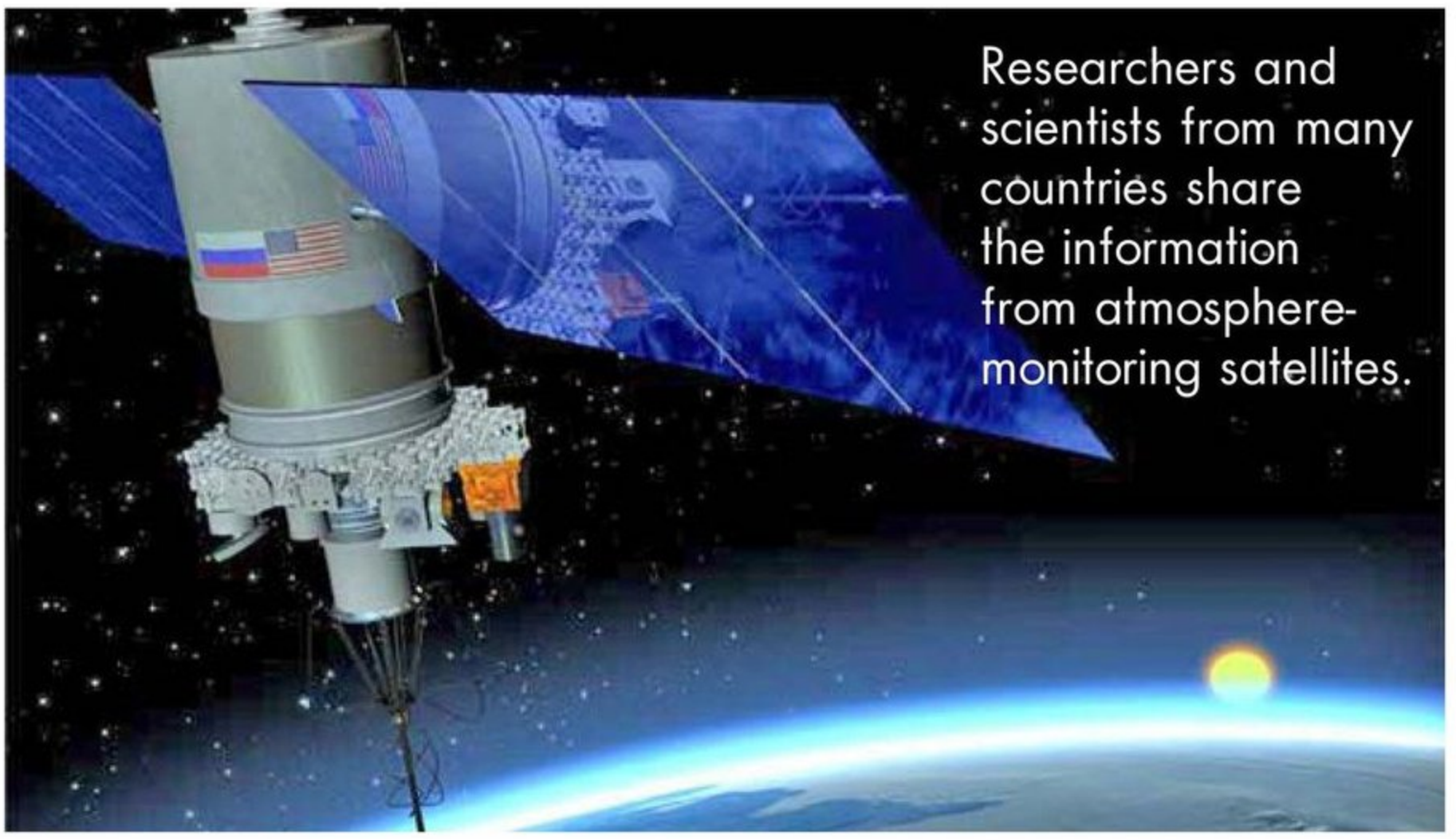
CFCs and ODCs rise into the stratosphere, where sunlight breaks these molecules into chlorine and bromine atoms. The chlorine and bromine then break down ozone molecules. One chlorine atom can destroy 100,000 ozone molecules. The process stops when the chlorine and bromine drift into space.

