OUR RESTLESS ATMOSPHERE

Teacher's Guide

OUR RESTLESS ATMOSPHERE

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CONTENTS

OUR RESTLESS ATMOSPHERE

TIME: 12 minutes

Presentation Overview

Ours is a restless atmosphere—a sea of air in constant change. Since the beginning of the industrial revolution some two hundred or so years ago, the pace of these changes has increased to a rate unequaled in human history.

A number of these changes have caused either grave ecological damage or, as many scientists fear, have the potential to do so in the not so distant future.

This presentation introduces students to and presents an overview of four of the most important of these concerns: (1) acid rain, (2) surface ozone pollution, (3) CFE damage to the ozone layer, and (4) global warming.

Each is explained in terms of its **causes** and environmental impact and what steps need to be taken to **reduce** or **eliminate it.**

Program Objectives

After viewing the video and participating in the activities, 7th through 12th grade viewers should be able to

- Describe the atmosphere as a mixture of gasses.
- Explain how this mixture is constantly changing.
- Analyze how the rate, or pace, of this change has increased rapidly since the beginning of the industrial revolution.
- Describe some of the changes that have taken place since then that have lead to serious environmental problems.
- Evaluate the steps that can be taken either to prevent them or reduce the damage they cause.
- Define in terms of **causes** and environmental **impact:**
  - acid rain
  - surface ozone pollution and smog
  - CFCs
  - global warming.

Video Summary

The presentation opens by introducing the fact that the atmosphere is a constantly changing mixture of gasses. It then proceeds to tell how the industrial revolution impacted this mixture.

Next, the program defines, in terms of their causes and damage to the environment, acid rain, ozone pollution, CFC damage to the ozone layer and global warming.

The video then closes with a discussion of some of the steps that must be taken to reduce the environmental impact of each of the problems presented.

Teacher Preparation

The Restless Atmosphere can be used in various kinds of audience settings. We suggest that you preview it before showing.

It is also helpful to review the **blackline masters** that are provided and duplicate those you think will be helpful. An answer key is provided in this guide.

Focus/Introducing the Video

One effective way of introducing this presentation is to ask students to define such terms as "atmosphere", "ozone layer", "acid rain", "global warming", before they see the video.

They can either come up with their own separate definitions, or work cooperatively (whole/small group) to come up with a collective definition.

If students are working in small groups, have them share their definitions with the whole class.

You can then facilitate a discussion in which students justify their definitions and critique those of other groups. Students can then vote to arrive at a single working definition.

Once you have shown the video, encourage students to defend/modify their definition(s).

Discussion

The news media and scientific journals at all levels are full of information on the topics covered in this presentation. These provide a wealth of information students can use to increase their understanding of the topics covered as do such popular encyclopedias as the ***World Book.***

Using such resources for background and from the student's own personal experience, discussions can be guided into such areas as:

1. How does pollution impact you personally?
   -At home
   -At school
   -In your community
   -With friends and other family members

2. What do you think needs to be done about the problems presented in the video?

3. Whose responsibility is it to try and protect the environmnent from problems such as those discussed in the video?

4. What steps would you take to protect the environment if you were the mayor of your town?

5. Who should pay for environmental cleanup?

6. What is the concept of costs versus benefits (cost/benefit analysis)?

7. Do you think the public would be ready to pay higher taxes to clean up the environment?

8. Are there steps that need to be taken in your

community to cope with the problems this presentation addresses?

9. If the answer is "yes" to the previous question, what steps can you, as a private citizen, take to try and make the changes you think are needed?

Projects

The material discussed in this program lends itself to a number of projects. Some can be completed by the students on their own, either at school or in their homes. Others are best carried out with the help of a teacher or other adult.

1. The acids involved in **acid rain** lend themselves to study. One obvious approach is for students to find how common various acid or base household substances (such as lemon juice and laundry bleach) are. To do this they will need some way of measuring pH such as a pH meter or test (litmus) papers.

   The students can also measure the pH of any precipitation and compare it to the above measurements.

   Prior to attempting this project it is helpful to explain the pH scale and explain its logarithmic nature.

2. It's simple to arrange a demonstration project involving **global warming.** Use a terrar-ium or any closed "box" sealed on all sides with anything from plastic film to sheet glass and a table lamp for heat. Show, using any available thermometer, how heat builds up in the greenhouse.

   Point out that in this demonstration the plastic or glass takes the place of the carbon dioxide "blanket" mentioned in the video.

   You can mention that what's going on in the demonstration is put to good use by florists, farmers and others who use greenhouses.

3. Many different state, local, and federal agencies are involved in the topics covered in this video. Often their representatives are more than glad to visit schools and to arrange field trips to their offices.

   This is a rich resource. It's also one that puts the students in personal contact with folks who are in the front lines of the battle to clean up our environment.

A Free-Form "Thought Experiment"

The video presents students with a number of different, but closely related, concepts. One way

to help them grasp the relationships between these concepts is to conduct a "thought experiment."

