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Its Getting Thinner and Thinner

Curriculum Unit 93.05.07
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In this unit I will discuss oxygen, ozone and life: the ozone layer today; oxygen and life; and cancer. Ozone is a form of oxygen which is a gas and an essential ingredient of the air that we breathe. Aerosol spray: the small squirts of fine mist of tiny droplets, called an aerosol. The term aerosol is synonymous with spray can. The compound CFCs is used in spray cans to push the active ingredient out of the can. Ozone Depletion: depletion of the ozone content of the stratosphere will cause temperature changes on earth and more ultraviolet radiation will penetrate to the earth.

My unit will include lesson plans, bibliographies for teacher and students, a vocabulary list, hands on activities and a film. This unit will be taught in the eighth grade science class for two weeks.

We realize that we play a major role in some of the problems that plague our environment. One such problem is the thinning of the ozone layer. It was not until after the ozone layer was developed that there was life on the land surface of the Earth. The ozone layer protects mankind and animals from ultraviolet radiation from the sun. Ultraviolet radiation can kill living things.

Scientific studies confirmed that one chemical compound responsible for the destruction of the ozone is chlorofluor-ocarbons. This particular chemical compound is used widely in many commodities from propellants in spray cans, to the manufacture of refrigerators and microchips.

It was in the spring of 1987 when scientists noticed that 11 miles above Antarctica half the ozone had been destroyed. Where the amount of chlorine oxides went up, the amount of ozone went down. The presence of chlorine atoms in the stratosphere is being blamed for the destruction of the ozone.

The question may be asked, are we self-destructing? You may be able to answer yourself by the knowledge that the hole in the sky is now the size of the United States and the depth of Mount Everest. The reason for concern is that in the 1970s, ozone was identified as a key feature in the earth’s ecosystem. Today, there are some corrective methods being implemented to correct the thinning of the ozone.

DISCOVERY

It was not until the advent of controlled electrical energy that ozone was discovered. Van Marum, observed a peculiar odor after passing an electrical discharge through oxygen and the Swiss Chemist Schonbein noted that the same odor occurred in oxygen and called it ozone.

Early scientists measured atmospheric ozone by exposing paper that had been impregnated with potassium iodide in a solution containing starch. Schonbein’s qualitative scale was used. This particular scale represented by the blueness of the exposed paper indicated the relative quantity of ozone on a scale of 1 to 10.

Today basically the methods used for measuring ozone involve optical or chemical techniques. In the global network, the Dobson spectrophotometer is the designated standard instrument for total ozone measurements. It is also used as a calibration base for other total ozone observing systems. Dobson’s determination of total ozone is based on assumptions, ie., the middle or lower layer of the stratosphere is the major part of the ozone layer. There are still many uncertainties associated with the calibrations as was pointed out by Dobson in a series of published papers in 1975. Some uncertainties involve:

1. the possible inaccuracy of the effective ozone absorption coefficient used with the Dobson spectrophotometer and the temperature dependence of these coefficients.
2. possible nonlinear variation of aerosol scattering coefficients in the Huggins band.
3. the need for correction for polarized light associated with zenith or cloudy sky observations.

OXYGEN, OZONE AND LIFE

Ozone in high concentrations is a poisonous pale blue gas. In small concentrations it has a pungent odor. It is produced naturally by electric discharges, by lightning, and high voltage electrical equipment. Near the ground level it forms a part of the photochemical smog and is produced by chemical reactions involving sunlight acting on pollution.

Ozone can be a beneficial compound when used in the chemical industry as a bleaching agent and a strong germicide to both sterilize drinking water and swimming pools. From a distance, ozone is essential to our well-being. In the stratosphere the ozone protects the surface of the Earth from ultraviolet radiation produced by the sun. Ozone is different from oxygen and is essential for all forms of life on Earth. Molecules of oxygen contain two oxygen atoms while molecules of ozone contain three oxygen atoms. The difference between the two is life and death for any animal that breathes in more than a trace of ozone.

The atmosphere of the Earth serves as a warm blanket of oxygen suitable for the life forms that have evolved under it. The hole in the sky over Antarctica generated great concern that the atmosphere may now be changing, triggering conditions never experienced before.

The atmosphere is divided into layers which are described in terms of the way temperature changes with altitude.