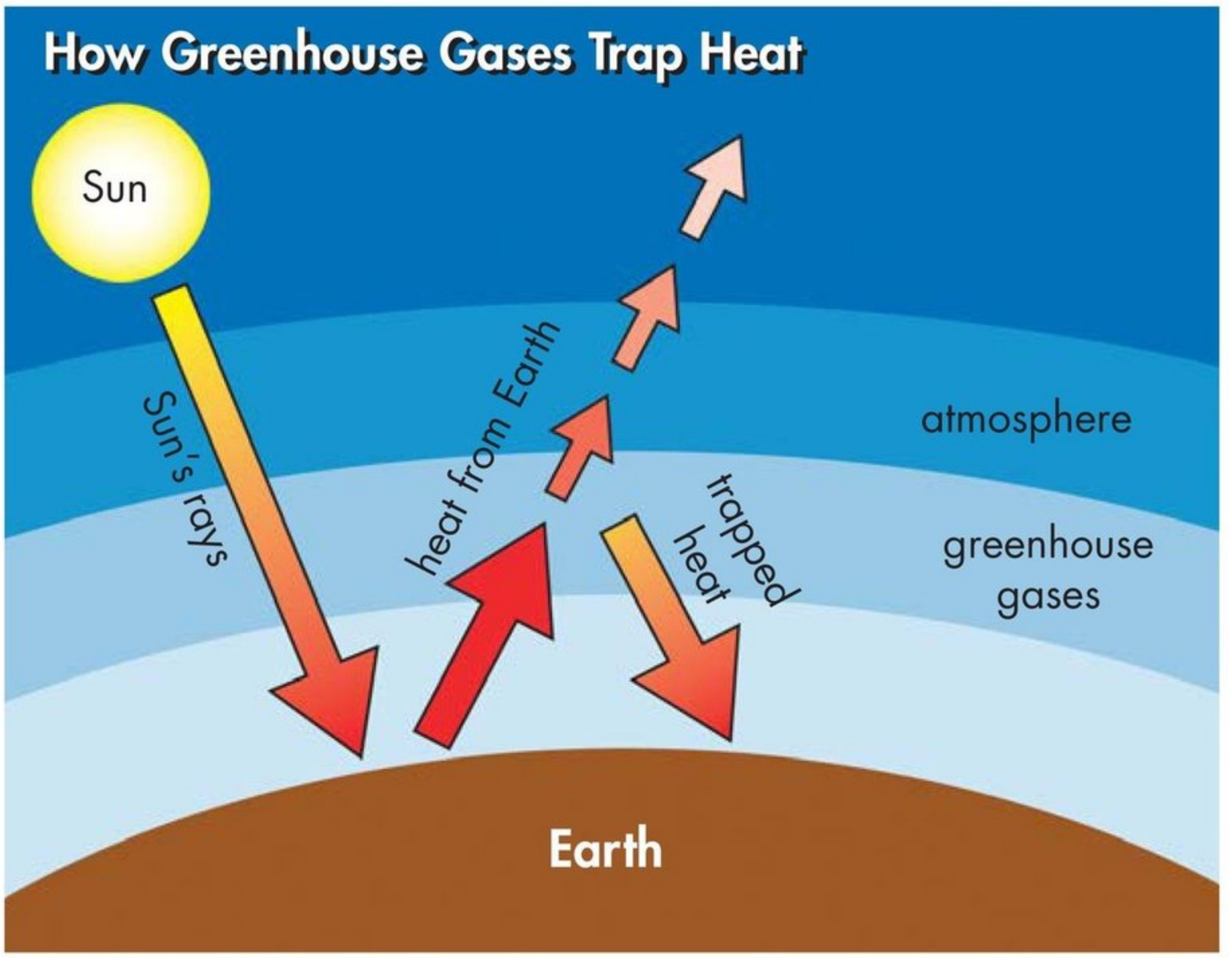
Natural sources of chemicals can also destroy ozone. One such source is erupting volcanoes, which spread hydrochloric acid high into the stratosphere, where it breaks down into ozone-destroying chlorine gas. While volcanoes and other natural events destroy some ozone, CFCs and ODCs from industry cause most of the damage.

The World Responds

Even after ozone destruction was connected to CFCs and ODCs, many countries continued to produce them. These chemicals were so useful that nobody wanted to give them up. It took cooperation between the governments of many nations to address this global problem.