There are many ways to do this. What follows is one approach:

You may want to break the class into small study groups before you start.

Ask the students **to imagine** that they are a bright green bullfrog sitting on a lily pad in the middle of a pond somewhere in a forest in the wilds of Maine (or anywhere else).

Once you have set this scene for them, then ask the students to imagine that the frog is very intelligent, and that he or she knows all about acid rain, surface ozone, CFCs and global warming.

Now pick one or more students to play the role of the frog, and ask them to explain how one or more of the problems covered in the video (such as ozone pollution or acid rain) impacts on their life as a frog and the pond environment they call home.

The goal is to get the students to put themselves into the setting and recognize the many **different ways** in which environmental pollution can affect them and their surroundings and to understand that a **combination** of such problems can have a

terrible impact on a given environment.

For example, one possible answer by students might be that if they were the frog in question, **acid rain** might make the pond so acid that they couldn't live in it. It might also kill the insects on which they feed.

Ozone poisoning could wipe out the trees that shelter the pond and provide food and cover for other wildlife. In addition, if **CFCs** were to harm the ozone layer badly, the increased ultra-violet radiation could cause cancers on their delicate skins.

And finally, severe global warming might change the climate so severely that the pond would dry up, depriving the frog of its home pond.

Follow-Up Activities

1. **Blackline Master** 1 is a concept map dealing with the atmosphere and changes that take place in it.

   (The students are to fill in the boxes using the words in the list. The connecting words will help in the formation of meaningful sentences. These concept maps may be used in several ways: individual in-or-out-of-class assignments; small group class

activities and class discussions).

2. **Blackline Master** 2 is a concept map dealing with our use of fossil fuels.

3. **Blackline Master** 3 is a concept map dealing with ozone.

4. **Blackline Master** 4 is a concept map dealing with global warming.

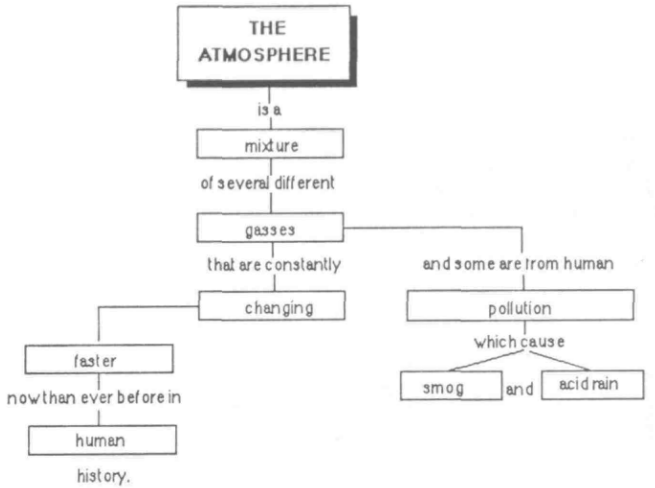
5. **Blackline Master** 5 Is a concept map dealing with acid rain.

6. **Blackline Master** 6 is a concept map dealing with the ozone layer.

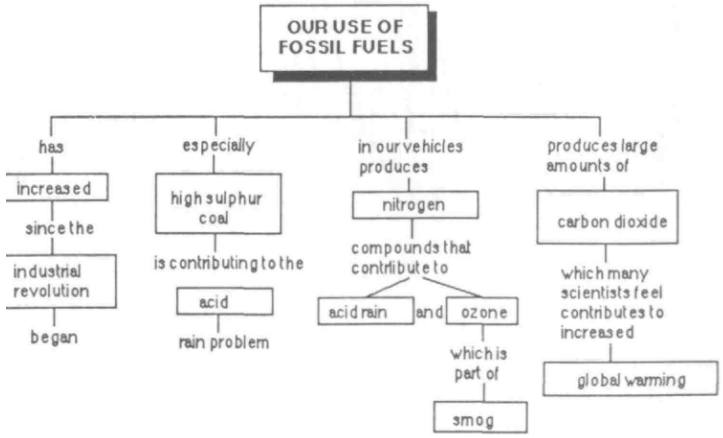
7. **Blackline Master** 7 is a Quiz with Discussion Questions.

