OZONE LAYER: WHO CARES? DO YOU?

Lisa Lyons
Psychology
DeSisto School, West Stockbridge, MA

[Assignment: Using the essays from Lester A. Brown's *State of the World* as your resource, write a paper analyzing an environmental problem confronting the contemporary world. As you write, remember that you will be presenting these papers to the class, as if you were at a conference on the environment and your classmates were fellow participants who will engage you with their questions after your presentation.]

In 1839, a German born scientist, Christian Friedrich Schobein, was a professor of chemistry at the University of Basel in Switzerland. Besides teaching, he performed lab experiments hoping to find what made up the atmosphere. To do this he combined and separated many liquids and gases. During one of these experiments Christian passed an electrical charge through a flask of water. Each time he passed the change through he noticed a peculiar smell. At first he thought it was electrically charged oxygen but finally he realized it wasn't. He had found a new substance which he named ozone. The word ozone comes from the German word *ozein*, meaning "to smell." The same smell is the smell that lingers after a electrical lightning storms. During a lightning storm, lightning cuts through the air, which separates the oxygen molecules. The oxygen then reforms as ozone. A molecule of oxygen is made up of two atoms and a molecule of ozone contains three atoms of oxygen.

Schonbein himself invented a crude way of measuring levels of ozone concentration. First, he soaked a piece of paper with a chemical. As the chemical dried, the ozone in the air oxidized it. This turned the paper blue. The more ozone present, the darker blue the paper became. Schonbein placed a new piece of paper outside every day in order to measure the levels of ozone in the air. In time, scientists came to refer to this technique as the Schonbein paper method. Unfortunately, this method shows only whether ozone levels are light, moderate, or heavy, so it is not very precise.

A better method for measuring ozone levels was developed in 1876. Charles Soret, a French scientist who had been studying ozone and weather, decided that the Schobein papers were not always accurate. So Soret devised his own approach. He measured ozone by the way it reacted with chemicals dissolved in water. Using this method, he was more able to accurately measure ozone. Soret measured the air every day for thirty-four years. Later, scientists used Soret's work to compare ozone layers of the past and present.

Modern scientists have an even more accurate method of measuring ozone. This method is called gas chromatography. This process works by filtering and burning gases containing ozone. The device used in this process is so precise that it can detect a single molecule of ozone among one million other molecules.
There are two general types of ozone: low-level and upper-level ozone. Low-level ozone exists near the earth's surface in the lowest portion of the atmosphere. This is why scientists refer to it as low-level ozone. This lowest atmospheric layer, occupying the space between the earth's surface and an altitude of about six to nine miles, is called the troposphere. Scientists also refer to low-level ozone as tropospheric ozone.

Tropospheric ozone, which can be harmful to living things, is created in many ways. Usually ozone is produced when sunlight reacts with chemicals released into the air. Sometimes, human activities are responsible for the creation of the ozone. Exhaust from gasoline-burning cars and trucks, for example, contain various pollutants, including hydrocarbons and nitric oxide. These substances react with each other and also with sunlight, creating ozone in the process. Emissions from coal gas, and from oil-burning utility plants, and vapors from paint strippers, dry-cleaning, and charcoal lighter fluids, also produce ozone when they mix with sunlight.

Fire, whether it occurs naturally or is set by human beings, is also a source of low-level ozone. The smoke from fire contains chemicals that produce ozone when mixed with sunlight. During the sugarcane harvest in Brazil, for instance, farmers often burn off excess vegetation that grows around the cane stalks. In some years, more than twenty thousand cane fires are set each week during the harvest season. Because Brazil is near the equator, it receives the sun's rays more directly than do areas further north or south. This combination of pollutants released by fires and plenty of direct sunlight produces huge amounts of ozone pollution.

