



**GRADES:** 7-11

**SUBJECTS:** Science, Social Science, Civics, Government, Health, Geography, Environmental Science, History

**TIME:** 4 Hours; 2 2/3 Blocks or 5 Periods

**STATE STANDARDS:**

**Civics Standard 3** - Citizenship, P.I. C.416 Grades 9-11

**Civics Standard 4** - Participation, P.I. C.4.19 - Grades 9-11

**Geography Standard 1** - Maps, P.I. G.402, G.404 - Grades 9-11

**Geography Standard 2** - Environment, P.I. G.405, G.406, G.407, G.408 Grades 9-12; 7.423, 8.423 - Grades 7-8

**History Standard 1** - Chronology, P.I. H.401 - Grades 9-11; 7.427, 8.428 - Grades 7-8

**History Standard 2** - Analysis, P.I. H.405 - Grades 9-11

**Science Standard 5** - Earth's Dynamic System (Components of Earth) 5.12; P.I. 9.75 - Grades 9-11

**Science Standard 8** - Ecology (Interaction of Humans Within Ecosystems) 8.31, 8.33; P.I. 9.75 - Grades 9-11

# 5 WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

## OVERVIEW OF THE LESSON

### Scope and Purpose of the Lesson:

This lesson contains a variety of activities that help students become aware that open burning has human risk factors and that these risk factors can be reduced.

#### ◆ Topics Addressed:

Open burning  
Human factors that are involved in open burning  
Delaware open burning regulations  
Air pollutants of open burning  
Reasons people continue to use open burning  
How to influence people to stop open burning  
Alternatives to open burning  
Composting

### Synopsis of the Lesson:

This lesson contains four activities that use a variety of instructional strategies and is focused around the organizing question of "What Impact Does Open Burning Have On Air Quality?"

## LEARNING OBJECTIVES

Students will be able to:

- ◆ Define open burning
- ◆ Describe the human risk factors that are involved in open burning
- ◆ Explain the open burning regulations in Delaware
- ◆ Identify the air pollutants of open burning
- ◆ Explain the reasons people continue to use open burning
- ◆ Explain some innovative approaches to influence people to stop open burning
- ◆ Identify some alternatives to open burning
- ◆ Describe the purpose and process of composting



## BACKGROUND

What is open burning and how do I know when I am in violation of open burning laws and regulations? Any time you light an outdoor fire, you are “open burning.” Open burning is defined in the Delaware Regulations Governing the Control of Air Pollution as, “Any outdoor fire or outdoor smoke producing process from which the products of combustion are emitted directly into the ambient (outdoor) air...” Open burning is typically conducted using burn barrels, screened pits, backyard incinerators, and just plain “piling up” of refuse, trash, yard trimmings or leaves.

Burn barrels are typically 55-gallon steel drums that are filled with refuse, trash, yard trimmings or leaves. Unlike incinerators, which burn hot and clean with temperatures approaching 2,500 degrees Fahrenheit, burn barrels typically smoke along at a comparatively low 400 to 500 degrees Fahrenheit. As a result, very inefficient combustion occurs, causing much higher levels of air pollutants to go up in the billowing smoke.

**Note to teacher:** More information on open burning and composting is available on the DNREC web page: <http://www.DNREC.state.de.us>. *Proton Dan Explores Open Air Refuse Burning* video is available from DNREC: (302) 739-4506 or from the Delaware Teachers Center 736-6723 (see Student Worksheet for video in Student Materials)

## LESSON PROCEDURE

**INTRODUCTION OF LESSON** - Start the lesson with a Warm-up, Mind Set, or Anticipatory Set on the overhead or chalk board. The WARM UP and THINK-PAIR SHARE ACTIVITY should take about **15 minutes**.

**1. WARM UP, MIND SET OR ANTICIPATORY SET** - What is open burning? Give students **3 to 4 minutes** to respond in writing.

**2. THINK-PAIR-SHARE ACTIVITY** - Divide the class into pairs and ask each pair to share their answers to the Warm Up and come to a consensus on their responses. Next have the youngest of each of the pairs of students share their consensus with the class. **(10-12 minutes)**

**3. LESSON OBJECTIVES** - The lesson objectives should be presented on an overhead or on the chalkboard. These should be read and explained to the class. **(2-3 minutes)**

**OPTION:** You may want the students to copy the lesson objectives in their notebooks.

## ACTIVITY 1: Reading

### 1. Description/Overview of Activity:

Students will work individually to complete Reading #1 and Student Worksheet #1 to develop a background and understanding of open burning.

### 2. Materials Needed:

Reading #1  
Student Worksheet #1

### 3. Performance Indicators of the Activity:

Geography P.I. G.405, G.406, G.407, G.408; 7.423, 8.423  
Science P.I. 9.75  
History P.I. H.401; 7.427, 8.428

### 4. Preparation for Activity:

Make copies of Reading #1 and Student Worksheet #1.