Answer Key

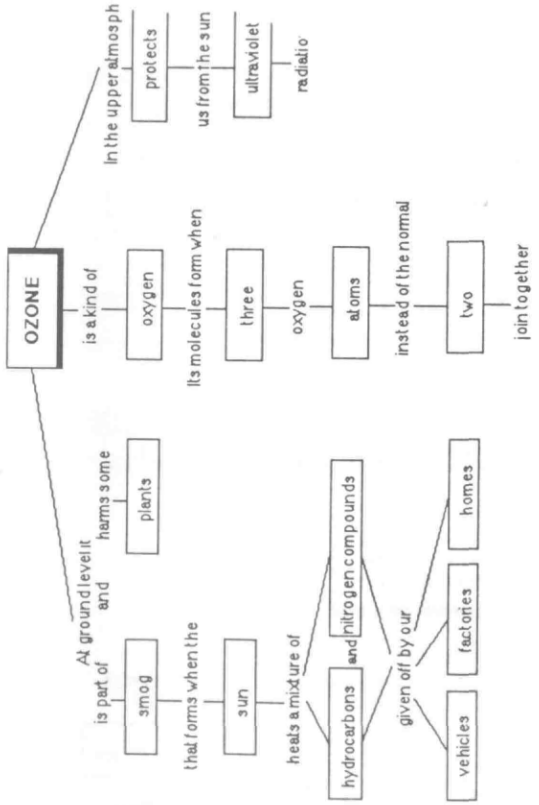
Blackline Master 1, "The Atmosphere."



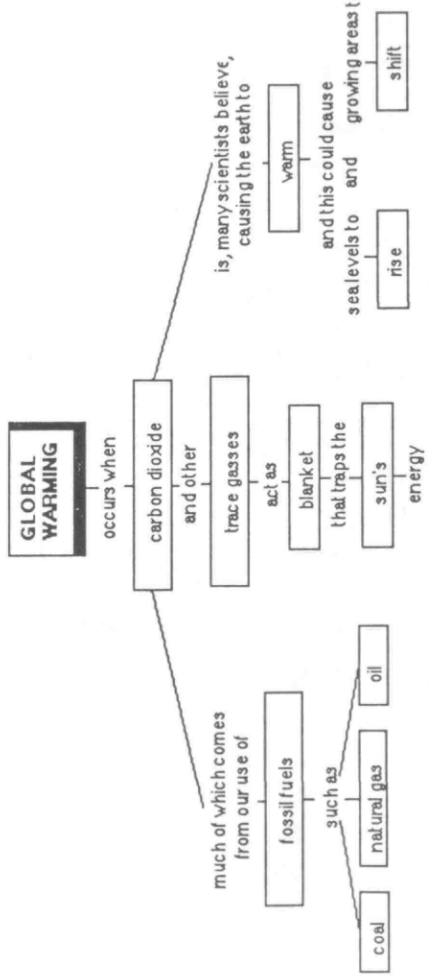
Blackline Master 2, "Our Use of Fossil Fuels"



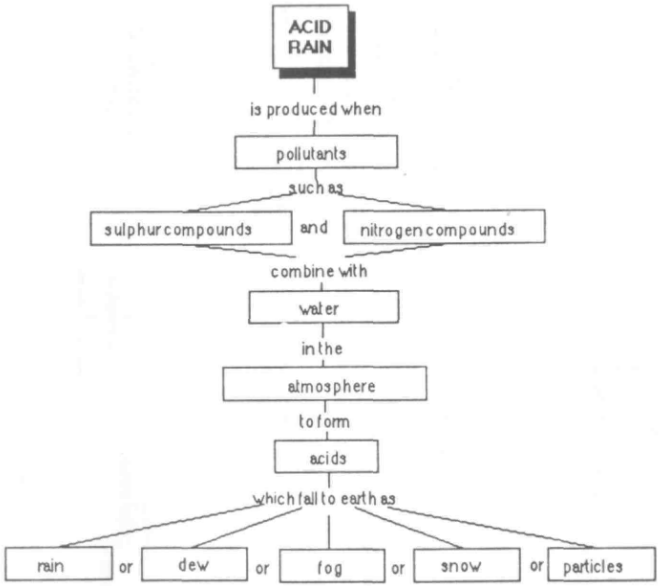
Blackline Master 3, "Ozone."



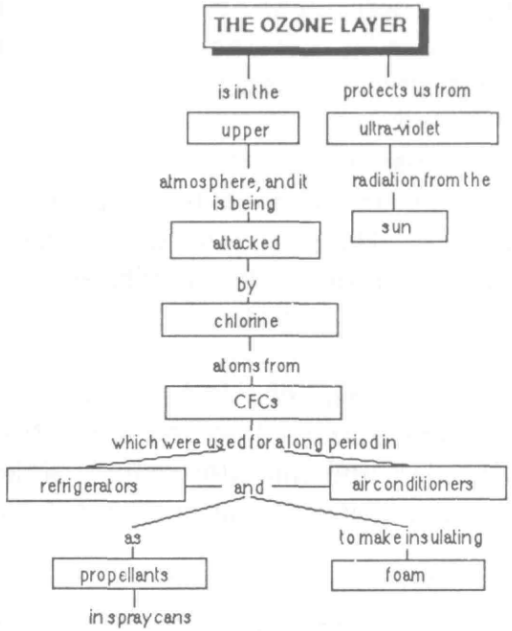
Blackline Master 4, "Global Warming."



Blackline Master 5, "Acid Rain."