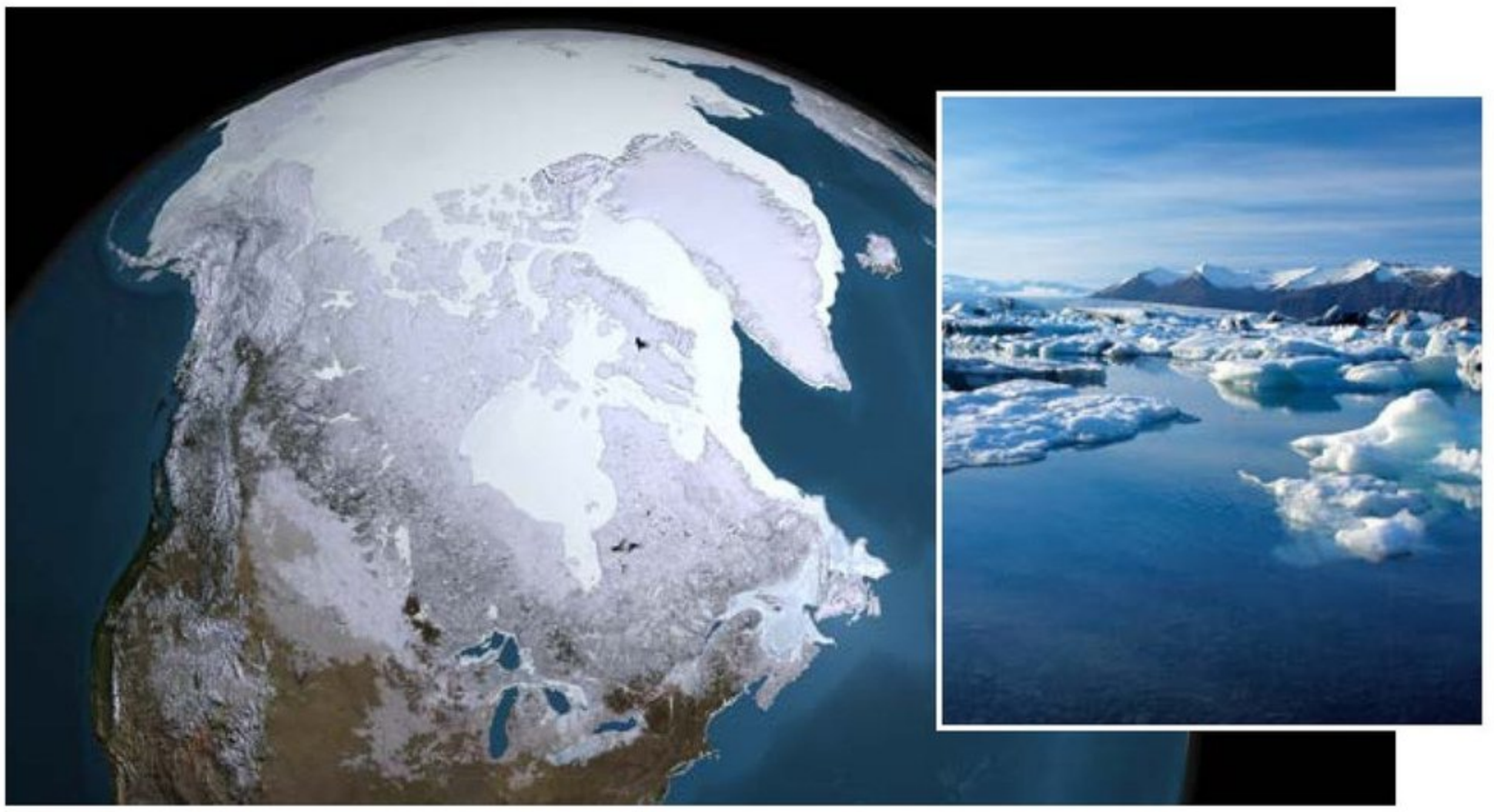
Countries joined together in 1987 and signed the Montreal Protocol. This agreement called for reducing and later banning the production of CFCs and ODCs by 1996. This is a success story because it is the first time that many nations have tackled an environmental issue on a global scale. As a result, since the year 2000, CFCs and ODCs in the atmosphere have been decreasing. However, it may take years to tell whether or not the ozone layer will fully recover.





Global Warming

Engineers quickly developed alternative chemicals to CFCs and ODCs in hopes of restoring the ozone layer. However, some of these ozone-friendly alternative chemicals are also powerful *greenhouse gases*. Greenhouse gases such as carbon dioxide and methane, when released into the atmosphere, trap heat near Earth's surface in the same way that glass traps heat in a greenhouse. The result is a condition known as the **greenhouse effect**. Some scientists think an increase in gases that create the greenhouse effect has caused the temperature of the air around Earth to gradually rise.



If Earth becomes hotter, polar ice on land might melt and break off into the sea, raising the oceans' water levels.

Earth has warmed by one degree over the last one hundred years. That may not seem like a lot, but scientists are concerned that, over time, a persistent warming trend might cause Earth's temperature to rise higher and higher.