### 5. Activity Outline and Directions to the Teacher:

**STEP 1:** Students will now complete **Reading #1** to develop a better background and understanding of open burning. Give the students **Reading #1** and **Student Worksheet #1** and ask them to complete both the reading and the worksheet individually. **(15 minutes)**

**STEP 2: CLASS DISCUSSION** - Have the class briefly discuss Reading #1 and their answers to Student Worksheet #1—see answer sheet in Teacher Materials. **(10 minutes)**

## ACTIVITY 2: Word Unscramble Activity

### 1. Description/Overview of Activity:

Students will complete the word unscramble activity in cooperative learning groups. The purpose of this activity is to identify the air pollutants of open burning and some of the health risks.

### 2. Materials Needed:

Activity Sheet #1

### 3. Performance Indicators of the Activity:

Geography P.I. G.405, G.406, G.407, G.408; 7.423, 8.423  
Science P.I. 9.75

### 4. Preparation for Activity:

Make copies of Activity Sheet #1. Divide the students into cooperative learning groups of 4 students each arranged heterogeneously by gender, race, and ability.

### 5. Activity Outline and Directions to the Teacher:

**STEP 1:** Have students move into their cooperative learning groups to complete this activity. Give students Activity



Sheet #1, Word Unscramble Activity, and have students complete the sheet. (5 minutes)

**STEP 2: LARGE GROUP DISCUSSION** Have students discuss the air pollutants put into the air by open burning and their effects. (5-10 minutes)

### ACTIVITY 3: Concept Development

#### 1. Description/Overview of Activity:

Students will complete Activity Sheet #2 in pairs. The purpose of this activity is to identify: reasons people continue to burn trash, some innovative approaches to get people to stop open burning, and some alternatives to open burning.

#### 2. Materials Needed:

Activity Sheet #2

#### 3. Performance Indicators of the Activity:

Geography P.I. G.404

Science P.I. 9.75

History P.I. H.405

#### 4. Preparation for Activity:

Make copies of Activity Sheet #2. Divide the students into pairs (students sitting next to each other).

#### 5. Activity Outline and Directions to the Teacher:

**STEP 1:** Give students a copy of Activity Sheet #2 to complete in pairs. (10 minutes)

**STEP 2: LARGE GROUP DISCUSSION** Discuss the reasons people continue to burn, answers to open burning, and open burning alternatives as you go over the answers to Activity Sheet #2. (15 minutes)

### ACTIVITY 4: Group Role Play

#### 1. Description/Overview of Activity:

Students will participate in a group role play activity in which they will develop a strategy to convince and influence public opinion to use composting as an alternative to open burning.

#### 2. Materials Needed:

Handout #1

Activity Sheet #3

Rubric #1

#### 3. Performance Indicators of the Activity:

Civics P.I. C.416, C.419

Geography P.I. G.402, G.404, G.408

Science P.I. 9.75

#### 4. Preparation for Activity:

Make copies of Activity Sheet #3. Handout #1, and Rubric #1. Divide the students into cooperative learning groups of four students each arranged heterogeneously by gender, race, and ability.

#### 5. Activity Outline and Directions to the Teacher:

**STEP 1:** Divide the class into cooperative learning groups of 4 students per group. Explain to the groups that they are going to role play employees of the Department of Natural Resources and Environmental Control working for the Director of the Division of Air and Waste Management. Their job will be to develop a strategy on how to convince and influence public opinion to use composting as an alternative to open burning. Explain that each group must discuss composting (using Handout #1) in order to try to convince the public to start composting. Have each group write their strategy on paper. Also explain that each group will do an oral presentation to the entire class limited to 10 minutes. Explain to the groups that these presentations will be graded—see Rubric #1. Give each group a copy of Handout #1, Activity Sheet #3, and Rubric #1. Students should have time to complete visual aids as homework. (45 minutes)

**STEP 2: ORAL REPORTS** - Each group will give an oral presentation on their strategy to convince the public to start composting—limited to 10 minutes. (70-80 minutes)

### ACTIVITY 5: Culminating Activity - Debate

#### 1. Description/Overview of Activity:

Students will participate in organizing a debate on open burning. This activity will be organized in cooperative learning groups.

#### 2. Materials Needed:

Activity Sheet #4

#### 3. Performance Indicators of the Activity:

Civics P.I. C.416

Geography P.I. G.402, G.404, G.408

Science P.I. 9.75

#### 4. Preparation for Activity:

Make copies of Activity Sheet #4. Divide the students into cooperative learning groups of four students each ar-



ranged heterogeneously by gender, race, and ability.

