



GRADES: 7-11

SUBJECTS: Social Science, Science, Health, Geography, Civics, Government and Environmental Science

TIME: 7 1/2 Hours; @ 5 Blocks or 10 Periods

STATE STANDARDS:

Civics Standard 3 - Participation in the Civic Process, P.I. C.416 Grades 9-11

Civics Standard 4 - Mechanisms for communicating with elected officials, P.I. - 8.409 - P.I. C. 418 Grade 8

Geography Standard 2 - Environment, P.I.s - G.405, G.407, G.408 - Grades 9-11; P.I.s - 7.423, 8.423 8.424 - Grades 7- 8

History Standard 1 - Chronology, P.I. H.401 - Grades 9-11

History Standard 2 - Analysis, P.I. H.405 - Grades 9-11; 7.429 - Grade 7

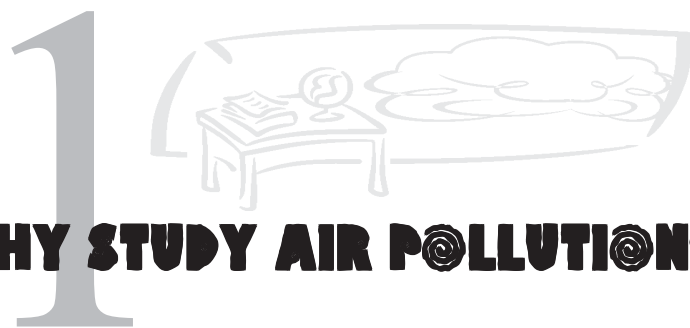
History Standard 3 - Interpretation, P.I. H.408 - Grades 9-11

Science Standard 2 - Materials and Their Properties (Material Technology), 2.41; P.I. 9.75 - Grade 9

Science Standard 3 - Energy and Its Effects (Production/ Consumption/ Application of Energy), 3.53; P.I. 9.75 - Grade 9; P.I. 8.316 - Grade 8

Science Standard 5 - Earth's Dynamic System (Components of Earth), 5.12; P.I. 9.75 - Grade 9; P.I. 8.316 - Grade 8

Science Standard 8 - Ecology (Changes in Ecosystems), 8.21, 8.22; Interaction of Humans Within Ecosystems, 8.31, 8.33; P.I. 9.75 - Grade 9; P.I. 8.348 - Grade 8



WHY STUDY AIR POLLUTION?

OVERVIEW OF THE LESSON

Scope and Purpose of the Lesson:

Students will examine the topic of air pollution, its possible solutions, and the government agencies that are responsible to deal with environmental issues.

◆ Topics Addressed:

Ingredients, causes, effects, and solutions of air pollution
Individual actions to improve air quality
Delaware air quality concerns
Formation of the atmosphere
Composition of the air today
Misuse of the atmosphere
Beginnings of pollution
Federal laws and agencies that address air quality
Stratospheric and Tropospheric ozone
"Criteria pollutants"

Synopsis of the Lesson:

This lesson contains four activities that use a variety of instructional strategies and are focused on answering the question of "Why Study Air Pollution?"

LEARNING OBJECTIVES

Students will be able to:

- ◆ Identify some ingredients of air pollution
- ◆ Identify some causes of air pollution
- ◆ Identify some effects of air pollution
- ◆ Identify some solutions to air pollution
- ◆ Describe some actions they can personally do to improve air quality
- ◆ Explain why air quality is of special concern to the Delaware area
- ◆ Describe a remedy to the air pollution problems in Delaware
- ◆ Describe how our atmosphere was formed
- ◆ Describe the composition of the air we breathe today
- ◆ Explain why man is misusing the atmosphere today
- ◆ Define air pollution
- ◆ Trace the beginnings of pollution by humans
- ◆ Identify present day federal laws and agencies that deal with the pollu-



tion problem

- ◆ Define ozone
- ◆ Explain how stratospheric and tropospheric ozone is formed
- ◆ Describe the ideal weather conditions for the formation of ground-level ozone
- ◆ Explain the action take by the EPA to reduce ground-level ozone
- ◆ Identify the “criteria” pollutants

BACKGROUND

The Earth's atmosphere is a constantly moving body of gases that encircle our planet. This body of gases known as air is a mixture—not a chemical combination—of a number of gases; that is, each gas retains its own characteristic properties. It consists of about 78 percent nitrogen; about 21 percent oxygen, and carries along with it water vapor, clouds, dust, smoke, soot, and a variety of chemical compounds. The remaining one-percent contains all the other gases including carbon monoxide, carbon dioxide, ozone, methane, and ammonia that contribute to air pollution. And at any time air may contain contaminants emitted by such natural occurrences as volcanic eruptions, forest fires, and decaying vegetation. Only during the past 20 years or so have we begun to understand that air is a resource that is limited and can be managed for health and environmental quality.

Millions of tons of harmful gases and pollutants are released into the air each year. Once inhaled, polluted air weakens the lungs' natural defenses against harmful contaminants. In fact, lung tissue has no reliable defense against air pollution, and therefore, is gradually destroyed by invasive pollutants.

There are many health effects of air pollution including irritation of the eyes, nose, mouth, and throat; chest pain; labored breathing; and increased susceptibility to lung infection. At its least severe levels, air pollution is a nuisance to healthy individuals and a burden to those with respiratory diseases.

Air pollution is a big problem in Delaware. Delaware exceeds the federal standard for ozone, and along with the Philadelphia area, is the seventh worst area in the nation for ground level ozone pollution.

Air pollution is nothing new. In medieval England, where burning coal was the primary method of heating, the black smoke from chimneys created problems. The King issued proclamations to regulate the use of coal, but this failed to solve the problem.

Hundreds of years later, in 1952, a five-day temperature inversion in London trapped fog laden with pollutants (created by burning coal) in which more than 4000 deaths were attributed to this deadly “black fog.”

Here in the United States, we have our own history of air pollution incidents. On October 27, 1948, Donora, Pennsylvania was blanketed in fog, mainly due to weather conditions, which included a temperature inversion. During the four days of the episode, streetlights had to be turned on during the day, and 17 people died on the third day, mainly from respiratory ailments. In 1955 the visibility was drastically reduced by dense smog in Los Angeles. Air pollution was blamed for causing 2000 auto accidents in a single day. In 1966 New York City had a three-day temperature inversion over Thanksgiving weekend that was blamed for the deaths of 168 people.

On December 2, 1984, a toxic gas cloud escaped from a chemical plant in Bhopal, India, killing and injuring thousands. Unfortunately it took that tragedy to focus the world's attention on the potential for death and destruction by accidents involving extremely hazardous chemicals.

The amount of air pollution in our air is directly related to the life-style choices we make as individuals. Delaware has a serious air pollution problem as measured by federal clean air standards. Air pollution is measured on a daily basis in most parts of the world—including Delaware.

Ozone is the number one air pollutant and major problem in the state of Delaware. Ozone is measured (hourly during the summer months) by Air Quality Monitoring Stations at seven different locations in Delaware: Brandywine, Bellefonte, Wilmington, Route 9 in Delaware City, Summit Bridge, Felton, and Seaford.

Whether our air becomes better, worse, or remains the same is primarily in our hands. By changing our behaviors we can directly impact the level of air pollution in Delaware.

LESSON PROCEDURE

INTRODUCTION OF LESSON

Start the lesson with a Warm-up, Mind Set, or Anticipatory Set on the overhead or chalk board.

1. WARM UP, MIND SET OR ANTICIPATORY SET - What is Air Pollution? Put this on the overhead (see overhead transparencies) or write it on the chalkboard and give students **three minutes** to write a response. **OPTION** - Begin class by stating the warm up as a question and discussing air pollution. (**3 minutes**)



2. LARGE GROUP DISCUSSION - Conduct a brief discussion on the student responses to the Warm-up. **(5 minutes)** Students should understand that air pollution is the excessive concentration of gases and small particles put into the atmosphere by human activity that, by themselves or in combination with other compounds, contaminate, harm or alter the purity of the atmosphere.