Blackline Master 6, "The Ozone Layer."



Blackline Master 7, "Quiz/Discussion Questions."

1. The earth's atmosphere is composed of a mixture of nitrogen, oxygen, and other gasses which are constantly changing in composition.

2. Since the development of industrial technology, pollutants have been discharged into the atmosphere at an alarming rate causing changes in its composition and creating serious environmental problems.

3. Many scientists believe that the carbon dioxide given off is contributing to global warming. The nitrogen compounds that their burning produces contributes to acid rain and ozone production.

4. When high-sulfur coal is burned it gives off sulfur compounds into the atmosphere. These combine with atmospheric water to form sulfuric acid, a main component of acid rain.

5. When CFCs drift into the upper atmosphere they break apart freeing chlorine atoms. These attack and break apart the ozone molecules that form the ozone layer, thus exposing the earth to potentially deadly ultraviolet radiation from the sun.

6. Surface ozone pollution contributes to the formation of smog and harms some kinds of plant life.

SCRIPT OF VIDEO PRESENTATION

Change —if there's any one single word that sums up our atmosphere, it's that-change. From sun to storm, from frying to freezing, when it comes to the atmosphere, that life-sustaining envelope of gasses which surrounds our home in the universe, *change* is it.

And of all the ways in which our atmosphere is changing, none are more critical than those taking place in its composition, in the mix of gasses from which it's made. Our atmosphere—the air which sustains us and so many other living thing— is a mixture of nitrogen, oxygen and other gasses.

During the earth's long history, this mixture has changed dramatically. The air we breathe today is very different from that which surrounded the planet long ago. Its composition has been changing ever since the planet was formed billions of years ago. However, scientists now believe that the rate, or pace, of this change has increased dramatically during the last 200 years or so.

This speedup began with the birth of the industrial age and the accompanying increase in pollution that the ever-growing number of factories began pouring into the atmosphere.

The atmosphere's composition has changed more during this brief span than ever before in human history. Unfortunately, many of these pollution-produced changes have been tremendously harmful. Take, for example, acid rain, or as scientists call it, "acid deposition."

We've all heard how in many areas acid rain is contributing to the decline of forests and other ecosystems. Acid rain is, for example, making numerous aquatic environments so acid that many kinds of fish and other aquatic life, can't survive in them.

Acid rain is caused by harmful sulfur and nitrogen compounds. These pollutants come from three main sources. The first is electric generating plants, particularly those that burn coal with lots of sulfur in it. The emissions from their smokestacks are the main source of acid rain producing sulfur. The exhausts of the millions of vehicles that take to our highways each day, plus emissions from our plants and factories, are the main source of polluting nitrogen compounds. Once in the atmosphere, these sulfur and nitrogen compounds mix with water to form both nitric and sulfuric acids. Later, these pollution-produced acids return to earth as acid rain, snow, fog, dew or solid particles, causing death-dealing damage to the environment wherever they land.

And while talking about damage, look at this leaf.

You don't need to be a scientist to see that it looks to be in awful shape. And that it is the victim of ozone, another pollutant whose buildup in the lower atmosphere is causing problems.

Ozone is a kind of oxygen. Its molecules form when three oxygen atoms join together, rather than the normal two, and it's a key ingredient of those lung-searing smogs that are so much a part of today's summer scene. Ozone forms when the sun heats the blend of nitrogen compounds and hydrocarbons our vehicles, businesses, and homes belch out into the air around them.

But ozone pollution isn't just a "city" problem. Its damage isn't confined just to urban areas. Scientists are finding that ozone, often blown in from cities many miles away, is also harming a wide range of rural environments, many of which provide important food and cover for wildlife along with valuable forest products and other resources.

Ozone is, however, a chemical with a split personality. Here at ground level it's definitely bad news. High above us, however, in the upper atmosphere, ozone shows its other side. Up there it's a life saver. That's where we find a thin, fragile, and all-important layer of natural ozone. This crucial layer shields us from much of the sun's potentially deadly ultra-violet radiation. Without its protection, we would suffer many more cases of skin cancer and vision-robbing

cataracts than is already the case. In addition, if the ozone layer did not filter much of the sun's ultra-violet radiation, many other organisms, raging from bacteria to food crops, would suffer. Obviously then, anything that threatens the ozone layer threatens us.

And that brings us to the chlorofluoro- carbons, or CFCs for short, pollutants to which, until quite recently, we've paid little attention. Introduced in the 1930's, for many years CFCs were widely used, among other things, in refrigerators and air conditioners and to make foam insulation such as the kind used in coffee cups, plates and food containers, and, until the late 1970's, as spray can propellents.

As useful as they are, however, CFC's and related chemicals suffer from one terrible problem. They're murdering the ozone layer. The trouble starts when CFCs, that have escaped in one way or other, drift up into the upper atmosphere and mix with the protective ozone layer. Once there, the CFC molecules break apart, releasing their chlorine atoms. These free chlorine atoms then attack and shatter the ozone molecules around them, ravaging the ozone layer in the process.