#### 5. Activity Outline and Directions to the Teacher:

**STEP 1:** As a culminating activity, explain to the class that they will participate in a debate on open burning. In order to prepare for the debate they must complete Activity Sheet #4 in cooperative learning groups. When students are finished, ask for 3 volunteers on each side of the issue to debate open burning. Each side should take about 10 minutes to prepare while the remainder of the class will prepare questions for both sides. **(30 minutes)**

## CONCLUSION

1. Refer the class back to the objectives to see if they have mastered the material from lesson 5. **(5 minutes)**

## EXTENDED ACTIVITIES

1. EDITORIAL - Students will analyze the issue of open burning and write an editorial or letter to the editor suggesting a solution. [PARTICIPATION]
2. POSITION PAPER - Students will prepare a position paper on open burning which might be used to influence the decision of a legislator or government agent. [CITIZENSHIP]





## OVERHEAD TRANSPARENCY: WARM-UP

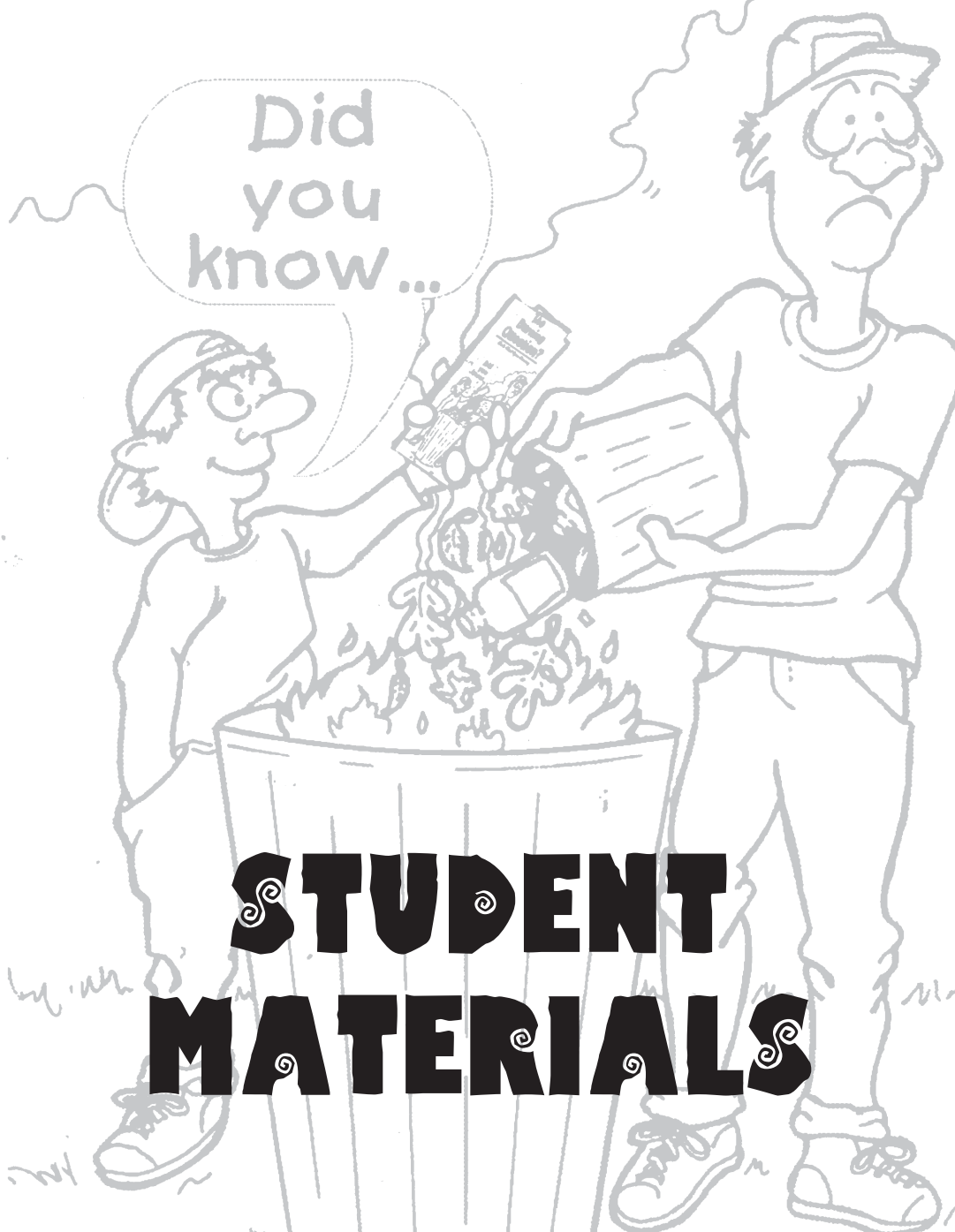




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OVERHEAD TRANSPARENCY:  
LESSON 3 OBJECTIVES

- ◆ Define open burning
- ◆ Describe the human risk factors that are involved in open burning
- ◆ Explain the open burning regulations in Delaware
- ◆ Identify the air pollutants of open burning
- ◆ Explain the reasons people continue to use open burning
- ◆ Explain some innovative approaches to influence people to stop open burning
- ◆ Identify some alternatives to open burning
- ◆ Describe the purpose and process of composting



# STUDENT MATERIALS

## LESSON 5 ACTIVITY 1





# WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

## Lesson 5 Activity 1

### Reading 1

"I've been burning trash all my life. My father burned trash. My grandfather burned trash. I'm on my own property and you'll never convince me that what I'm doing hurts a soul."