3. LESSON OBJECTIVES - Have the lesson objectives written on the chalkboard or on an overhead. Go over the objectives with the class before beginning the lesson. It is a good idea to have students write the objectives into notebooks. **(5 minutes)**

ACTIVITY 1: Cornering Air Quality

1. Description/Overview of Activity:

Activity 1 is a kick-off activity that helps students understand the basics of air pollution, including causes, effects, ingredients, and potential solutions. One of the purposes of this activity is to explore the guiding question of the lesson: Why study air pollution?

2. Materials Needed:

Photocopies of Air Pollution Posters - one of each—total of four (included) - see Teacher Materials
Photocopies of Air Pollution Strips - one of each - one strip per student (included) - see Student Handouts #1-4
Photocopies of Student Handout #5 - one per student (included) - see Student Materials
Photocopies of Student Handout #6 - one per group (included) - see Student Materials
Tape to fasten posters and Air Pollution Strips to the wall (not included)

3. Performance Indicators of the Activity:

Geography P.I. G.407, G.408; 7.423, 8.423
History P.I. H.401
Science P.I. 9.75

4. Preparation for Activity:

Place the four posters or placards in each corner of the room before class begins with the titles:

Air Pollution: Some Ingredients

Air Pollution: Some Causes

Air Pollution: Some Effects

Air Pollution: Some Solutions

Make copies of the Air Pollution Strips on Student Handouts 1, 2, 3, and 4. Cut the strips into individual strips.

5. Activity Outline and Directions to the Teacher:

STEP 1: As students enter the classroom, hand each of them an Air Pollution Strip (there are 35 strips—if you have less than 35 students, give some students 2 strips from the same handout). Tell the students to find the corner that best matches their strip(s). Have students tape their strips under each poster for the entire class to see. **(2 minutes)**

STEP 2: Discuss the placement of the strips with the students to be certain they are in the correct spots. (See answers in Teacher Materials). Once all strips are in the correct corners, ask students to copy the information from each poster and strips in outline form in their notebooks. **(10 minutes)**

STEP 3: Next, tell each of the four groups (one for each poster) to sit down as a team and briefly discuss the items and answer the questions on Handout #5. Give each group a copy of Handout #6 for reference. Then have each team select a spokesperson to share their answers and opinions with the rest of the class. **(5 minutes)**

STEP 4: When the four teams have answered their questions, bring the class together and ask each group or team to make its presentation (limit groups to a 3-minute presentation). **(15 minutes)**

- ◆ Which of the air pollution causes, effects, ingredients and solutions, surprised them?
- ◆ Which of the air pollution causes, effects, ingredients and solutions, concern them the most?
- ◆ What other air pollution causes, effects, ingredients and solutions, would they add to the list?
- ◆ Which of the solutions could they participate in right now?

ACTIVITY 2: Air Pollution IQ Quiz

1. Description/Overview of Activity:

In Activity 2, students take an Air Pollution IQ test to check their knowledge of Air Pollution.

2. Materials Needed:

Photocopies of Air Pollution IQ Quiz 1 per student (included)

3. Performance Indicators of the Activity:

Geography P.I. G.407; G.408; 7.423, 8.423
History P.I. H.401
Science P.I. 9.75; 8.316

4. Preparation for Activity:

Make a copy of the Air Pollution IQ quiz for each student.



5. Activity Outline and Directions to the Teacher:

STEP 1: Tell students they are now going to take a quiz to determine their **Air Pollution IQ**. Explain that this will not count as part of their grade. Give each student a copy of the quiz and explain to them to circle either True or False on their papers. **(10 minutes)**

STEP 2: Students are to exchange papers with another student. Go over the answers and explanations as the students correct the quiz. (Answer sheet is included in the Teacher Materials) Students will return quiz when finished. On the board write the three categories and corresponding scores (from the back of the answer sheet) and ask students to find the category they fit into based on the number of questions they had correct. Ask how many are: **1) Well informed? 2) Informed? 3) What they don't know may hurt them?** **(20 minutes)**

ACTIVITY 3: Jigsaw Activity

1. Description/Overview of Activity:

Activity 3 is a cooperative Jigsaw activity that provides students with an in-depth understanding of air, air pollution, ozone, the Clean Air Act, and reasons for studying air quality.

2. Materials Needed:

Photocopies of Readings 1, 2, 3, 4, 5 - (included)
Photocopies of Student Worksheets 1, 2, 3, 4, 5 - 1 per student (included)

3. Performance Indicators of the Activity:

Geography P.I. G.407; G.408; 7.423, 8.423
History P.I. H.401; H.405
Science P.I. 9.75

4. Preparation for Activity:

Make copies of student readings 1, 2, 3, 4, & 5 (divide number of students by five which will give you the number of each reading needed). Make copies of Student Worksheets 1, 2, 3, 4, & 5 for each student. These should be stapled in the form of a packet. Make an Overhead Transparency of the Warm-up question and lesson objectives (see Teacher Materials). Divide the class into Cooperative Learning Groups of five students per team—they should be chosen heterogeneously by intelligence, race and gender. Any students left over should be placed into one of the existing groups of five.

5. Activity Outline and Directions to the Teacher:

STEP 1: Introduction of Jigsaw. **Student Directions:** Explain to the students: "for this next activity we are going to be

using a new way of learning—it is called Jigsaw. In jigsaw, you will be working on two different teams. There is a base group, and another group called an expert group. In the first group, the base group, you will divide up the responsibility for reading a packet of information on air pollution. Each member of the base group will be assigned a different reading to read and prepare to teach the other members of the group. In that way, you have only part of the material to read, but it also means that you will have to become an expert in that reading or section. That's where the expert group comes in. The expert group is made up of all the people who are responsible for the same reading. You will meet together and make sure that you will all become **experts**. You will read the section together, take notes, and prepare ways to teach the material to the rest of your base group. Your expert group will compare and discuss answers to the student worksheet. You should plan an interesting way to present the information to your home group to enhance their understanding of the material that you read. **(5 minutes)**

STEP 2: Team Assignments - "Now I will tell you which BASE team you will be on. When I read your name, find your teammates and sit next to them. Then choose a team name. Students should move desks or tables together to face each other in a circle—circles of learning. Record the team names chosen by the teams on the TEAM SUMMARY SHEETS (in teacher packet). **(10 minutes)**

STEP 3: Pass out the Readings and Student Worksheets. Each student should be given all five student worksheets in the form of a packet (stapled together). Each student in the base group should be given a different reading. Make the assignments randomly within each group; it is not important who gets which reading.

STEP 4: Begin Reading and Completing Student Worksheets. Students in base groups will begin to read and answer the questions on the student worksheets. Students should read over the worksheet before starting to read. This will give them a guide in their reading. **(15 minutes)**

STEP 5: Introduce Expert Groups. After the students have finished reading and completing the student worksheets begin to assign expert groups: "Now you will all have a chance to discuss your readings with others who have the same topic. In a moment, I will ask everyone who has Reading #1 to sit together, and so on. In these expert groups you will be able to talk about your topic and share answers to the worksheets. I will appoint a leader for each expert group just for today. The leader's job is to get every student in the expert group to help add ideas." Next point out a place for each expert group to assemble. "All students with Reading #1 should meet here. All students with Reading #2 should meet over here, etc." **(10 minutes)**



STEP 6: Expert Reports. When the students have completed their work in expert groups have them return to their base groups. Each member will now share information in their reading and the answers to the student worksheets. All members of the base group will be expected to fill in their worksheets as each member reports. The student should emphasize the main points and anticipate what might be on the test in preparing their teammates. Explain to the students that the lesson objectives will provide a guide to test questions. **(25 minutes)**

STEP 7: LARGE GROUP DISCUSSION - You may now wish to have a brief class discussion of the material in each reading to prepare the students for the test. **(15 minutes)**

ACTIVITY 4: Culminating Activity - Position Paper

1. Description/Overview of Activity: Activity 4 is a student position paper developed on an air quality issue chosen by each student.