Other sources of tropospheric ozone are completely natural. During electrical storms, bolts of lightning rip through the troposphere, separating the atoms of some oxygen molecules. Some of these atoms are combined with other oxygen molecules to create ozone. There are other ways nature makes low-level ozone. Ozone forms when sunlight combines with methane, a gas given off by decaying plants and animal tissue and by the gaseous wastes of grazing animals like cows and sheep. Another natural source of tropospheric ozone was not fully understood by scientists until the late 1980s. In 1987, Ronald Lindsay and Jennifer Richardson, both of the Georgia Institute of Technology, studied ozone levels around Atlanta, Georgia. They found that the amount of ozone in the air was far too great to be attributed to cars and factories alone. The researchers finally concluded that trees in the Atlanta area were creating ozone. The researchers found that trees released hydrocarbons during photosynthesis. This is the process by which green plants use sunlight to create energy. When the hydrocarbons reacted with the sunlight and pollutants, they created ozone. Trees generate large amounts of hydrocarbons. In fact, scientists found that the amount of hydrocarbons released by trees in the Atlanta area was about the same as the amount emitted by cars and industrial factories. This does not mean that trees pollute. Only when the hydrocarbons released by the trees combine with other pollutants given off by fuel-burning activities of humans is too much ozone produced.
The second general type of ozone exists in the upper portion of the earth's atmosphere and is called upper-level ozone. This layer of the atmosphere, extending from about twelve to twenty-four miles above the earth's surface, is known as the stratosphere. Therefore, scientists also refer to this upper-level ozone as stratospheric ozone. This ozone layer blocks the most dangerous of the sun's rays and prevents them from harming living things on earth. This role as protector of life below began billions of years ago when there was little oxygen in the air. When ocean plants first appeared on earth, most had to stay below the water's surface. This was to avoid ultraviolet light, a kind of solar ray that damages living tissue. Ultraviolet light flooded the primitive earth, making the development of life a slow, painstaking process.

As the oxygen given off by the early plants slowly built up in the atmosphere, some of it floated high into the stratosphere. There, the oxygen molecules encountered sunlight that was stronger than the sunlight that reaches the surface. This combination of sunlight and oxygen molecules produced ozone, a gas that could readily absorb ultraviolet light. With protection provided by the ozone layer, plants thrived in the ocean and on its surface. The amount of oxygen in the air increased and formed more ozone. Eventually, the stratospheric ozone layer grew thick enough to protect more advanced forms of life from ultraviolet radiation. Life evolved on land and proliferated into the millions of varieties of plant and animal species known today, including human beings.

The nature of ozone appears to go against common sense. On the hand, there is low-level, tropospheric ozone, which is classified as a pollutant. Then, there is the upper-level, stratospheric ozone that is essential to the existence of life. The amount of both kinds of ozone is changing. Low-level ozone is increasing, while upper-level ozone is decreasing. Scientists disagree on what these changes mean. But it appears that there is too much of one kind of ozone and too little of the other. Researchers are trying to determine how these levels of ozone will affect the world environment and people's lives.

The main cause of depletion of the ozone is chlorofluorocarbons, referred to as CFC's. CFC's are ozone-destroying chemical compounds developed in 1930 as coolants for refrigerators. Later, these chemicals were used in spray cans and other products. CFC's all contain five elements referred to as halogens. Halogens consist of fluorine, chlorine, bromine, iodine, and astatine. In actuality, even though the CFC's destroy the ozone, they eventually break down the ozone into oxygen again so the whole process starts over. Since all CFC's do not rejuvenate, the ozone layer is still being destroyed, which is forming a hole in the atmosphere. The CFC's stay intact for sixty to one hundred years. So even though we've reduced emission, there are still significant amounts of CFC's in the atmosphere that haven't reacted yet with the ozone.

Until 1987 not much was being done about the protection of the ozone layer. Then, in 1987, the Montreal Protocol took place. It was signed by many nations. The major countries involved were the United States, Canada, Sweden, Finland, Switzerland, and New Zealand. The protocol established controls on certain chemicals that destroy the stratospheric ozone layer. Many countries were not involved because at
the time the protocol was made, many countries were in conflict and didn't want to get together to discuss the ozone while they were at war.

If we don't do more to help protect the stratospheric ozone layer, great damage will begin to occur. Each one percent of ozone equals two percent increase in ultraviolet rays. If an increase in ultraviolet rays occurs then there will be a five to seven percent increase in skin cancer, of which one percent will be deadly. At the rate we are going, by the year 2075 it is said that an extra one hundred and seventy million cases of skin cancer will occur. We need to do something in order to protect our environment now and for the future generations.

[Editor's Note: Students and teachers might profit from analyzing this essay closely to see how Lisa uses most if not all of the rhetorical modes listed in our Table of Contents in the process of educating her readers about ozone and the ozone layer.]