Does this sound familiar? Unfortunately, this type of attitude is all too typical. Despite a regulation that has been around since 1968, many Delawareans in rural areas continue to burn trash and leaves in barrels, screened pits or piles, unaware that they are sending chemicals into the air that risk the health and comfort of their families and their neighbors. Open burning produces a great amount of smoke which is also known as particulates. A small amount of refuse can produce a large sum of particulates. A typical burn barrel filled with refuse can produce 1 to 5 pounds of particulates. Some studies show that 60,000 U.S. residents may die prematurely that are exposed to particulates at or below legally allowable levels per year. Recent surveys suggest some 40 to 60 percent of Americans use burn barrels or burn in open piles, with the practice varying by region.

What is open burning and how do I know when I am in violation of open burning laws and regulations? Any time you light an outdoor fire, you are "open burning." Open burning is defined in the Delaware Regulations Governing the Control of Air Pollution as, "Any outdoor fire or outdoor smoke producing process from which the products of combustion are emitted directly into the ambient (outdoor) air..." Open burning is typically conducted using burn barrels, screened pits, backyard incinerators, and just plain "piling up" of refuse, trash, yard trimmings or leaves.

Burn barrels are typically 55-gallon steel drums that are filled with refuse, trash, yard trimmings or leaves. Unlike incinerators, which burn hot and clean with temperatures approaching 2,500 degrees Fahrenheit, burn

barrels typically smoke along at a comparatively low 400 to 500 degrees Fahrenheit. As a result, very inefficient combustion occurs, causing much higher levels of air pollutants to go up in the billowing smoke.

According to Dr. James M. Melius, New York's Director of Public Health, "While almost any combustion process poses potential environmental health risks, I believe that the increasing use of these burn barrels poses a potentially more serious local problem. Much of our household and commercial waste consists of plastic and other synthetic materials. These materials when burned may release a large number of toxic chemicals which may significantly impact the health of nearby residents. Elderly people with respiratory or heart disease, asthmatics, and young children are more susceptible to effects from this type of exposure." These materials can kill fish and other wildlife, damage crops and forests, and cause cancer and permanent damage to humans. And what is even more noteworthy, some chemicals released in burning refuse combine with chemicals in the air to form ozone which causes lung damage and contributes to smog, haze and reduces visibility.

The Delaware Division of Air and Waste Management has come up with some rough estimates of the annual tonnage of some air pollutants emitted from trash burning in rural Kent and Sussex Counties. They are eye-opening: total particulates, 134 tons; sulfur dioxide, 29 tons; carbon monoxide, 392 tons; nitrogen oxides, 14 tons; volatile organic compounds, 110 tons; and hydrogen chloride, 3 tons. (Formaldehyde, vinyl chloride and lead are also released). That's a total of 682 unnecessary tons of air pollution.

The Natural Resource Defense Council, using American Cancer Society risk assessments, estimates that in northern Delaware there are 36 cardiopulmonary deaths attributable to particulate air pollution per 100,000 residents. That means more than 240 northern Delawareans are dying each year as a result of particulate air pollution.



The EPA has recently announced new air pollution standards for particulates that will prevent an estimated 15,000 premature deaths, 9,000 hospital admissions, 60,000 cases of chronic bronchitis, 250,000 cases of aggravated coughing and painful breathing in children, 250,000 cases of aggravated asthma in children and adults, and 1.5 million cases of significant breathing problems each year.

Burning certain materials in burn barrels is illegal. The burning of yard debris such as limbs and tree trimmings is legal. The burning of leaves and garbage is always illegal. During the months of June, July, and August there is a burning ban in Kent and New Castle Counties in Delaware. Since 1968, Delaware has prohibited the burning of trash by individual property owners, and by commercial, industrial, and governmental facilities. Penalties range from a simple warning with a copy of the regulations to fines from \$50 to \$500 plus a criminal record for more serious violators.

People should report any illegal open burning that they witness. Enforcement officials are on duty 24 hours a day, and people can report illegal activity by calling 1-800-662-8802. For additional information, people can contact: the Department of Natural Resources and Environmental Control, Division of Air and Waste Management, in the **Air Quality Management Section**, 89 Kings Highway, Dover, DE 19901, or phone (302) 739-4791. (Air Quality Management website: [http://www.dnrec.state.de.us/air/aqm\\_page/aqm.htm](http://www.dnrec.state.de.us/air/aqm_page/aqm.htm)).