2. Materials Needed:

Photocopies of Handout #7 and # 9 - One for science and one for social studies (student directions) - 1 per student (included)

Photocopies of Handout #8 and #10 - One for science and one for social studies (scoring rubric) - 1 per student (included)

3. Performance Indicators of the Activity:

Civics P.I. C.416; 8.409; 7.423; 8.424

Geography P.I. G.407; G.408

History P.I. H.401; H.405; H.408

Science P.I. 9.75; 8.348

4. Preparation for Activity:

Make copies of Handout 1 and 2 and copies of the scoring rubric - one for each student.

5. Activity Outline and Directions to the Teacher:

STEP 1: Students working in their base groups will make a list of five to ten most important air quality issues. Then each member of the group will select a different issue on the list to research and write a position paper which might be used to influence the decision of a legislator or government agency. **(10 minutes)**

STEP 2: Distribute Handouts 7 and 8 to each student. Ask students to read student directions on Handout 7 and then examine the scoring rubric on Handout 8. **(5 minutes)**

STEP 3: Students should be taken to the library to research their air quality issue. Students should be allotted at least an hour to do their research. **(60-90 minutes)**

STEP 4: Explain to the students that they will have time in class to write their position papers. This work should be completed individually. Students should be instructed to write a rough draft first before starting on their final copy. Students should also have time to type their position papers either in a computer lab or at home. **(60-90 minutes)**

CONCLUSION

1. Refer the class back to the learning objectives to be sure they have mastered the material from lesson 1. **(5 minutes)**

EXTENDED ACTIVITIES

1. CREATE POSTERS - Have each of the students, or cooperative learning teams, create posters illustrating both **polluted** and **pollution-free** scenes. These scenes should come from their daily lives—things they see or do every day. They should illustrate how these things could look before and after exposure to air pollution.

2. SHOW VIDEO - Ozone: Double Trouble This video is produced by the U.S. Environmental Protection Agency.

3. POLITICAL LETTER - Have either individual students, or cooperative learning teams, select an important political issue (e.g., air pollution, air toxics regulation, acid rain), students would then examine news reports to find out what position different office-holders take on the issue. Each student should then research the issue and prepare a letter to one of the office-holders advocating a particular course of action. [PARTICIPATION]

4. AIR POLLUTION REPORTS - Students could undertake research which helps them understand how technology and human needs have altered the air quality in the state of Delaware. They could then prepare reports on this issue and also how ozone can place constraints on human activity. [ENVIRONMENT]



High School and Middle School Air Quality Education Program



VERHEAD TRANSPARENCIES

INTRODUCTION OF LESSON 1



OVERHEAD 1
WARM UP QUESTION

A large, faint, light-gray illustration of a chair with a decorative, patterned backrest, serving as a background for the main text.

WHAT IS AIR POLLUTION?



OVERHEAD 2
LESSON ONE OBJECTIVES

Identify some ingredients of air pollution

Identify some causes of air pollution

Identify some effects of air pollution

Identify some solutions to air pollution

Describe some actions they can personally take to improve air quality

Explain why air quality is of special concern to the Delaware area

Describe a remedy to the air pollution problems in Delaware

Describe how our atmosphere was formed



OVERHEAD 2
LESSON ONE OBJECTIVES

Describe the composition of the air we breathe today

Explain why man is misusing the atmosphere today

Define air pollution

Trace the beginnings of pollution by humans

Identify present day federal laws and agencies that deal with the pollution problem

Define ozone

Explain how stratospheric and tropospheric ozone is formed



STUDENT MATERIALS

LESSON 1 ACTIVITY 1



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 1

Student Handout 1

Air Pollution Causes (Cut into strips)

FACTORIES

DRY CLEANERS

CHEMICAL SOLVENTS

ELECTRIC POWER PLANTS

BURNING FOSSIL FUELS

CARS AND TRUCKS

Source: *Sky High: An Air Quality Curriculum* - Project Clean Air, Ventura, CA



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WHY STUDY AIR POLLUTION?

Lesson 1 Activity 1

Student Handout 1

Air Pollution Causes (Cut into strips)

**HAIR SPRAYS, LAWN MOWERS,
LEAF BLOWERS**

**GLASS AND OVEN
CLEANERS**

MOTOR BOATS

MOTORCYCLES

Source: *Sky High: An Air Quality Curriculum* - Project>Clean Air, Ventura, CA



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 1

Student Handout 2

Air Pollution Causes (Cut into strips)

CAUSES LUNG DISEASE

FADES PAINT

CAUSES EYE IRRITATION

**DESTROYS BUILDING
MATERIALS**

**BREAKS DOWN
IMMUNE SYSTEM**



High School and Middle School Air Quality Education Program



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 1

Student Handout 2

Air Pollution Causes (Cut into strips)

STUNTS PLANT GROWTH

CRACKS WINDSHIELD WIPERS

REDUCES VISIBILITY

**REDUCES AGRICULTURAL
CROP YIELDS**

Source: *Sky High: An Air Quality Curriculum* - Project Clean Air, Ventura, CA



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 1

Student Handout 3

Air Pollution Causes (Cut into strips)

OZONE

PARTICULATE MATTER

CARBON MONOXIDE

SMOKE

SULFUR DIOXIDE

LEAD

Source: *Sky High: An Air Quality Curriculum* - Project Clean Air, Ventura, CA



High School and Middle School Air Quality Education Program



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 1

Student Handout 3

Air Pollution Causes (Cut into strips)

OXIDES OF NITROGEN

DUST

**REACTIVE ORGANIC
COMPOUNDS**

UV RAYS OF THE SUN

Source: *Sky High: An Air Quality Curriculum* - Project Clean Air, Ventura, CA



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 1

Student Handout 4

Air Pollution Causes (Cut into strips)

**INVEST IN ELECTRIC
CAR RESEARCH**

USE CLEAN-FUELED VEHICLES

RIDE A BIKE

TAKE A BUS

**TUNE-UP MOTOR
VEHICLES**

Source: *Sky High: An Air Quality Curriculum* - Project Clean Air, Ventura, CA



High School and Middle School Air Quality Education Program



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 1

Student Handout 4

Air Pollution Causes (Cut into strips)

DRIVE THE SPEED LIMIT

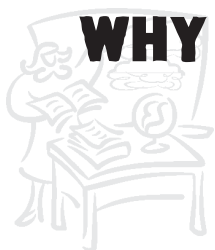
DRIVE FEWER MILES

USE NON-AEROSOL PRODUCTS

LIMIT INDUSTRIAL WASTE

**USE ELECTRIC
OR PUSH MOWERS**

Source: *Sky High: An Air Quality Curriculum* - Project>Clean Air, Ventura, CA



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 1 Student Handout 5 Questionnaire

Name: _____ Date: _____

Class: _____ Period or Block: _____

1 Which items (causes, effects, ingredients, and solutions) surprised your team?

- A. _____
- B. _____
- C. _____
- D. _____
- E. _____

2 Which items (causes, effects, ingredients, and solutions) concerned the team the most?

- A. _____
- B. _____
- C. _____
- D. _____
- E. _____

3. What other items (causes, effects, ingredients, and solutions) would your team add to the list?

- A. _____
- B. _____
- C. _____
- D. _____
- E. _____

4. Which solutions could you participate in right now?

- A. _____
- B. _____
- C. _____
- D. _____
- E. _____

Source: *Sky High: An Air Quality Curriculum* - Project>Clean Air, Ventura, CA



WHY STUDY AIR POLLUTION?



Lesson 1 Activity 1 Student Handout 6 Components of Air Pollution

ROC	Reactive Organic Compounds	Compounds that contain hydrogen and carbon. Found in gasoline and petrochemicals.
NO _x	Nitrogen Oxides (Oxides of Nitrogen)	Combinations of nitrogen oxide, nitrogen dioxide, and other oxides of nitrogen that are created as a result of combustion.
SO _x	Sulfur Dioxide	A colorless gas produced during combustion and natural decomposition (sewer gases).
CO	Carbon Monoxide	A colorless, odorless, toxic gas given off during incomplete combustion, primarily from motor vehicles.
PM ₁₀	Particulate Matter	Solid particles or liquid droplets, including fumes, smoke, dusts, and aerosols.
O ₃	Ozone	A gas that forms in the atmosphere when 3 atoms of oxygen are combined (O ₃). High in the stratosphere surrounding the earth, a layer of ozone gas forms an important and effective protective barrier against the sun's ultraviolet rays. Tropospheric ozone or ground-level ozone is a major pollutant and is harmful.