The layer of atmosphere closest to the earth is the troposphere: It is the part that we breath and in which our weather occurs driven by convection. The troposphere is relatively thin due to the weight of the air above it. The troposphere is the densest part of the atmosphere containing 85 percent of the atmosphere's mass. The remaining 15 percent is virtually in the stratosphere which contains air mass below 25 miles altitude. The air in the stratosphere is thin. The stratosphere also absorbs heat from the sun in the form of ultraviolet radiation (UV), because the oxygen seeping up from the troposphere absorbs energy from the sun. Chemically, solar radiation breaks apart the 2 atoms of oxygen in a molecule of diatomic oxygen, and forming two molecules of ozone as a result. The term ozone layer is synonymous with stratosphere. The stratosphere is warmer at higher altitudes. Therefore, hot air does not rise since the air above is hotter than the air below. Hence, convection cannot occur. Since the stratosphere acts like a lid on the troposphere, it keeps convection and weather below the tropopause.

Ozone Layer Today

The ozone layer exists because of the production of oxygen by living things in the troposphere seeping up into the stratosphere and reacting with sunlight forming triatomic molecules of ozone. The presence of so much free oxygen today explains how the ozone is maintained.

The validity of the explanation depends on both the nature of the radiation of the sun and the manner in which ozone and oxygen respond to that radiation. The sun emits energy mostly in the form of yellow light which has a wavelength range of 500 to 600 nanometers (nm). To our eyes the visible light appears red at 76 nm to violet at 400 nm. Nevertheless, there is still a significant amount of solar energy radiated from the sides of the band in the infrared and the ultraviolet.

Specific wavelengths of radiation affect all molecules and a certain amount of energy is needed to break the connection of any particular molecular bond.

In the stratosphere ozone is constantly being produced and destroyed by interactions involving sunlight and oxygen.

RELATIONSHIP BETWEEN LIFE AND OZONE

It is believed that water is the key to the origin of life on Earth. Oxygen could have been released in the atmosphere as soon as the atmosphere was formed by the process of photo-dissociation of water caused by UV from the sun. The sun breaks the hydrogen and oxygen atoms in water in a similar manner to the breakdown of oxygen molecules in the stratosphere today. However, today the oxygen in the air was produced by the action of living things (via photosynthesis).

Man is baffled as to exactly how life emerged, however, evidence suggests that UV may have been an important contributor. Ultraviolet radiation from the sun provided the necessary energy to rearrange molecules and cause chemical processes in pools of water on the Earth referred to as "primordial soup."

In the process of photosynthesis, living organisms use energy directly from the sun and discard oxygen as a waste product. In the process of respiration, living organisms use available energy by letting oxygen react with carbon as a power supply, therefore, releasing carbon dioxide back into the environment. Human beings depend on photosynthesis by plants to provide food from which carbon is extracted to form with oxygen in the body. Without the free oxygen in the atmosphere, respiration would be impossible. Consequently, without oxygen in the atmosphere there would be no ozone layer and intense ultraviolet light would penetrate through to the ground and man would not be able to survive.

VEGETATION AND DISEASE

In the 1970's the ozone layer was linked with cancer due to human's sensitivity to ultraviolet radiation. The ultraviolet radiation band from the sun is known as UV-B. The ozone layer in the stratosphere absorbs most of the ultraviolet radiation passing through but UV-B is a small part of the solar radiation that reaches the ground. The highly affected areas are the tropics and the high slopes on mountains where the sun shines down with intense force. There is also less troposphere above to absorb the UV. UV-B causes sunburn and certain forms of skin cancer (malignant melanoma). By comparing data on cancer statistics from different regions, researchers from the Environ-mental Protection Agency (EPA) have calculated that with the depletion of one percent of ozone in the stratosphere there would be a five percent increase in the number of nonmalignant skin cancer each year in the United States. These cancers can be removed surgically. Those cancers also occur later in life as a result of many years of exposure to UV-B.

It is believed that the increase of malignant melanoma is caused by the changing fashions. Modern clothes expose large areas of the body coupled with sun bathing. Studies have also indicated that cancers are more common among people leading indoor lives who are exposed intermittently to intense UV-B for short periods of time. Skin cancer has also proven to be more of a problem to people with fair skin.