**Sources:** *Outdoor Delaware*, 1996. by Jack Sipple *Proton Dan Explores Open Air Refuse Burning*. Video, 1998



# WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

## Lesson 5 Activity 1

### STUDENT WORKSHEET 1

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Class: \_\_\_\_\_ Block or Period: \_\_\_\_\_

**DIRECTIONS:** Use the information from Reading #1 to answer the questions below.

1. How is open burning defined? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

2. Describe the typical attitude that people have concerning open burning: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

3. Describe a typical burn barrel: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

4. What do recent surveys reveal about the number of Americans who use burn barrels? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

5. Why do burn barrels pose serious environmental health risks? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

6. What people are more susceptible to effects from burn barrels? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_



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7. According to the Delaware Division of Air and Waste Management, what is the rough estimates of the annual tonnage of some air pollutants emitted from trash burning in rural Kent and Sussex Counties?

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8. Explain the legality of burning trash in burn barrels: \_\_\_\_\_

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9. What are the penalties for open burning? \_\_\_\_\_

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10. Describe the procedure for reporting any illegal open burning: \_\_\_\_\_

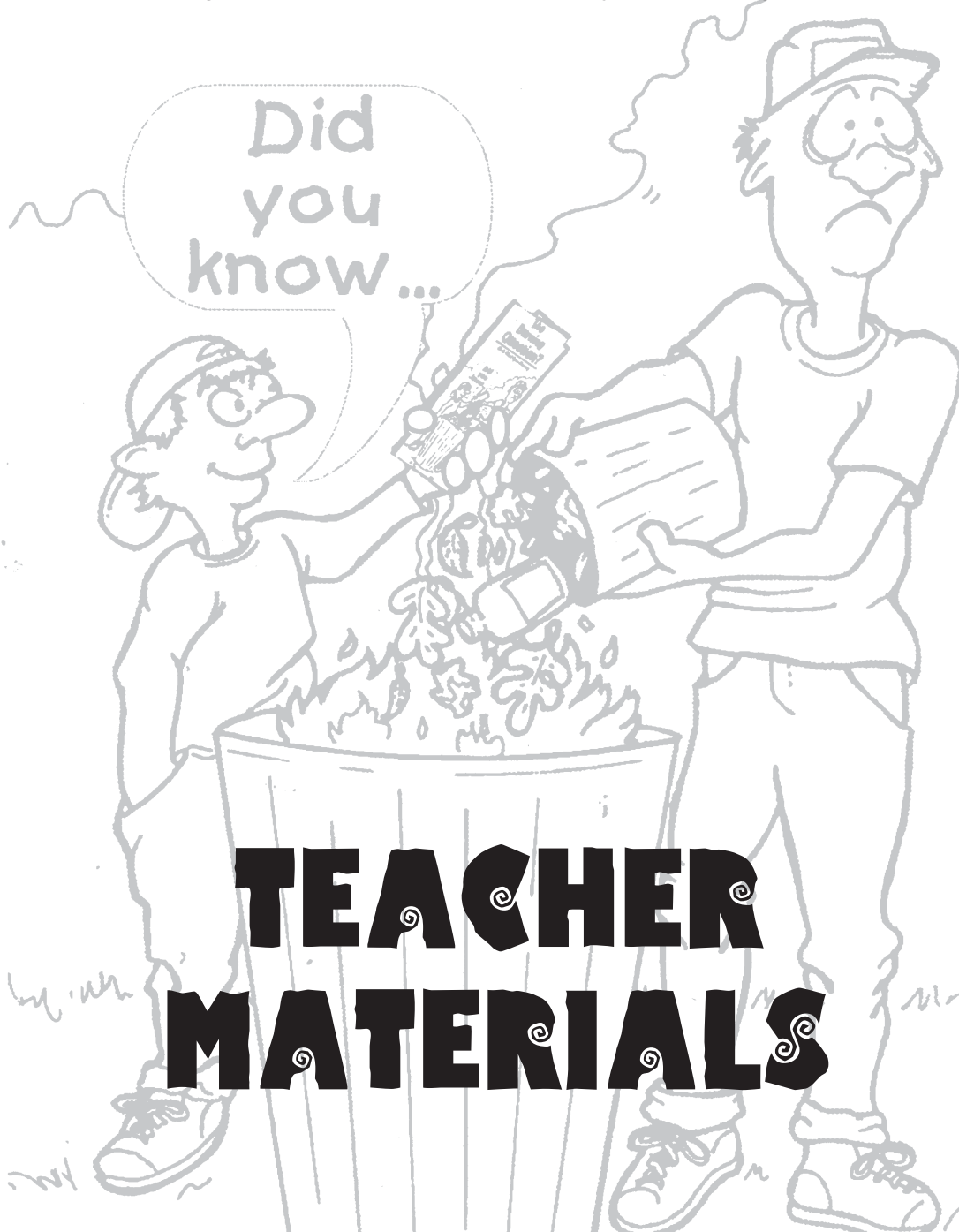
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# TEACHER MATERIALS