Chlorine atoms are such deadly ozone killers that just one can destroy as many as 100,000 ozone molecules. This attack is so harmful that many scientists fear that unless CFCs, and related

chemicals, are completely banned, the ozone layer will soon be so damaged that it won't be able to protect us adequately from the sun's potentially deadly rays.

So far, we've seen how changes in the atmosphere's composition are harming the environment. But, as bad as the problems we've seen so far are, there's another change going on that may prove even more deadly. Simply put, many experts warn that the earth is getting a fever—that our climate is warming faster than normal.

Known as the "greenhouse effect," many think this global warming is caused largely by the buildup of carbon dioxide and other gasses in the atmosphere—that our widespread use of fossil fuels, such as coal, oil, gasoline and natural gas, has produced since the industrial age began in the 1850's. Whenever these, or anything else, is burned, carbon dioxide is released. This, and other greenhouse gasses, forms a "blanket" that traps some of the sun's energy, thus, many scientists fear, causing the earth's climate to warm faster than normal.

Just how fast this global warming is taking place and how <u>far</u> it will go is uncertain. However, scientists are now beginning to get at least <u>some</u> idea of what to expect. Rising sea levels, caused by the melting of the world's ice caps, and the flooding that would accompany it, is one widely

predicted result. Our agriculture could also suffer if abnormal warming made it impossible to grow some crops where they once were. Our forests could also be damaged if global warming killed off those trees that could not adapt fast enough to a warmer environment.

Well, there you have it—change, change, and more change—the story of our atmosphere and what's happening to it. Acid rain isn't a pleasant story. Neither are ozone damaged plants, smog, a CFC ravaged ozone shield, or global warming. They're not a pretty combination, but they're one we must face up to.

The problems our pollution-changed atmosphere poses are tough, as are the cures for them; cures, such as a world-wide ban on CFCs and related chemicals, reducing pollution from our power plants, factories, businesses and homes, developing fuel efficient vehicles, and similar conservation measures, and perfecting alternative energy sources. Such steps are, unfortunately, likely to be both complex and expensive.

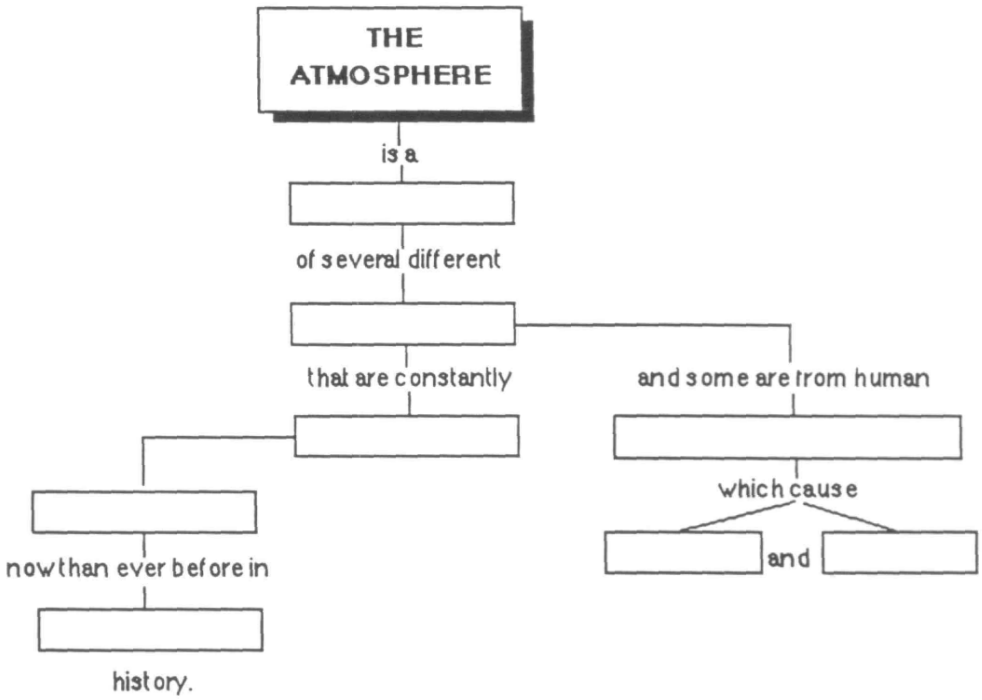
But there's no escaping the fact that our planet has but one atmosphere. The air around us is all we have. Destroy it and we destroy ourselves.

Name_____

OUR RESTLESS ATMOSPHERE

THE ATMOSPHERE

Directions: Select the correct words from the list below to complete this chart.