Radiation suppresses the body's natural defense mechanism making it easier for tumors to grow because the body is not able to fight back effectively. Some problems that can affect people of all skin color are hepatitis, infections of the skin caused by parasites, and a likely increase in incidents of infections by the herpes virus. These findings were published in 1987 by the EPA.

Animals are not the only organisms to be affected by the depletion of the ozone. Plants have also been affected. Soybean crops have suffered a 15 percent decrease in the yield when UV-B has risen by 25 percent.

Research has revealed that domesticated food animals such as cattle contract cancer of the eye and can induce pink eye when exposed to more UV-B. The effect on wild animals and uncultiva-ted vegetation over the Earth can only be speculated.

If the average concentration of ozone declined by one or two percent, there would be a global increase in the intensity of UV-B over a long period of time. This could cause a change in temperature. A six degree F shift in the global average temperature would, in one direction, send us back into the ice age or in the other direction would cause the polar caps to melt, inundating cities such as New York and Leningrad.

AEROSOL CANS

The term aerosol spray is a fine mist of tiny droplets. Scientist believe that aerosol particles occur naturally throughout the atmosphere including the stratosphere in many different forms. Lay terminology that is synonymous to aerosol is spray can, not with the fine mist of particles that come out of the nozzle. Non scientists are not aware that the term aerosol can also be used to describe nitric acid an sulfuric acid droplets floating many miles above the ground. That is why the more prosaic term spray can may be a better terminology.

In 1970 spray cans were big business in the United States. They were filled with products ranging from hair spray and insecticides to disinfectants and polishes. Many of these cans used compounds known as chlorofluorocarbons, or CFCs to propel the active ingredients out of the can. When the nozzle is pressed the CFSs propellants are rushed out through the tiny hole accompanied by a fine mist of the active ingredient.

CHLOROFLUOROCARBONS (CFCs)

CFCs have been regarded by the chemical industry as a miracle substance. Their properties were discovered by accident after being originally developed as the working fluid used in refrigerators. They were ideal since they boiled at about -40 F and at 32 F were nonflammable, nontoxic, inexpensive to manufacture, easy to store and chemically stable. CFCs had proven to be useful as solvents effective in such items as cleaning delicate semiconductor circuitry, blowing foams (e.g. the foamed hard plastic of coffee cups), and fast food packaging cartons.

Seventy-five percent of CFCs emission into the environment came from spray cans, 15 percent from leaky refrigerators and air conditioning systems, especially car air conditioners. Due to the stability of CFCs, they get into the atmosphere and remain there for a long period of time.

Lovelock believed that there is nothing known in the troposphere that can attack CFCs and break down their chemical structure. They do not interact with living things, nor dissolve in the ocean. They are not washed out of the air by precipita-tion. They do, however, gradually work their way upward into the stratosphere. It is in the stratosphere where they are chemically broken apart by ultraviolet radiation releasing chlorine atoms.

The problem presented by CFCs is that they contain chlorine. The compounds, chlorofluorocarbons indicate that they are built up from atoms of chlorine, fluorine, and carbon. DuPont gave his manufactured CFCs the brand name Freons and consequently, developed a labeling system that indicates how many atoms of each kind are present in a particular type of Freon. The two most commonly used CFCs are (F-11) trichlorofluoromethane (CCl3 F) and F-12 dichlorofluoromethane (CCl2 F2). F-11 is estimated to survive 75 years before being broken down in the atmosphere.

F-11, F-12, and F-13 do not absorb radiation with wavelengths longer than 240 nm. One nanometer is one-billionth of a meter. In the troposphere the ozone layer protects them from photodecomposition. Once the CFCs percolate up to ultraviolet radiation with wavelengths ranging from 200 to 220 nm, because of the exposure to ultraviolet radiation, decomposition can occur.

CCL + UV -> C1 + CCL F

CCL F + UV -> C1 + CC1 F

Free chlorine posing a hazard to ozone in the stratosphere once the chlorine catalytic chain is present.

C1 + 03 -> C10 + 02

C10 + -> C1 + 02

Net Effect

0 + 03 -> 02 + 02

Another threat is the remaining fragments of CFCs, CC12 F and CC1 F2 because they are chemically active and will react with other atmosphere molecules. The reason for the reaction is the odd number of elections that like to pair up with each other.