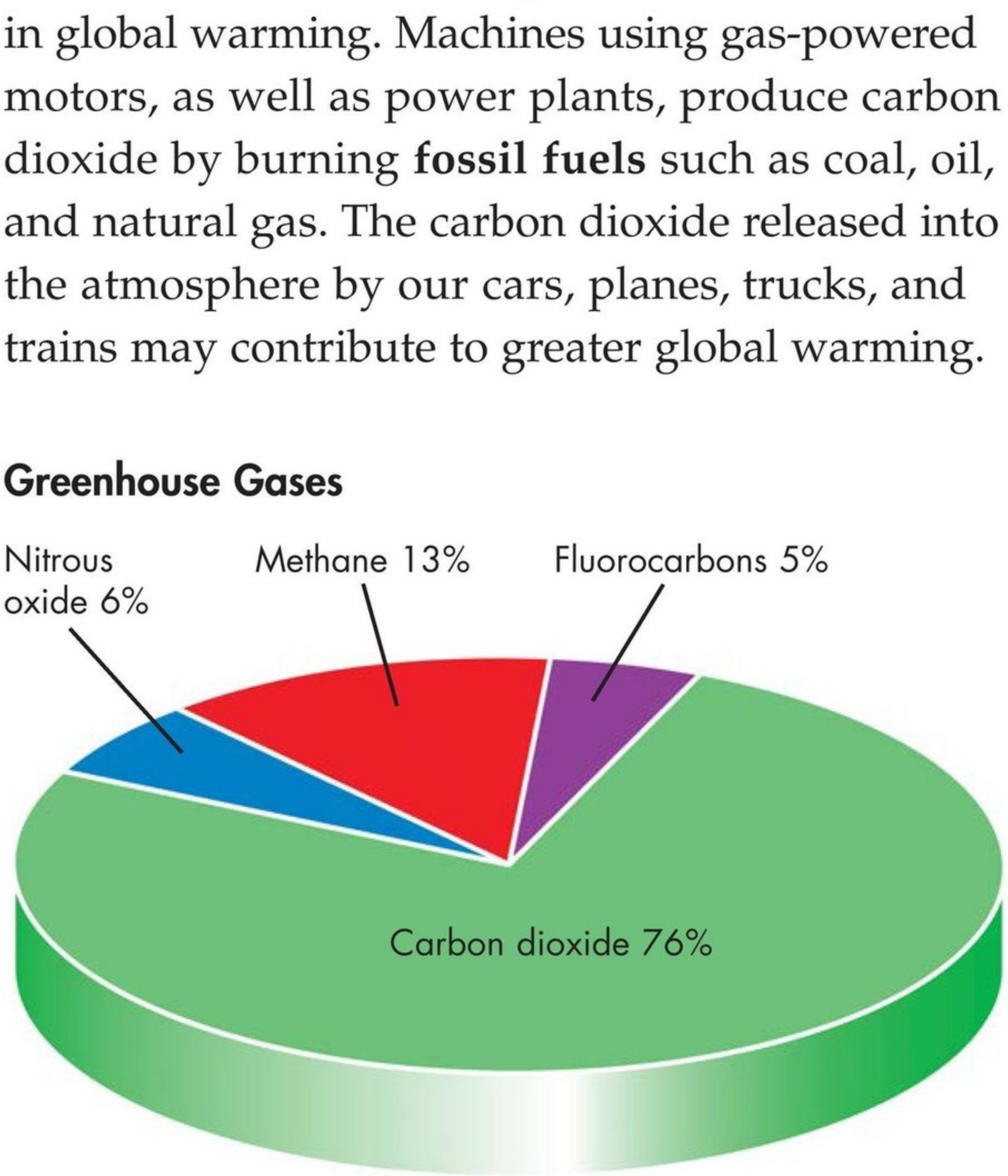
A hotter Earth may lead to the melting of the polar ice caps and warming of the oceans. If ice on land melts, the world's oceans would rise and flood land near the coast, destroying habitats of living things. A warmer Earth would also create changes in weather patterns that could lead to habitat destruction and the deaths of some plants and animals. Some immobile living things, such as the oceans' corals, would be trapped and doomed. The sea life that depends on the coral reefs for shelter and food would also die.

Greenhouse Gases

Four different greenhouse gases contribute to **global warming** when they are released into the atmosphere. The four gases are carbon dioxide, methane, nitrous oxide, and fluorocarbons.

Most scientists believe carbon dioxide causes about three-fourths, or 76 percent, of the increase in global warming. Machines using gas-powered motors, as well as power plants, produce carbon dioxide by burning **fossil fuels** such as coal, oil, and natural gas. The carbon dioxide released into the atmosphere by our cars, planes, trucks, and trains may contribute to greater global warming.