## LESSON 5 ACTIVITY 1



## WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

### Lesson 5 Activity 1

### STUDENT WORKSHEET 1

### ANSWER KEY TO STUDENT WORKSHEET 1

1. How is open burning defined? **Any time you light an outdoor fire, you are "open burning."** Open burning is defined in the Delaware Regulations Governing the Control of Air Pollution as, "Any outdoor fire or outdoor smoke producing process from which the products of combustion are emitted directly into the ambient (outdoor) air..." Open burning is typically conducted using burn barrels, screened pits, backyard incinerators, and just plain "piling up" of refuse, trash, yard trimmings or leaves.
2. Describe the typical attitude that people have concerning open burning: **I've been burning trash all my life. My father burned trash. My grandfather burned trash. I'm on my own property and you'll never convince me that what I'm doing hurts a soul.**
3. Describe a typical burn barrel: **Burn barrels are typically 55-gallon steel drums that are filled with refuse, trash, yard trimmings or leaves. Unlike incinerators, which burn hot and clean with temperatures approaching 2,500 degrees Fahrenheit, burn barrels typically smoke along at a comparatively low 400 to 500 degrees Fahrenheit.**
4. What do recent surveys reveal about the number of Americans who use burn barrels? **Recent surveys suggest some 40 to 60 percent of Americans use burn barrels or burn in open piles, with the practice varying by region.**
5. Why do burn barrels pose serious environmental health risks? **Much of our household and commercial waste consists of plastic and other synthetic materials. These materials when burned may release a large number of toxic chemicals which may significantly impact the health of nearby residents.**
6. What people are more susceptible to effects from burn barrels? **Elderly people with respiratory or heart disease, asthmatics, and young children are more susceptible to effects from this type of exposure.**
7. According to the Delaware Division of Air and Waste Management, what is the rough estimates of the annual tonnage of some air pollutants emitted from trash burning in rural Kent and Sussex counties? **Total particulates, 134 tons; sulfur dioxide, 29 tons; carbon monoxide, 392 tons; nitrogen oxides, 14 tons; volatile organic compounds, 110 tons; and hydrogen chloride, 3 tons. (Formaldehyde, vinyl chloride and lead are also released). That's a total of 682 unnecessary tons of air pollution.**
8. Explain the legality of burning trash in burn barrels **Burning trash in burn barrels is illegal. Since 1968, Delaware has prohibited the burning of trash by individual property owners, and by commercial, industrial, and governmental facilities.**



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9. What are the penalties for open burning? **Penalties range from a simple warning with a copy of the regulations to fines from \$50 to \$500 plus a criminal record for more serious violators.**
  10. Describe the procedure for reporting any illegal open burning: **People should report any illegal open burning that they witness. Enforcement officials are on duty 24 hours a day, and people can report illegal activity by calling 1-800-662-8802. For additional information, people can contact: the Department of Natural Resources and Environmental Control, Division of Air and Waste Management, in the Air Quality Management Section, 89 Kings Highway, Dover, DE 19901, or phone (302) 739-4791.**



## REGULATION NO. 13

# OPEN BURNING

02/08/95

### Section 1 - Prohibitions- All Counties

- 1.1 No person shall cause or allow the disposal of refuse by open burning.
- 1.2 No person shall cause or allow open burning in the conduct of a salvage operation.
- 1.3 No person shall cause or allow the open burning of fallen leaves.

02/08/95

### Section 2 - Prohibitions - Specific Counties

- 2.1 Kent and New Castle Counties:
  - a. No person shall cause or allow open burning from June 1 through August 31.
  - b. The Department may grant permission to conduct open burning between June 1 and August 31 for circumstances that threaten the health, safety or welfare of any person or persons. Such circumstances must pose a more serious threat than the health threat posed by the open burning. Permission will be granted to applicants on a case-by-case basis.

02/08/95

### Section 3 - General Restrictions - All Counties

- 3.1 Open burning, as permitted by this regulation, may be conducted without prior approval of the Department, except as provided in Sections 3.2c, 3.2d, and 3.9.
- 3.2 No person shall cause or allow open burning except for the purposes of:
  - a. Domestic burning of branches and limbs that have been cut from trees or shrubbery originating on the premises and conducted by individuals domiciled on the premises;
  - b. The clearing of land in agricultural or silvicultural operations to cultivate and/or prepare the soil for the purpose of producing crops or supporting livestock;
  - c. Prescribed burning for conservation practices, wildlife habitat management, or plant, pest, or disease control, provided that:
    1. The applicant documents to the satisfaction of the Department that prescribed burning is the most effective method to achieve this purpose; and
    2. Permission to burn is given by the Department before such burning takes place;
  - d. The burning of wooden buildings solely for fire fighting instruction conducted by authorized fire companies, provided that:
    1. The company documents to the satisfaction of the Department that all refuse has been removed from the building prior to burning; and
    2. Permission to burn is given by the Department before such burning takes place.