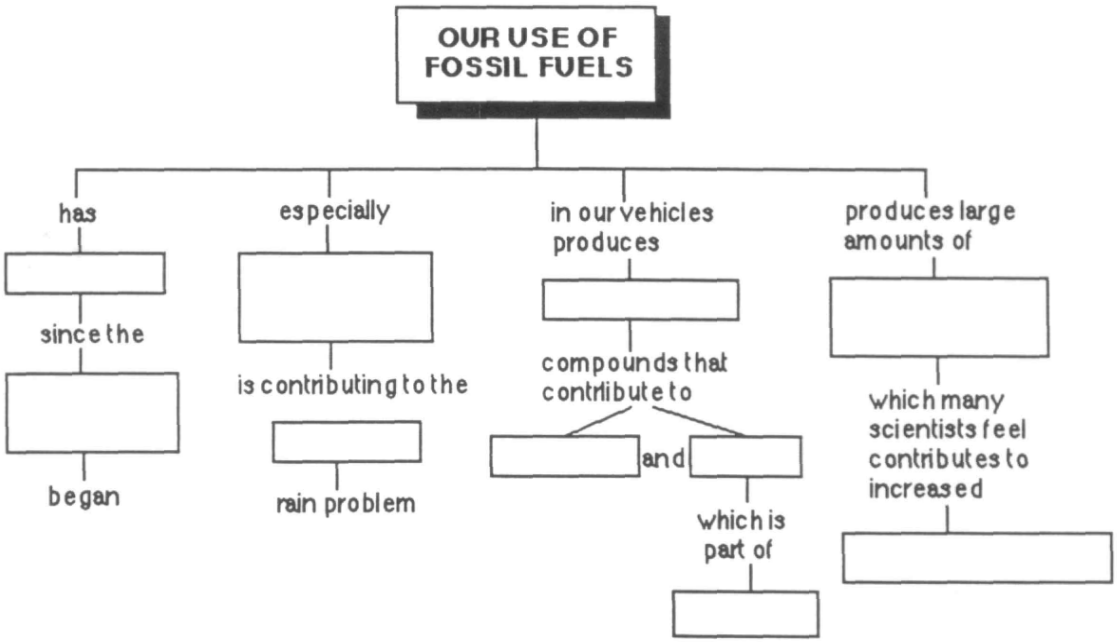
acid rain	human
changes	mixture
faster	pollution
gasses	smog

Name_____

OUR RESTLESS ATMOSPHERE

OUR USE OF FOSSIL FUELS

Directions: Select the correct words from the list below to complete this chart.



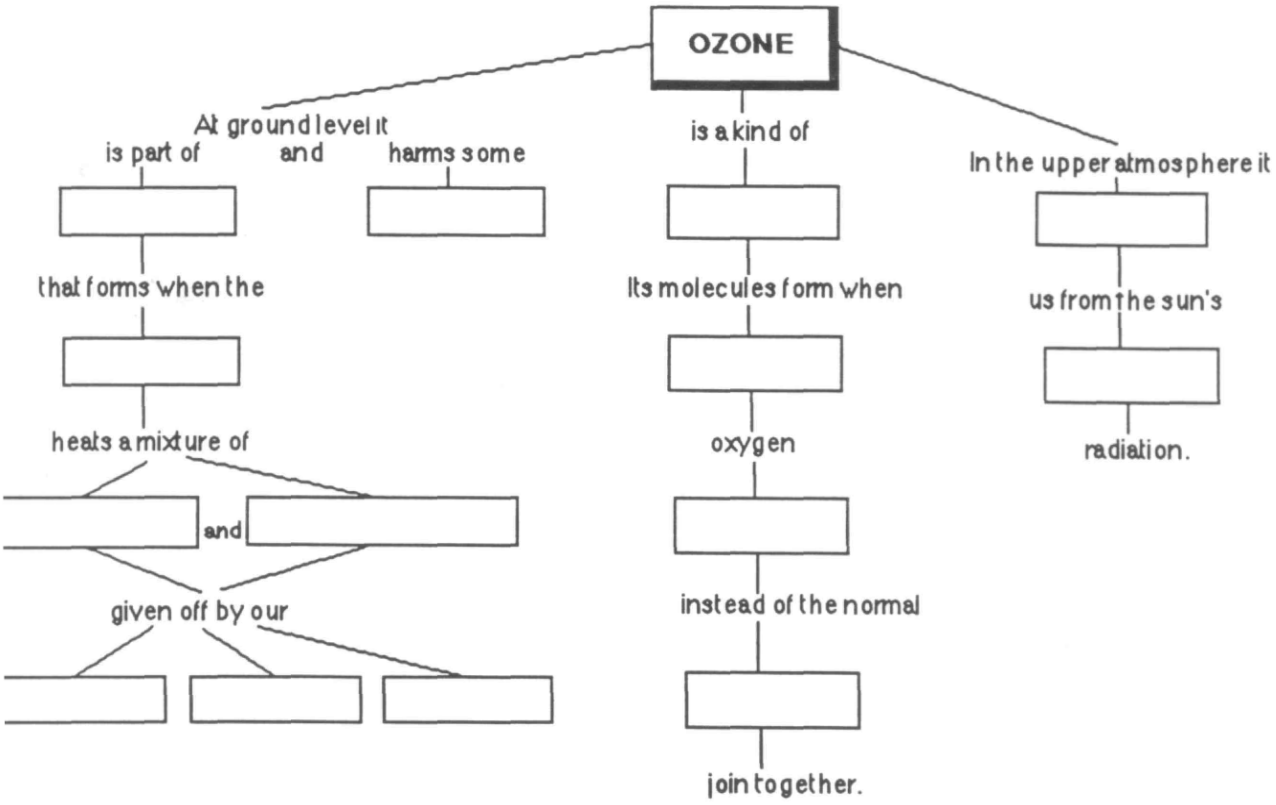
acid	increased
acid rain	industrial revolution
carbon dioxide	nitrogen
global warming	ozone
high sulphur coal	smog