Greenhouse Gases



Most scientists think these four gases are responsible for current trends in global warming.

Methane is responsible for about 13 percent of global warming. Methane is produced naturally in swamps and by livestock passing gas. It is also a product of rotting garbage.

Nitrous oxide is the third-worst **contributor** to global warming. Nitrous oxide is found mostly in fertilizers. The nitrogen in fertilizers is an important plant food, but when it mixes with soil it produces nitrous oxide. Nitrous oxide is also produced when animal waste **decomposes**.

The final contributor to global warming is fluorocarbon gases. Fluorocarbons also contribute to the destruction of ozone. Fluorocarbons rarely occur in nature. They are almost totally human-made, so their production can be prevented.

Rotting garbage at landfills produces methane, a greenhouse gas.

Carpooling and taking public transportation would reduce the amount of carbon dioxide released into the atmosphere by gas-powered cars and trucks.

World Debate

Not everyone agrees on the seriousness of the global-warming problem. Some say that a one-percent rise is nothing to be concerned about. Others think that the problem will worsen and that people ought to take steps now to prevent future global warming. These people believe that we should find ways to reduce greenhouse gas production before it is too late.

Reducing the amount of greenhouse gases may also slow down the destruction of the ozone layer. Global warming of the lower atmosphere actually cools the upper atmosphere. This cooling leads to conditions that can cause

Riding bicycles, skateboards, and scooters instead of riding in the car helps to reduce production of greenhouse gases.

further breakdown of the ozone layer. So, if we can learn how to decrease the production of greenhouse gases, we might prevent further destruction of the ozone layer.

There are no definite answers to the global-warming problem, but many scientists around the world are looking into effective solutions. They feel it is in everyone's best interest to understand as much as possible about decreasing the release of greenhouse gases.

What You Can Do to Help

Governments and industries around the world have taken steps to reduce ozone-destroying chemicals. They are cooperating in programs to measure and monitor the ozone layer. There are also things we can do as individuals to protect the atmosphere. We can stop producing more ground-level ozone by reducing the use of automobiles. And we can use hand-powered mowers instead of mowers that burn gasoline.

Protecting the upper-level ozone layer means trying to avoid releasing CFCs and ODCs into the atmosphere. Recycle the chemicals that cool old refrigerators and air conditioners. Avoid foam packaging, if possible. Write letters to industries that still use CFCs and ODCs, and ask them what they are doing to find alternatives.

Using public transportation helps to decrease ozone depletion.

Conclusion

Factories and certain products we use release chemicals that are destroying part of the protective blanket surrounding Earth. The chemicals being released into the air may be causing Earth's atmosphere to warm up. Actions taken by governments from all around the world have helped ban certain chemicals. However, more action is needed to prevent future harm to our atmosphere.

The ozone problem has taught us many things. We now know that we need to control the use of certain chemicals. Scientists, politicians, and concerned citizens work together toward common goals. Perhaps the most important thing it has taught us is that we need to start thinking about how our current activities might affect not only people today, but also our future well-being and the health of our planet.

Glossary

atmosphere *(n.)* the gas surrounding a celestial body, such as Earth (p. 4)

atoms *(n.)* the smallest particles of elements that can exist alone (p. 7)

chemicals *(n.)* substances produced by or used in a chemical process (p. 9)

constant *(adj.)* steady; not changing (p. 7)

contributor *(n.)* a donor or supplier of something (p. 18)

decomposes *(v.)* breaks down in decay (p. 18)

fossil fuels *(n.)* organic substances, such as coal and oil, found underground and used as sources of energy (p. 17)

global warming *(n.)* an increase in the temperature of Earth's atmosphere, especially a rise great enough to change the climate (p. 17)

greenhouse effect *(n.)* the process by which heat is trapped inside Earth's atmosphere by gases (p. 15)

molecules *(n.)* the smallest parts of a substance that are formed when two or more atoms are held together (p. 7)

pollutants *(n.)* things that cause something to no longer be pure (p. 9)

precipitation *(n.)* different forms of water that fall to the ground, such as hail, sleet, rain, snow, or mist (p. 5)

ultraviolet *(adj.)* relating to a form of light energy that cannot be seen (p. 6)

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Explore More

On the Internet, use *www.google.com* to find out more about topics presented in this book. Use terms from the text, or try searching for glossary or index words.

Some searches to try: *global warming*, *ozone hole*, or *CFCs*.

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