Sherry Rawland’s study revealed that a single atom of chlorine released into the stratosphere would destroy 100,000 molecules of ozone before being locked up in some less reactive form such as G12 . F-11 and F-12 are being put into the atmosphere six times faster than they are being destroyed by ultraviolet radiation in the stratosphere.

In 1980 the Environmental Protection Agency under the Carter administration made great strides in limiting the overall production of CFCs in the United States. In 1981 the Reagan administration killed off all the plans.

In 1970 environmental lobbyists won the war on the spray can in the United States, but only to realize that it was just the tip of the iceberg. Other countries continued their use of CFCs in spray cans and chemical fertilizer. There was also still the problem of pollution from car exhausts and volcanoes spewing chemicals into the atmosphere.

In April 1993 the “New Haven Register” published an article from the “Washington Post” stating that the ozone layer which has been under long assault had taken another blow from industrial chemicals. Credit was also given to Mount Pinatubo.

The article also stated that during late 1992 and early 1993 the ozone over our plant as a whole was 2 percent to 3 percent lower since 1979 when scientists started monitoring the ozone. The measurements took place over the temperate zone of the western United States and Eurasia. The past winters loss was 14 percent.

Researchers added that if Pinatubo caused a depletion of the ozone within 1 to 2 years, natural processes will start to replenish the loss amount of ozone. It is also believed that the ozone will continue to thin until around the year 2000. At that time there should start to be some visible changes. The ozone should start to get thicker.

The predicted turnaround is to be the result from the phase-out of ozone destroying CFCs and other chemicals mandated by an international treaty, the Montreal Protocol.

A collaboration of scientists from the National Aeronautics and Space Administration Goddard Space Flight Center in Greenbelt, Maryland and the National Oceanic and Atmospheric Administration pointed out that the Northern Hemisphere is not experiencing an ozone hole relative to that forming annually over the South Pole. The loss of the ozone does not pose a significant health hazard.

Richard S. Stolarski, a spokesperson from Goddard, pointed out that last winter's great depletion came about when ozone levels were naturally at a high point in their annual cycle. Even though the ozone is being reduced there is still significant amounts overhead.

Data on the ozone is based on observations by several Earth-orbiting satellites operated by NASA and NOAA. Included also is data from latest shuttle flight and is confirmed by ground based ozone monitoring instruments.

If Pinatubo is to blame for ozone loss, it was a delayed effect. The chemicals from the volcano which is located in the Philippines reached into the stratosphere and began circling in an equatorial latitude. Over a period of months, the particles reach north and south. Universal ozone destruction occurred in late 1991. The particles also shaded the ground, contributing to a global cooling trend which brought about a temporary reversal of global warming.

Scientist speculate that Pinatubo possibly affected the ozone layer in three ways. One is by the injection of large quantities of particles into the stratosphere. This caused ozone destroying chemical reactions. The second is that Pinatubo altered the patter of winds in the stratosphere. Rising air could block normal winds causing ozone rich air. The third is the possibility that the warmed stratosphere would also alter the rates at which new ozone is formed or the rate at which old ozone is destroyed.

NITROUS OXIDE

The anesthetic properties of nitrous oxide when taken in small doses produces symptoms of drunkenness. There is not natural occurring chemical reactions that destroy it in the troposphere.

Nitrous oxides when released drift around in the atmosphere and find their way up into the stratosphere. Once in the stratosphere, ultraviolet radiation causes reactions that break up nitrous oxides and produce NO which reacts with the ozone.

Crutzen in 1974 identified the problem that by adding nitrate fertilizer to soil in general that we are providing a raw material for denitrifying bacteria to feast on and, consequently, adding to the problem of N O in the stratosphere and NO in the stratosphere.

Nitrous oxide is also added to the atmosphere by combustion whenever coal or oil is burned in the air. The heat from the fire causes a breakdown of some of the nitrogen molecules in the atmosphere and some is then combined with oxygen to make N O. These nonbiological nitrous oxides follow the same atmospheric cycle as laughing gas is released by denitrification.

In 1989 the measured amount of N O in the troposphere was 304 parts per billion (ppb) and rising at a rate of 0.7 ppb per year. It is erroneous to believe that refusing to purchase spray cans containing CFCs, the potential hazards from nitrous oxide used as a propellant is just as bad.