Name_____

OUR RESTLESS ATMOSPHERE

OZONE

Directions: Select the correct words from the list below to complete this chart.



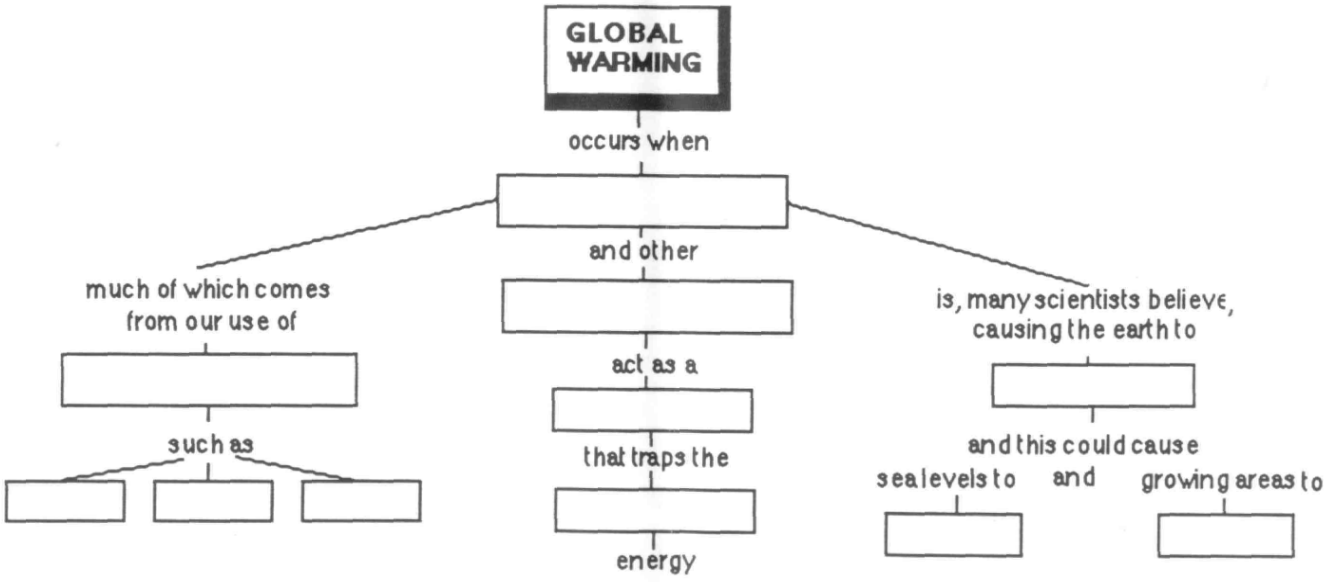
atoms	nitrogen compounds	sun
factories	oxygen	three
homes	plants	two
hydrocarbons	protects	ultra-violet
	smog	vehicles

 Name_____

OUR RESTLESS ATMOSPHERE

GLOBAL WARMING

Directions: Select the correct words from the list below to complete this chart.