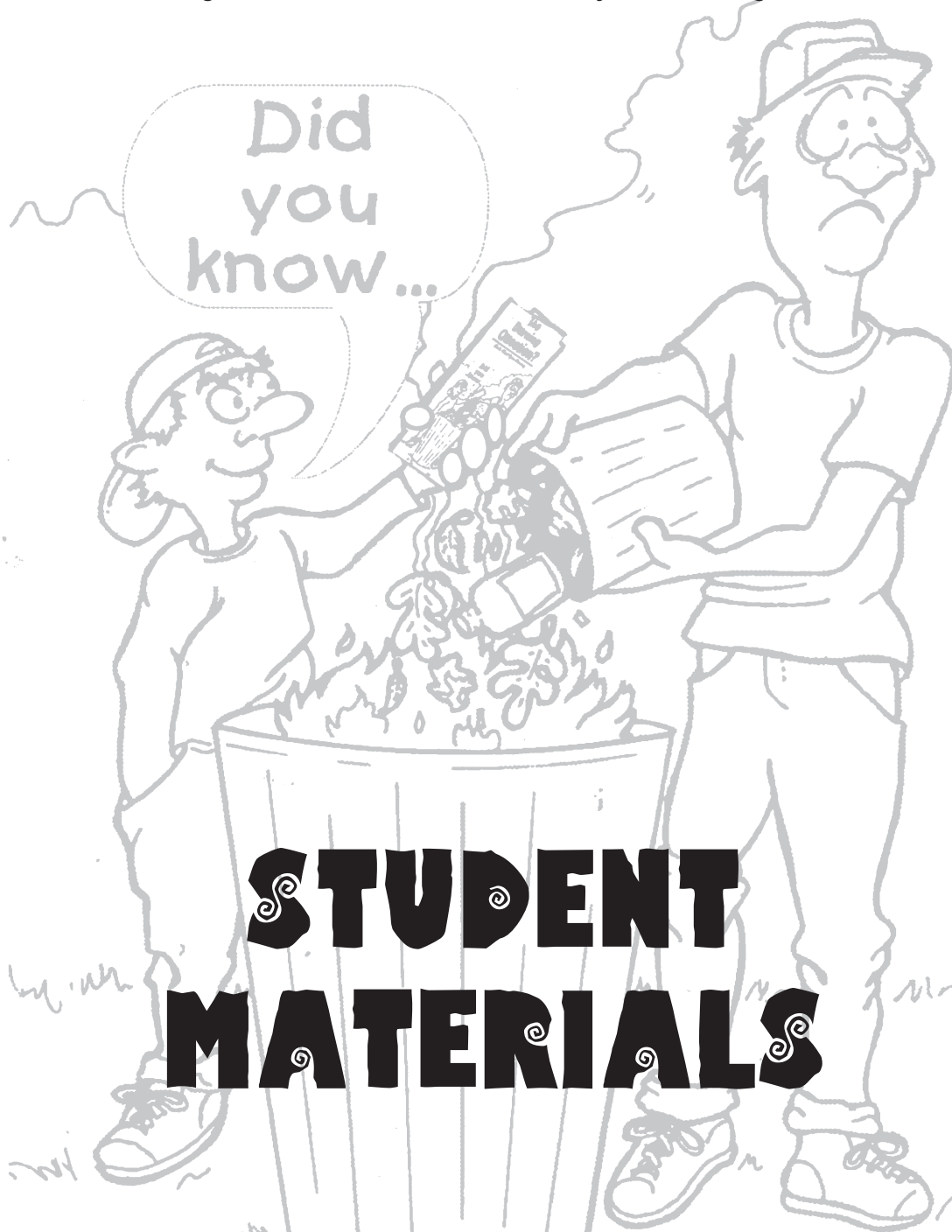


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- 3.3 No person shall conduct any open burning allowed by this regulation without giving prior notice to the Fire Call Board for the county in which the fire will occur.
  - 3.4 No person shall conduct open burning as permitted by this regulation when, in the judgement of the Department:
    - a. A condition of air stagnation exists;
    - b. Any national ambient air quality standard may be violated; or
    - c. The open burning causes unreasonable interference with a person's health, safety, comfort, or use or enjoyment of his or her real property.
  - 3.5 Upon notification by the Department, open burning shall be terminated immediately.
  - 3.6 All fires shall remain under supervision until completely extinguished.
  - 3.7 Tires, waste oil, or any oil heavier than No. 2 shall not be used as an auxiliary fuel. Only the minimum amount of auxiliary fuel needed to initiate the fire shall be used.
  - 3.8 Open burning, as permitted by this regulation, may be conducted only between the hours of 8:00am and 4:00pm.
  - 3.9 Burning outside of the hours permitted in Section 3.8 may be conducted, provided that:
    - a. The applicant documents to the satisfaction of the Department that burning outside of the permissible hours will lead to smoke reduction, or a more efficient, complete, or safer burn; and
    - b. Permission to burn during the extended hours is given by the Department before such burning takes place.