Of the several hundred million tons of N O being released in the troposphere each year, only a few tens of millions of tons get transferred to the stratosphere.

The engines of high altitude aircraft emit NOx directly as a combustion byproduct. Rocket motors similarly deposit NOx in launch plumes. Space shuttle re-entering earth's atmosphere from space produce N0 by fractional of the air. N0x are generated during photochemical decomposition of anthropogenic N 0 which is released at ground level and transported into the stratosphere.

The major source of atmospheric N 0 is in bacterial denitrification processes. The second source is in combustion and lightening. Humans contribute in the use of manufactured fertilizers where by fixed nitrogen applied to soil is reduced to N 0.

BROMINE

In a minute way, bromine can eat up ozone. Bromine is in the same chemical family as chlorine, the halogens and reacts more effectively with ozone. Bromine is an agriculture chemical that is used as a fumigant against insects and rodents, in both food and tobacco.

Natural sources of chlorine add to the depletion of ozone. Volcanic eruptions are occasionally responsible for injecting large quantities of chlorine compounds into the stratosphere which causes an impact. Chloromethane in the atmosphere original from burning plant material. This may include both natural forest fires or slash and burn agriculture.

The use of carbon tetrachloride, the dry cleaning agent has been restricted in Europe and North America because of its toxic properties. Carbon tetrachloride has a great potential to eat ozone. Carbon tetrachloride contains chlorine and has a lifetime of about 50 years in the atmosphere. Today carbon tetrachloride is used in fire extinguishers and as a fumigant.

CONCLUSION

The troposphere is the lowest layer of the atmosphere. It is the part that we breath and where our weather occurs. Blanketing the troposphere is the stratopause, which is where the ozone layer is located.

The most important aspect of the ozone layer pertaining to the biosphere is its absorption of solar ultraviolet radiation before it reaches the earth's surface. The ultraviolet radiation can be harmful to both animals and plant life. Ozone is sensitive to a number of human and natural activities. Ozone changes will eventually cause serious environmental and global damage.

Chemical compounds, such as, CFCs, nitrous oxides, and bromine are depleting the atmospheric layer of the ozone. From the damage that has already been done to the ozone layer, the results will be around to plague mankind for many years to come. Possibly up to the twenty-second century.

The biosphere must be protected from further excessive contamination where possible.

LESSON PLAN I

Performance Objective:
The students will design posters on the ozone to be judged. First, second, third and honorable recognition prizes are suggested (all participants should receive a certificate).

Action Plan

1. state a problem

2. learn all you can about the problem

3. set goals (workable and realistic)

4. design steps (plans toward reaching your goal)

5. involve others (family, or other group members)

6. self-evaluation (did you work as planned, did you obtain goals, did you achieve all you set out to do, possible changes)

*share your evaluation with the class

*optional: design a skit around your poster—skits are to be videoed by teacher to be played back later.

LESSON PLAN II

Performance Objective:
The students will design a board game on the depletion of the ozone.

Sample of game:

Rules:
1. students in groups of 5

2. students will decide on a name for the game

3. students will state the objective

4. students will state how many can play at one time

5. students will determine who goes first

6. students will determine how a player is rewarded for correct answers

7. students will determine how a player is rewarded for incorrect answers

8. students will determine when game is over

9.students will decide how the winner is determined

10 . students will appoint a monitor to ask the questions

Materials

1. cardboard cut in hexagonal shape

2. stick pin or thumb tack

3. clock hands

4. a stack of questions (20) on ozone depletion

5. index cards

Procedure

1. 4-6 people may play the game

2. turns are to go in a clockwise direction

3. questions are to be placed on 1 x 3” cards

4. questions are to be chosen from the pile of questions

5. if question is answered correct, you may take a turn at spinning the wheel

6. the first person to reach 25 wins the game

7. the winner may challenge the winner of another group of players

Assembly of Game

“Here Today Gone Tomorrow Game”

(figure available in print form)

1. join each corner diagonally with a line

2. write numbers in the spaces, 1-6

3. diagram must be at least 8 x 8”

4. put the stick pin into the end of the clock hand stick it into the cardboard

*cardboard box works best

Sample Questions

1.Q—Spell the continent where the hole in the sky was sighted?
A -Antarctica

2.Q -What does CFCs stand for?

A -chlorofluorocarbons

3.Q -What is another name for spray can?