TEACHER MATERIALS

LESSON 1 ACTIVITY 1



POSTER

AIR POLLUTION: SOME EFFECTS

Source: *Sky High: An Air Quality Curriculum* - Project>Clean Air, Ventura, CA



POSTER

AIR POLLUTION: SOME CAUSES

Source: *Sky High: An Air Quality Curriculum* - Project>Clean Air, Ventura, CA



POSTER

AIR POLLUTION: SOME INGREDIENTS

Source: *Sky High: An Air Quality Curriculum* - Project>Clean Air, Ventura, CA



POSTER

AIR POLLUTION: SOME SOLUTIONS

Source: *Sky High: An Air Quality Curriculum* - Project>Clean Air, Ventura, CA



WHAT IS AIR POLLUTION?

Answer Outline

Lesson 1 Activity 1

AIR POLLUTION: Some Ingredients

- ◆ Ozone
- ◆ Particulate Matter
- ◆ Carbon Monoxide
- ◆ Smoke
- ◆ Sulfur Dioxide
- ◆ Lead
- ◆ Oxides of Nitrogen
- ◆ Dust
- ◆ Reactive Organic Compounds
- ◆ Sun

AIR POLLUTION: Some Solutions

- ◆ Invest in electric car research
- ◆ Carpool
- ◆ Use clean-fueled vehicles
- ◆ Ride a bike
- ◆ Take the bus
- ◆ Tune-up Motor Vehicles
- ◆ Drive the speed limit
- ◆ Use none-aerosol products
- ◆ Limit industrial waste
- ◆ Use electric or push mowers

AIR POLLUTION: Some Effects

- ◆ Causes lung disease
- ◆ Fades paint
- ◆ Causes eye irritation
- ◆ Destroys building materials
- ◆ Breaks down immune system
- ◆ Stunts plant growth
- ◆ Cracks windshield wipers
- ◆ Reduces visibility
- ◆ Reduces agricultural crop yields

AIR POLLUTION: Some Causes

- ◆ Factories
- ◆ Dry Cleaners
- ◆ Chemical Solvents
- ◆ Electrical Power Plants
- ◆ Burning Fossil Fuels
- ◆ Cars and trucks
- ◆ Hair sprays, lawn mowers, leaf blowers
- ◆ Glass and oven cleaners
- ◆ Motor Boats
- ◆ Motorcycles



STUDENT MATERIALS

LESSON 1 ACTIVITY 2



WHY STUDY AIR POLLUTION?

LESSON 1 ACTIVITY 2

WHAT'S YOUR AIR POLLUTION I.Q.?

DIRECTIONS: Circle true or false in each of the following questions. Then check your answers with your teacher to figure your Pollution I.Q.

1. Air pollution is harmful only in cities.	True	False
2. Air pollution is worse in big cities than small ones.	True	False
3. Nationwide, automobiles are the major source of air pollution.	True	False
4. Ozone smog is a problem only in Los Angeles.	True	False
5. Inversions—in which air at ground level is trapped by warmer air above—come from air pollution.	True	False
6. Chronic respiratory diseases are aggravated by air pollution.	True	False
7. Air pollution affects only the respiratory system.	True	False
8. Air pollution can kill.	True	False
9. When the plume from a smokestack is white, no pollution is coming out.	True	False
10. Air pollution is expensive.	True	False
11. At any time our air may contain contaminants (air pollution) emitted by natural occurrences such as forest fires, volcanic eruptions, and decaying vegetation.	True	False
12. Our atmosphere at one time was poisonous to breathe.	True	False
13. Ozone is a pollutant in the lower atmosphere, but an essential component of the upper atmosphere.	True	False
14. You could live nearly a month without food, and a few days without water, but deprived of air, you would survive for only a few minutes.	True	False
15. Pollution control has not improved overall air quality.	True	False
16. Most air pollution caused by human activity originates with combustion.	True	False



17. In recent years, rain in industrialized nations has become less acidic.	True	False
18. Industrial activity is the main source of air pollution.	True	False
19. Destruction of material and crops by air pollution represents a significant economic loss for our nation.	True	False
20. Air pollution first occurred during the Industrial Revolution.	True	False
21. Clean, unpolluted air is a pure substance.	True	False
22. Two of the top 10 industrial chemicals are "mined" from the atmosphere.	True	False
23. The composition of the atmosphere varies widely at different locations on Earth.	True	False
24. The air closest to us is the part of the atmosphere known at the stratosphere.	True	False
25. Air is an unlimited resource that can be managed for health and environmental quality.	True	False

Sources: *American Lung Association 1992 and Delaware Environmental Science Summer Institute 1995*



TEACHER MATERIALS

LESSON 1 ACTIVITY 2



WHY STUDY AIR POLLUTION?

LESSON 1 ACTIVITY 2

WHAT'S YOUR AIR POLLUTION I.Q.? ANSWER SHEET

- 1. False** The air carries pollution far beyond the city. So do automobiles and out-of-city factories.
- 2. True** Although special circumstances cause exceptions, pollution generally increases with population.
- 3. True** Automobiles, trucks, and buses account for about 40 percent of our nation's pollution.
- 4. False** Los Angeles-type ozone smog forms in many places – wherever automobile exhaust and pollution from other sources are acted upon by sunlight.
- 5. False** Inversions occur naturally. They do keep pollution from being dispersed, however.
- 6. True** Studies indicate that pollution worsens these diseases and causes more hospital admissions from respiratory disease-related problems.
- 7. False** Among other things, pollution is linked to heart failure in chronic respiratory disease patients.
- 8. True** In a number of famous long-lasting inversions, pollution brought death to many people. More recently, air pollution has been linked to premature death in big cities.
- 9. False** Many polluting gases are colorless and many polluting particles are white.
- 10. True** The American Lung Association estimates that because of sickness and death, air pollution costs each man, woman and child in this country over \$200 a year. Industry also must spend money to clean up pollution.
- 11. True** The eruption of Mount St. Helen's and fires that ravage Western states vividly demonstrate sources of natural air pollution.
- 12. True** For the first billion years, the atmosphere was probably mainly nitrogen, hydrogen, carbon dioxide, and water vapor. It contained no oxygen. Through the process of photosynthesis, plants exhaled oxygen after taking in carbon dioxide. After time passed, there was enough oxygen in the atmosphere for animals to live.
- 13. True** In the lower atmosphere, ozone is a component of photochemical smog that causes direct damage by corroding metals and plastics, and oxidizing biological tissue. In the stratosphere, ozone acts to filter out harmful ultraviolet radiation.
- 14. False** The quality of air has improved since the Clean Air Act and the establishment of the Environmental Protection Agency.
- 15. True** Major combustion products are CO_2 and H_2O , and a variety of other substances such as unburned hydrocarbons, NO_x , SO_x , and particulates.
- 16. False** The rain in industrialized nations has become more acidic causing both environmental and political problems.



- 17. False** In terms of total mass of pollutants emitted, industrial activity falls behind transportation, space heating, and electricity generation. The important implication is that each of us, by our lifestyle and personal habits, contributes to air pollution. It is not just a problem of industry.
- 18. True** Estimates of economic loss due to air pollution run as high as \$16 billion annually in the United States.
- 19. False** Air pollution is at least as old as civilization. Early fires from cooking and smelting operations polluted the air in ancient times. Since the Industrial Revolution the amount of pollution per person has increased along with our increased use of resources.
- 20. False** Air is a mixture that contains a variety of substances (N_2 , O_2 , Ar, CO_2 , H_2O , etc.) of both biological and industrial importance.
- 21. True** Oxygen is number five on the top 10 chemical list. Nitrogen is number three on the top 10 chemical list.
- 22. False** If this were true, living organisms would be limited in the habitats they could occupy.
- 23. False** The air closest to us is the part of the atmosphere known as the troposphere.
- 24. False** Air is a limited resource that can be managed for health and environmental quality.