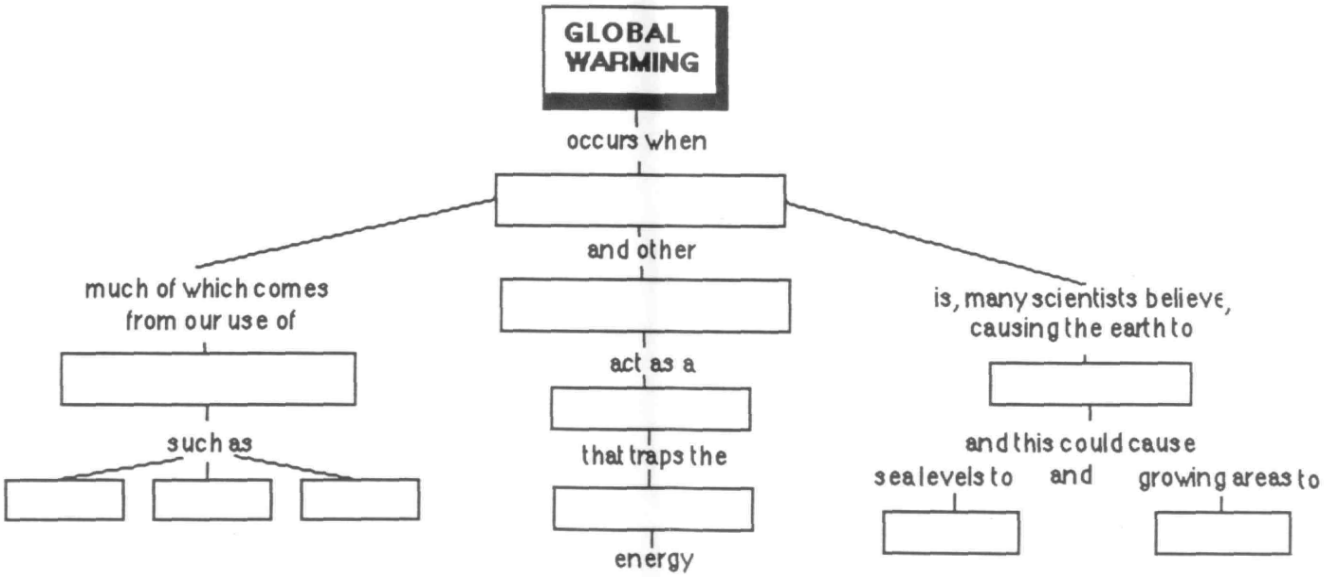
blanket	oil
carbon dioxide	rise
coal	shift
fossil fuels	sun's
natural gas	trace gasses
	warm

 Name_____

OUR RESTLESS ATMOSPHERE

GLOBAL WARMING

Directions: Select the correct words from the list below to complete this chart.

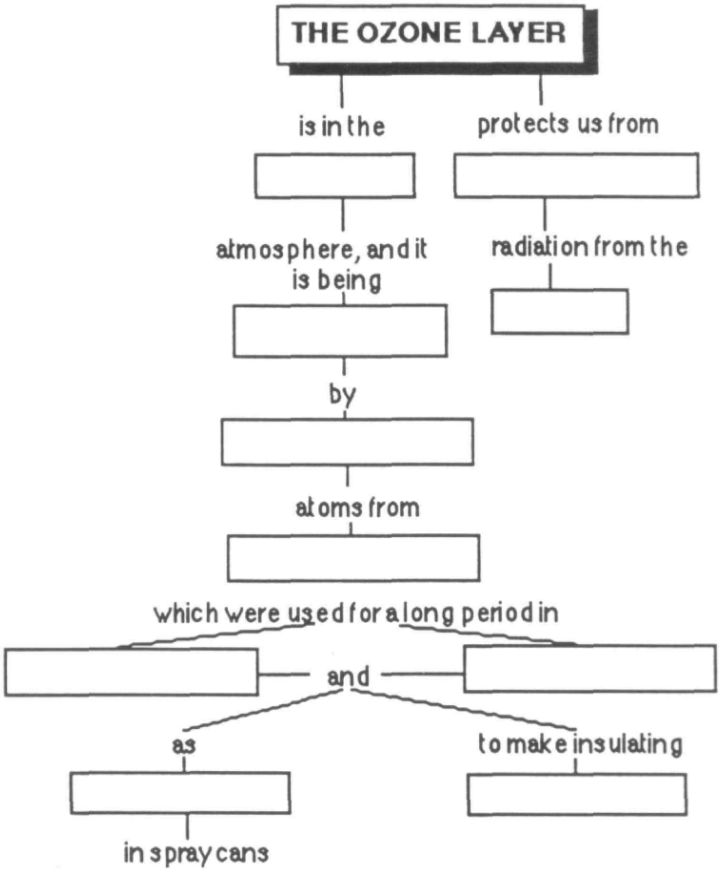


blanket	oil
carbon dioxide	rise
coal	shift
fossil fuels	sun's
natural gas	trace gasses
	warm

Name_____

OUR RESTLESS ATMOSPHERE

THE OZONE LAYER Directions: Select the correct words from the list below to complete this chart.



air conditioners
attacked
CFCs
chlorine
foam
propellants
refrigerators
sun
ultra-violet
upper

 Name_____

OUR RESTLESS ATMOSPHERE

QUIZ/DISCUSSION QUESTIONS

Directions: If you do not have enough space to answer the following questions, use the back of this sheet.

1. Of what is the earth's atmosphere composed?

2. How has the industrial revolution brought about change in the atmosphere?

3. What are some of the impacts that our widespread use of fossil fuels has on the atmosphere?

4. Discuss a major problem that is associated with the use of high-sulfur coal as a fuel.

5. Discuss the negative impact that CFCs have on the environment.

6. Describe the harm that ozone pollution can cause.