A -aerosol can

4.Q—Can ultraviolet rays cause skin cancer?

A -yes

5.Q -Tell what UV stands for and spell it.

A -Ultraviolet radiation, u-l-t-r-a-v-i-o-l-e-t r-a-d-i-a-t-i-o-n

LESSON PLAN III

Performance Objective:

The students will be able to list the layeres of the atmosphere with 80% accuracy.

The students will construct a collage by classes.

I. Vocabulary

A. Ozone E. ultraviolet

B. Molecule F. photodissociation

C. Troposphere G. mesosphere

D. Tropopause H. melanoma

II.Layers of the Atmosphere

(Scientist divided the atmosphere into layers according to the way temperature changes with altitude.)

A.Troposphere

1. closest to the ground
2. heated by sunlight
   a. sea
   b. land
   c. vegetation

3. infrared radiation—going out—greenhouse effect
4. higher you go, cooler it becomes
a. 5 miles over pole
b.10 miles over equator
5. tropopause
B.Stratosphere (10-30 miles up)
1. about 10-30 miles up
2. absorbs heat from sun
3. ozone layer
a. ultraviolet radiation
b. diseases
4. Stratopause

C. Mesosphere

III. Construct a Collage

A. Use pictures

B. Use articles

* choose a topic

* set a time limit to complete project

* use 5-10 minutes to affix pictures

IV. Quiz

A. List the layers of the atmosphere.

B. What layer of the atmosphere is closest to the earth?

C. What layer of the atmosphere is the ozone layer located in?

V. Homework: Use reference books to write a one page essay on the ozone.

VOCABULARY

ozone

biosphere

UV Radiation

melanoma

non melanoma

tropapause

troposphere

stratosphere

anthropogenic

clorofluorocarbons (CFCs)

spectrophotometer

bromine

nitrous oxide (N 0)

methane

aerosol

atmosphere

stratopause

nanometers (nm)

photodissociation respiration

malignant

tumor

phytoplankton

anesthetic

combustion

RESOURCE MATERIAL

Video—Ozone: The Hole Story
Sixty minute video—Bill Jurtis uses computer graphics and interviews with ozone researchers to explain this critical environmental issue. Teaching guide included ($24.95)

Telephone: 1-800-243-6877

By mail:
Write to—Ozone: The Hole Story

5000 Park Street North

St. Petersburg, FL 33709

Average temperature profile of air above the earth's.

(figure available in print form)
Simplified diagram of the atmospheric behavior of chlorofluorocarbons.
(figure available in print form)
Processes that Control Ozone in the Stratosphere.
(figure available in print form)
(figures available in print form)

BIBLIOGRAPHY

1. Gribbin, John "The Hole in the Sky;" Bartam Books, New York: May 1988, p. 1-22, 39-62, 63-84

2. "New Haven Register," "Bad News for Earth: Its Ozone is Thinner," "Washington Post" March 4, 1993, p. 1 and 11

3. Prosad, Sheo S. and Whitten, Robert C. "Ozone in the Free Atmosphere;" Van Nostrand Reinhold Company, New York: 1988, p. 6, 7, 16, 17, 123, 126, 127, 243, 254 and 255.

4. Seidel, Stephen "Can We Delay A Greenhouse Warming," U.S. Environmental Protection Agency, Washington, D.C.: September 1983, p. 36-37

5. EPA, 1987 Skin Cancer

TEACHER’S READING LIST

1. Brever, Georg “Air in Danger,” Cambridge University Press, New York: 1988

2. Dotto, Lydia and Schiff, Harold “The Ozone War,” Doubleday, New York: 1978

3. Gribbin, John “The Hole in the Sky,” Bantam Books, New York: May 1988

4. Roland, F. “Chlorofluorocarbons and the Depletion of Stratospheric Ozone,” American Scientist; Jan-Feb 1989

STUDENT’S READING LIST

1. Gribbin, John “The Hole in the Sky;” Bantam Books, New York: May 1988

2. Prosad, Sheo S. and Whitten, Robert C. “Ozone in the Free Atmosphere,” Van Nostrand Reinhold Company: New York 1988

3. Seidel, Stephen “Can We Delay a Greenhouse Warming,” U.S. Environmental Protection Agency, Washington, D.C.: September 1983.