Score

You are well informed 23-25

You are informed 20-22

What you don't know may hurt you under 20

Sources: *American Lung Association 1992 and Delaware Environmental Science Summer Institute 1995.*



STUDENT MATERIALS

LESSON 1 ACTIVITY 3



High School and Middle School Air Quality Education Program

1



WHAT IS AIR?

LESSON 1 ACTIVITY 3

READING 1

Scientists believe that the earth is four and a half billion years old. Our atmosphere, the air, was very different when the earth was new. Many believe that it was formed from escaped gases from volcanoes, coming from deep within the earth. It was dangerous to breathe! For the first billion years, the atmosphere was probably mainly nitrogen, hydrogen, carbon dioxide, and water vapor. It contained no oxygen; none of today's plants and animals could have survived in that atmosphere.

Gradually, within the oceans, some of the organisms developed an ability to use the sun's energy to take the carbon dioxide and water and make food for themselves. This amazing process is called photosynthesis (to make with light), the same process that all green plants live by today.

Photosynthesis changes the earth's air through plants "exhaling" oxygen after taking in carbon dioxide. After time passed, there was enough oxygen in the atmosphere for animals to live. Green plants are still essential to our air cycle, by using carbon dioxide and then releasing oxygen. One mature tree consumes an average of 13 pounds of carbon dioxide per year that would otherwise be in the atmosphere and contribute to global warming. One acre of trees uses over two and a half tons of carbon dioxide a year.

The Earth's atmosphere is a constantly moving body of gases that encircle our planet. This body of gases known as air is a mixture—not a chemical combination—of a number of gases; that is, each gas retains its own characteristic properties. It consists of about 78 percent nitrogen; about 21 percent oxygen, and carries along with it water

vapor, clouds, dust, smoke, soot, and a variety of chemical compounds. The remaining one-percent contains all the other gases including carbon monoxide, carbon dioxide, ozone, methane, and ammonia that contribute to air pollution. And at any time air may contain contaminants emitted by such natural occurrences as volcanic eruptions, forest fires, and decaying vegetation. Only during the past 20 years or so have we begun to understand that air is a resource that is limited and can be managed for health and environmental quality.

Bound to the earth by forces of gravity, the atmosphere extends about 600 miles into space. On a clear day, the supply of air looks endless. But the air we breathe is taken from the troposphere, a tiny portion of that vast ocean of air. The troposphere is no more than seven to ten miles thick.

Although only the air in the troposphere is suitable for breathing, the upper atmospheric layers are also important for life on earth. The next layer of atmosphere above the troposphere is the stratosphere. In this layer, ozone filters out dangerous ultraviolet rays from the sun. This filtering helps control the earth's temperature and helps prevent skin cancer resulting from overexposure to the sun. Today humans so arrogantly misuse the atmosphere in their rush toward increased comforts that we are very close to suffocating ourselves and destroying all the life around us. That must not happen. We must prevent it. Before the sun is further dimmed, before more flowers wither and die, before more people suffocate in a rank and poisoned world, we must change our ways and learn to live within the laws of nature. We must learn the facts of life.

Source: *Kids For Clean Air*, Clean Air Program, Pima County Department of Environmental Quality, Tucson, Arizona



WHAT IS AIR?

Lesson 1 Activity 3 Reading 1 Student Worksheet

Name: _____ Date: _____

Class: _____ Period or Block: _____

1. How old is the earth according to scientists? _____

2. How do scientists believe our atmosphere was formed? _____

3. What was the composition of the original atmosphere? _____

4. What was missing from the original atmosphere that is necessary for life on earth? _____

5. Where did this missing ingredient in the atmosphere eventually come from? _____

6. What is the composition of the air we breathe today? _____

7. What is the troposphere? _____

8. What is the stratosphere and what is its importance? _____

9. Why are humans misusing the atmosphere today? _____



High School and Middle School Air Quality Education Program

1

WHAT IS AIR POLLUTION?

Lesson 1 Activity 3

READING 2

Webster's College Dictionary defines pollution as "the introduction of harmful substances into the environment." The American Medical Association defines air pollution as "the excessive concentration of foreign matter in the air which adversely affects the well-being of the individual or causes damage to property." Our air is polluted whenever certain gases or particulate matter in the air affect the health of humans, animals, or plants, and damage materials. These statements and definitions can be expanded into a working definition of air pollution: *gases and small particles put into the atmosphere by human activity that, by themselves or in combination with other compounds, contaminate, harm or alter the natural balance of ecosystems.* Air pollution then is the damage to the purity of the atmosphere by various noxious (harmful) chemicals and refuse materials. To pollute is to render unclean and cause harm in varying degrees depending on the concentration and type of pollutant.

It is a common statement among polluters opposed to reform that the air has never been pure. They are right. Long before man put his busy mind to work on the internal combustion machine, volcanoes were belching lava that blackened the skies, and decayed marshes were polluting the countryside. But in the past nature had time to make adjustments. It was able to evolve a self-cleansing atmosphere that, for eons before man, was certainly life supporting.

Humans started to pollute the air when they first learned to use fire. Air pollution didn't become a problem until the dawn of the Industrial Age when the greater use of fossil fuels and the products of combustion, began to foul the air.

Today nature is fighting a losing battle with man-made air pollution. Vast expanses of countryside smolder and stink. Dreamy fogs are accomplices to murder. Sunny, windless

days carry, like a disease, the threat of suffocation.

While this air pollution problem has existed for centuries, the present day industrial boom and population explosion have made it a critical one. Two centuries later we have finally become aware of the hazards that air pollution poses to our health and environment. With the help of technology, we have begun the costly and complex task of cleaning the air.

The first set of air pollution ordinances began in England in the 1300s. In 1306, King Edward's wife had bronchitis caused by air pollution. As a result of her illness, King Edward passed a set of environmental ordinances in an attempt to clean the air. In recent times, beginning with the Clean Air Act of 1963, a whole package of acts and amendments were passed which is sometimes referred to as the Clean Air Act of 1970.

Effective environmental action also materialized in recent times with the creation of the Environmental Protection Agency (EPA), which was established on December 2, 1970. EPA was vested with the authority to enforce the provisions of the Clean Air Act. Prior to the creation of EPA, diverse programs and organizations were dealing with the pollution problem. EPA pulled together these diverse environmental programs and organizations into a single, viable agency, whose recent budget is in the billions of dollars.

The levels of the major pollutants in the air have declined over the past two decades as a result of actions taken by the federal government and many state governments. But this improvement is only the beginning. If more improvements are not made by all of us, our future life could be in peril.

Source: *Clean Air And You: A Delaware Perspective*, Delaware Nature Society and The Department of Natural Resources and Environmental Control High School and Middle School Air Quality Education Program



WHAT IS AIR POLLUTION?

Lesson 1: Activity 3 Reading 2 Student Worksheet

Name: _____ Date: _____

Class: _____ Period or Block: _____

1. How does Webster's College Dictionary define pollution? _____

2. How does the American Medical Association define pollution? _____

3. Write a working definition of air pollution from these statements and definitions.

4. Explain why the air has never been pure: _____

5. When did humans first begin to pollute? _____
6. When did air pollution become a major problem for civilization? _____

7. Describe who is winning the battle of pollution: _____

8. When did the first set of air pollution ordinances pass? _____

9. Identify present day federal laws and agencies to deal with the pollution problem: _____

10. What will be the result of the pollution battle if more improvements are not made? _____



1

WHY IS AIR POLLUTION A PROBLEM IN DELAWARE?

Lesson 1 Activity 3

READING 3

The quality of our air has important and diverse ramifications. Both visible and invisible air pollutants have severe impacts on our environment, our health, and the quality of our lives. It has been well documented that air pollution costs Americans billions of dollars a year through its effects on our forests and crops, our buildings and cities, and our bodies. Air quality is also of special concern to us here in the Delaware area, where the economic well-being of our state is linked to visitors who come here to enjoy the climate, beaches, and other natural and historical settings.

The air that is found in Delaware and that surrounds the earth has been with us for millions of years. The earth is a closed system, therefore, the air we breathe today may have been the very same air used by the early Native Americans who lived in the United States over a thousand years ago. We will be receiving no more air from outer space. Our air is a precious resource that we must take responsibility for protecting. Nature has been recycling air for centuries, keeping it clean. The ingredients of the atmosphere have been held in balance for millions of years, but pollution by human activity is upsetting this balance and creating many problems. Cars and factories burn fuels that dirty the air. People have learned how to make plastics and chemicals that nature cannot recycle. The atmosphere is getting too warm, the protective ozone layer is being destroyed, acid rain is damaging lakes and forests, and dangerous chemicals are poisoning living things.

However, threats to the air, whether through ground-level ozone, acid rain, holes in the ozone layer, global warming, or indoor air pollution, are problems that do have solutions. But, the remedy to these problems will come about only with widespread education and behavioral changes.

Air pollution is a growing problem in our state primarily because of the amount of driving that takes place. Motor vehicles are the source of most of our air pollution. On the average, for every 25 miles driven, a pound of pollution is emitted into the air. Thus, through our daily transportation choices, each of us can be a part of the pollution problem or solution. Most adults are aware that driving causes air pollution, and some are even beginning to explore alternative modes of transportation. Nevertheless, many of us are entrenched in our driving habits, and rarely consider carpooling, taking the bus, or riding a bike. Because breathing clean air is one of our most basic needs, and because the cause and effect relationship between transportation and pollution is so closely linked to our everyday lives, the topic of air quality is especially relevant to Delaware citizens of all ages. Understanding these connections can empower you to make a contribution toward solving this important environmental problem and make a difference in improving your own future.

Source: *Students For Clean Air*, Clean Air Program, Pima County Department of Environmental Quality, Tucson, Arizona



WHY IS AIR POLLUTION A PROBLEM IN DELAWARE?

Lesson 1 Activity 3 Reading 3 Student Worksheet

Name: _____ Date: _____

Class: _____ Block or Period: _____

1. Why is air quality of special concern to the Delaware area? _____

2. Explain what is meant when scientists say the earth is a closed system?

3. Identify five problems created by air pollution:
 - a. _____
 - b. _____
 - c. _____
 - d. _____
 - e. _____
4. Explain why air pollution is a growing problem in Delaware:

5. Explain a remedy to these air pollution problems? _____

6. Name three things you and your family can do to help solve the air pollution problem? _____
 - a. _____
 - b. _____
 - c. _____



High School and Middle School Air Quality Education Program

1

ZONE: IS IT GOOD OR BAD?

Lesson 1 Activity 3

READING 4

The word “ozone” has prompted a great deal of confusion over the past few years. This confusion persists in part because ozone conjures both good and bad images in the mind of the public, and in fact both perceptions are correct. From a beneficial standpoint, we know that the ozone layer in the upper atmosphere (stratosphere) is essential because it filters harmful ultraviolet radiation from the sun, reducing the amount reaching the earth’s surface. On the other hand, high accumulations of ozone gas in the lower atmosphere (troposphere) near ground level can be harmful to people, animals, crops and other materials. The ozone gas in both upper and lower atmosphere is the same; the difference is that one benefits and one harms.

Ozone is a complex form of oxygen. It is a gas that forms in the atmosphere when 3 atoms of oxygen are combined (O_3). It is not emitted directly into the air, but at ground level is created by a chemical reaction between oxides of nitrogen (NO_x), and volatile organic compounds (VOC) in the presence of sunlight. Although molecular oxygen in the form of O_2 is essential to life, molecular oxygen as O_3 is toxic.

Ozone occurs naturally in the stratosphere, a layer of the Earth’s atmosphere about 7 to 22 miles above the Earth’s surface. The concentration of “good” ozone within the stratosphere is called the ozone layer. It shields the Earth and all living things from almost all of the harmful ultraviolet (UV) radiation emitted by our sun. Without stratospheric ozone, we could not live on Earth.

Some artificial compounds that people use, like chlorofluorocarbons (CFCs), rise to the stratosphere over a period of years. These compounds were used for decades as propellants in aerosol sprays and as coolants for refrigerators and air conditioners.

Over time, their negative effects became clear. In the stratosphere, they act to increase chemical reactions that break down triatomic oxygen (O and O_2). Depletion of ozone in the stratosphere allows more UV rays to reach Earth’s surface. This radiation is causing an increased incidence of skin cancer and cataracts and may damage the human immune system, as well as injure other animals and damage plants.

In contrast to stratospheric ozone, ozone in the troposphere, a layer of the Earth’s atmosphere from 0 to 10 miles above the Earth’s surface, has no function in nature and is harmful. A limited amount of ground-level ozone originates from natural sources, including plants. This naturally-occurring ozone is at very low concentrations that have no effect on humans. Human activities can drastically increase tropospheric ozone. At these higher concentrations, ground-level ozone is a major pollutant. It is one of the six criteria pollutants for which the Environmental Protection Agency has set National Ambient (outside) Air Quality Standards. Ozone is found in larger amounts and in more places in the U.S. and Delaware than any other air pollutant.

A hot, sunny and still day is the most dangerous kind for ozone pollution. That’s when the sun bakes unburned gases from auto (tailpipe) emissions, fuel evaporation and smokestacks to create ozone. Ozone can form in both urban and rural areas. Both areas can have high ozone levels, depending on wind speed, direction and the lay of the land. If the air is stagnant, ground-level ozone can form over a large region.

Source: *Ozone: Is It Good? Is It Bad?*, TNRCC Air Quality Mobile Source, Texas



WHY IS AIR POLLUTION A PROBLEM IN DELAWARE?

Lesson 1 Activity 3 Reading 4 Student Worksheet

Name: _____ Date: _____

Class: _____ Block or Period: _____

1. Why has the word ozone prompted a great deal of confusion recently?

2. Compare ozone in both the upper and lower atmosphere:

Stratospheric Ozone: _____

Tropospheric Ozone: _____

3. What is ozone? _____

4. How is ozone formed in the stratosphere? _____

5. How is ozone formed in the troposphere? _____

6. Explain the difference between O_2 and O_3 : _____

7. Describe the ideal weather conditions for the formation of ground-level ozone: _____

8. Explain where ground-level ozone is found in the U.S. _____

9. What has the Environmental Protection Agency (EPA) done to try to reduce ground-level ozone? _____



High School and Middle School Air Quality Education Program

1

WHAT IS THE CLEAN AIR ACT?

Lesson 1 Activity 3

READING 5

The original Clean Air Act was passed in 1963, but our national air pollution control program is actually based on the 1970 version of the law. The 1990 Clean Air Act Amendments revised the 1970 law.

The overall goal of the 1990 Amendments is to reduce pollutants in our air by 56 billion pounds a year—224 pounds for every person in the country—by the time the law is fully implemented in 2005. The new law builds on the strengths of the Clean Air Act of 1970 and the environmental lessons learned over the past 20 years. As the goals of the law are met, we will be breathing cleaner air every year.

Two kinds of pollutants are regulated under the Clean Air Act. There are only six in the first group, which are called “criteria” pollutants. These pollutants—carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone, lead, and particulate matter—are discharged in relatively large quantities by a variety of sources, and they threaten human health and welfare across broad regions of the country. EPA sets national standards for each of the criteria pollutants, and the states must take action to insure the standards are met. Failure to meet the standards is called “non-attainment.” Many urban areas are classified as “non-attainment areas” for at least one criteria air pollutant.

The other kind of pollutants—and there are hundreds in this group—are the ones that are immediately hazardous to human health and are associated with specific sources. Some of these air toxics are cancer-causing; some produce other health and environmental problems. The threat is highest for people living near large industrial facilities or in heavily polluted urban corridors. The list of toxics emitted into the air is a long one, and it includes some familiar names. Benzene, for example, is a potent cancer-causing substance. Gasoline sold in the United States is, on average, 1.6 percent benzene. Eighty-five percent of human exposure to benzene comes from gasoline.

A second example is mercury. Mercury is a metal found in trace amounts in coal and is released to the air when the coal is burned. Mercury also is released by incinerators burning garbage. It is used in latex paints to prevent mildew, and as the paint weathers, substantial amounts of mercury may be released into the air.

Another aspect of air-toxics regulation focuses on the sudden and potentially catastrophic chemical accident. For the period 1982 to 1986, accidental releases of toxic chemicals in the United States caused 309 deaths, 11,341 injuries, and the evacuation of 464,677 people from homes and jobs. The most publicized accidental release of dangerous chemicals occurred in Bhopal, India, in 1984, when 3,000 were killed and over 200,000 injured.

Areas of non-attainment for criteria pollutants have been classified according to the extent of pollution. The five classes range from marginal (relatively easy to clean up quickly) to extreme (will take a lot of work and a long time to clean up). The 1990 Clean Air Act uses these classes to tailor cleanup requirements to the severity of the pollution and set realistic deadlines for reaching cleanup goals. If deadlines are missed, the law allows more time to clean up, but usually a non-attainment area that has missed a cleanup deadline must meet the stricter requirements set for more polluted areas.

States do most of the planning for cleaning up criteria air pollutants using a system of permits to make sure power plants, factories, and other pollution sources meet their cleanup goals. A variety of cleanup methods are required in non-attainment areas, many of which involve motor vehicles.

The quality of the air is critical to life on earth. As we become more aware of the importance of air quality, we are also becoming increasingly aware of the global impacts. Other air quality issues of the present and future are even more world-wide: agricultural impacts, global climate change, decreasing visibility, and acid deposition.

Source: *Project A.I.R.E.* United States Environmental Protection Agency



WHAT IS THE CLEAN AIR ACT?

Lesson 1 Activity 3 Reading 5 Student Worksheet

Name: _____ Date: _____

Class: _____ Period or Block: _____

1. When was the original Clean Air Act passed? _____
2. What law is our national air pollution control program based on? _____

3. What year was this pollution control program revised? _____
4. What is it called when there is a failure to meet these standards? _____
5. Identify the "criteria" pollutants:
 - a) _____
 - b) _____
 - c) _____
 - d) _____
 - e) _____
 - f) _____
6. How did the EPA (Environmental Protection Agency) deal with these "criteria" pollutants and what role do the states play?

7. Identify two pollutants that are immediately hazardous to human health:
 - a) _____
 - b) _____
8. Who does most of the planning for cleaning up criteria air pollutants and what system is used? _____



TEACHER MATERIALS

LESSON 1 ACTIVITY 3



TEAM SUMMARY SHEET

Base Groups Lesson 1 Activity 3

GROUP 1

TEAM NAME _____

NAMES OF TEAM MEMBERS

1. _____
2. _____
3. _____
4. _____
5. _____

GROUP 2

TEAM NAME _____

NAMES OF TEAM MEMBERS

1. _____
2. _____
3. _____
4. _____
5. _____

GROUP 3

TEAM NAME _____

NAMES OF TEAM MEMBERS

1. _____
2. _____
3. _____
4. _____
5. _____

GROUP 4

TEAM NAME _____

NAMES OF TEAM MEMBERS

1. _____
2. _____
3. _____
4. _____
5. _____

GROUP 5

TEAM NAME _____

NAMES OF TEAM MEMBERS

1. _____
2. _____
3. _____
4. _____
5. _____

GROUP 6

TEAM NAME _____

NAMES OF TEAM MEMBERS

1. _____
2. _____
3. _____
4. _____
5. _____

GROUP 7

TEAM NAME _____

NAME OF TEAM MEMBERS

1. _____
2. _____
3. _____
4. _____
5. _____

GROUP 8

TEAM NAME _____

NAME OF TEAM MEMBERS

1. _____
2. _____
3. _____
4. _____
5. _____



WHAT IS AIR?

Answer Key

Lesson 1 Activity 3

Reading 1 Student Worksheet

1. How old is the earth according to scientists?
Scientists believe that the earth is four and a half billion years old.
2. How do scientists believe our atmosphere was formed?
Many scientists believe that our atmosphere was formed from escaped gases from volcanoes, coming from deep within the earth.
3. What was the composition of the original atmosphere?
For the first billion years, the atmosphere was probably mainly nitrogen, hydrogen, carbon dioxide, and water vapor.
4. What was missing from the original atmosphere that is necessary for life on earth?
The atmosphere contained no oxygen; none of today's plants and animals could have survived in that atmosphere.
5. Where did this missing ingredient in the atmosphere eventually come from?
Gradually, within the oceans, some of the organisms developed an ability to use the sun's energy to take the carbon dioxide and water and make food for themselves. This amazing process is called photosynthesis, the same process that all green plants live by today.
6. What is the composition of the air we breathe today?
It consists of about 78 percent nitrogen; about 21 percent oxygen, and carries along with it water vapor, clouds, dust, smoke, soot, and a variety of chemical compounds. The remaining one percent contains all the other gases including carbon monoxide, carbon dioxide, ozone, methane, and ammonia that contribute to air pollution.
7. What is the troposphere?
A tiny layer of the atmosphere that is no more than seven to ten miles thick.
8. What is the stratosphere and what is its importance?
The next layer of atmosphere above the troposphere is called the stratosphere. In this layer, ozone filters out dangerous ultraviolet rays from the sun.
9. Why are humans misusing the atmosphere today?
Today humans so arrogantly misuse the atmosphere in their rush toward increased comforts.



WHAT IS AIR POLLUTION?

Answer Key

Lesson 1 Activity 3

Reading 2 Student Worksheet

1. How does Webster's College Dictionary define pollution?
Webster's College Dictionary defines pollution as "the introduction of harmful substances into the environment."
2. How does the American Medical Association define pollution?
The American Medical Association defines air pollution as "the excessive concentration of foreign matter in the air which adversely affects the well-being of the individual or causes damage to property."
3. Write a working definition of air pollution from these statements and definitions.
A working definition of air pollution is: gases and small particles put into the atmosphere by human activity that, by themselves or in combination with other compounds, contaminate, harm or alter the natural balance of ecosystems.
4. Explain why the air has never been pure:
Long before man put his busy mind to work on the internal combustion machine, volcanoes were belching lava that blackened the skies, and decayed marshes were polluting the countryside.
5. When did humans first begin to pollute?
Humans started to pollute the air when they first learned to use fire.
6. When did air pollution become a major problem for civilization?
Air pollution didn't become a problem until the dawn of the Industrial Age when the greater use of fossil fuels and the products of combustion, began to foul the air.
7. Describe who is winning the battle of pollution:
Today nature is fighting a losing battle with man-made air pollution. Vast expanses of countryside smolder and stink. Dreamy fogs are accomplices to murder. Sunny, windless days carry, like a disease, the threat of suffocation.
8. When did the first set of air pollution ordinances pass?
The first set of air pollution ordinances began in England in the 1300s. In 1306, King Edward's wife had bronchitis caused by air pollution. As a result of her illness, King Edward passed a set of environmental ordinances in an attempt to clean the air.
9. Identify present day federal laws and agencies to deal with the pollution problem:
In recent times, beginning with the Clean Air Act of 1963, a whole package of Acts and Amendments were passed which is sometimes referred to as the Clean Air Act of 1970. Effective environmental action also materialized in recent times with the creation of the Environmental Protection Agency (EPA), which was established on December 2, 1970.
10. What will be the result of the pollution battle if more improvements are not made?
The levels of the major pollutants in the air have declined over the past two decades as a result of actions taken by the federal government and many state governments. But this improvement is only the beginning. If more improvements are not made by all of us, our future life could be in peril.



High School and Middle School Air Quality Education Program


WHY IS AIR POLLUTION A PROBLEM IN DELAWARE?

Answer Key

Lesson 1 Activity 3

Reading 3 Student Worksheet

1. Why is air quality of special concern to the Delaware area?
Because the economic well-being of Delaware is linked to visitors who come here to enjoy the climate, beaches, and other natural and historical settings.
2. Explain what is meant when scientists say the earth is a closed system?
A closed system means that it is a system that will always be the same. The air we breathe today may have been the same air used by the early Native Americans who lived in the U.S. over a thousand years ago. We will be receiving no more air from outer space.
3. Identify five problems created by air pollution:
 - a. **Ground-level ozone**
 - b. **Acid rain**
 - c. **Holes in the ozone layer**
 - d. **Global warming**
 - e. **Indoor air pollution**
4. Explain why air pollution is a growing problem in Delaware:
Because of the amount of driving that takes place. Motor vehicles are the source of most of our air pollution.
5. Explain a remedy to these air pollution problems?
The remedy to these problems will come about only with widespread education and behavioral changes.
6. Name three things you and your family can do to help solve the air pollution problem?
 - a. **Carpooling**
 - b. **Using the bus**
 - c. **Riding a bike**



Answer Key
Lesson 1 Activity 3
Reading 4 Student Worksheet

1. Why has the word ozone prompted a great deal of confusion recently?
This confusion persists in part because ozone conjures both good and bad images in the mind of the public, and in fact both perceptions are correct.
2. Compare ozone in both the upper and lower atmosphere:
From a beneficial standpoint, we know that the ozone layer in the upper atmosphere (stratosphere) is essential because it filters harmful ultraviolet radiation from the sun, reducing the amount reaching the earth's surface. On the other hand, high accumulations of ozone gas in the lower atmosphere (troposphere) near ground level can be harmful to people, animals, crops and other materials. The ozone gas in both upper and lower atmosphere is the same; the difference is that one benefits and one harms.
3. What is ozone?
Ozone is a complex form of oxygen. It is a gas that forms in the atmosphere when 3 atoms of oxygen are combined (O_3). It is not emitted directly into the air, but at ground level is created by a chemical reaction between oxides of nitrogen (NO_x), and volatile organic compounds (VOC) in the presence of sunlight.
4. How is ozone formed in the stratosphere?
Ozone occurs naturally in the stratosphere, a layer of the Earth's atmosphere about 7 to 22 miles above the Earth's surface. The concentration of "good" ozone within the stratosphere is called the ozone layer. It shields the Earth and all living things from almost all of the harmful ultraviolet (UV) radiation emitted by our sun. Without stratospheric ozone, we could not live on Earth.
5. How is ozone formed in the troposphere?
A limited amount of ground-level ozone originates from natural sources, including plants. This naturally-occurring ozone is at very low concentrations that have no effect on humans. Human activities can drastically increase tropospheric ozone. A hot, sunny and still day is the most dangerous kind for ozone pollution. That's when the sun bakes unburned gases from auto (tailpipe) emissions, fuel evaporation and smokestacks to create ozone.
6. Explain the difference between O_2 and O_3 :
Although molecular oxygen in the form of O_2 is essential to life, molecular oxygen as O_3 is toxic.
7. Describe the ideal weather conditions for the formation of ground-level ozone:
A hot, sunny and still day is the most dangerous kind for ozone pollution.
8. Explain where ground-level ozone is found in the U.S.
Ozone can form in both urban and rural areas. Both areas can have high ozone levels, depending on wind speed, direction and the lay of the land. If the air is stagnant, ground-level ozone can form over a large region.
9. What has the Environmental Protection Agency (EPA) done to try to reduce ground-level ozone?
Ozone is one of the six criteria pollutants for which the Environmental Protection Agency has set National Ambient (outside) Air Quality Standards.



WHAT IS THE CLEAN AIR ACT?

Answer Key

Lesson 1 Activity 3 Reading 5 Student Worksheet

1. When was the original Clean Air Act passed?
The original Clean Air Act was passed in 1963.
2. What law is our national air pollution control program based on?
Our national air pollution control program is actually based on the 1970 version of the law.
3. What year was this pollution control program revised?
The 1990 Clean Air Act Amendments revised the 1970 law.
4. What is it called when there is a failure to meet these standards?
Failure to meet the standards is called "non-attainment."
5. Identify the "criteria" pollutants:
Carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone, lead, and particulate matter.
6. How did the EPA (Environmental Protection Agency) deal with these "criteria" pollutants and what role do the states play?
EPA sets national standards for each of the criteria pollutants, and the states must take action to insure the standards are met.
7. Identify two pollutants that are immediately hazardous to human health:
Benzene, for example, is a potent cancer-causing substance. A second example is mercury.
8. Who does most of the planning for cleaning up criteria air pollutants and what system is used?
States do most of the planning for cleaning up criteria air pollutants using a system of permits to make sure power plants, factories, and other pollution sources meet their cleanup goals. A variety of cleanup methods are required in non-attainment areas, many of which involve motor vehicles.



STUDENT MATERIALS

LESSON 1 ACTIVITY 4



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 4

Handout 7

Air Quality Issue

Social Studies Position Paper

Student Directions

DESCRIPTION: You will apply what you have learned in this Air Pollution lesson and measure the application of knowledge and skills from the performance indicators of the lesson.

Directions:

1. You will participate in a culminating activity by writing a two page (typed - double spaced) position paper on an air quality issue that you have chosen. Be sure to select an issue that is an important political issue such as air pollution, air toxics regulation, acid rain, etc.
2. You should support your position with well developed ideas and details from your reading and what you have learned in class.
3. You should do library or other research about the air quality issue you plan to write about. You should be able to support your position with details from your research.
4. Be sure to explain the course of action that needs to be followed to help solve the issue that you are addressing. In other words, a well developed position.
5. In a concluding paragraph, explain the method you used to influence the decision of a legislator or government agent.
6. Be sure to examine the scoring rubric that will be used to evaluate and grade your position paper.



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 4 Handout 8

SCORING RUBRIC FOR SOCIAL STUDIES POSITION PAPER

- 4 – The position is clear and well developed
- 3 – The position is somewhat clear and well developed
- 2 – The position is vague and somewhat developed
- 1 – The position is vague and not well developed

	0	1	2	3	4	
1. Description of Air Quality Issue P.I. H.401	_____	_____	_____	_____	_____	x 5 = _____
2. Supporting details P.I. H.408	_____	_____	_____	_____	_____	x 5 = _____
3. Evidence of research P.I. H.405	_____	_____	_____	_____	_____	x 5 = _____
4. Well developed position P.I. C.416	_____	_____	_____	_____	_____	x 5 = _____
5. Course of action and influence P.I. C.418 P.I. G.407	_____	_____	_____	_____	_____	x 5 = _____

GRADE _____



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 4 Handout 9 Air Quality Issue Science Position Paper Student Directions

Description: You will apply what you have learned in this Air Pollution lesson and measure the application of knowledge and skills from the performance indicators of the lesson.

Directions:

1. You will participate in a culminating activity by writing a two page (typed-double spaced) paper on the greenhouse effect. First you will describe the greenhouse effect issue.
2. The second section of your paper will describe human activities that have an adverse impact on geochemical cycles that create the greenhouse effect.
3. In section three, you will explain what individuals can do to make a difference in the amount of carbon dioxide that is emitted into the air. Be sure to explain the course of action that needs to be followed to help solve this important issue.
4. You should do library or other research about the global warming issue you plan to write about. You should be able to support your findings with details from your research.
5. In a concluding paragraph, explain the method you could use to influence the decision of a legislator or government agent to help reduce global warming.
6. Be sure to examine the scoring rubric that will be used to evaluate and grade your position paper.



WHY STUDY AIR POLLUTION?

Lesson 1 Activity 4

Handout 10

SCORING RUBRIC FOR SCIENCE POSTION PAPER

- 4 – The description of the issue is clear and well developed
- 3 – The description of the issue is somewhat clear and well developed
- 2 – The description of the issue is vague and somewhat developed
- 1 – The description of the issue is vague and not well developed

	0	1	2	3	4	
1. Description of the issue P.I. 8.316	_____	_____	_____	_____	_____	x 5 = _____
2. Description of adverse human activities P.I. 9.75 P.I. 8.348	_____	_____	_____	_____	_____	x 5 = _____
3. Description of helpful human activities P.I. 9.75 P.I. 8.348	_____	_____	_____	_____	_____	x 5 = _____
4. Evidence of research P.I. 9.75 P.I. 8.316	_____	_____	_____	_____	_____	x 5 = _____
5. Course of action and influence P.I. 9.75	_____	_____	_____	_____	_____	x 5 = _____

GRADE _____