02/08/95

#### **Section 4 - Exemptions - All Counties**

- 4.1 The following operations are exempt from Sections 1 through 3 of this regulation provided that they are not used for the disposal of refuse and are of a minimum size sufficient for their intended purpose:
  - a. Fires used for cooking of food for human consumption, provided that only unpainted/untreated wood, charcoal, propane, or natural gas is burned;
  - b. Fires used for recreational purposes such as campfires, provided that only unpainted/untreated wood is burned;
  - c. Ceremonial fires, provided that only unpainted/untreated wood is burned;
  - d. Flares;
  - e. Backburning to control or suppress wildfires;
  - f. Fire fighting instruction conducted by the Delaware State Fire School.



# STUDENT MATERIALS

## LESSON 5 ACTIVITY 2



# WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

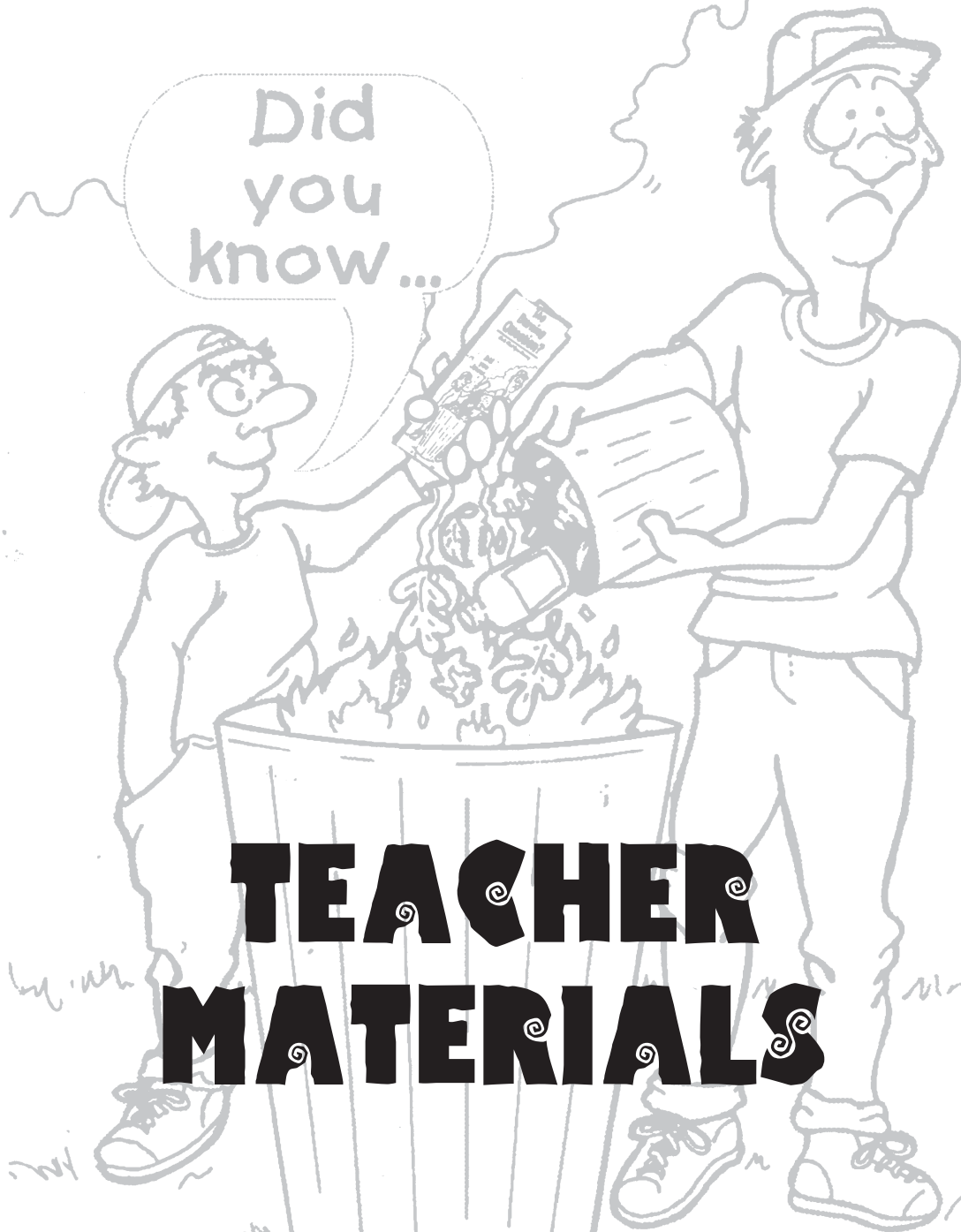
## Lesson 5 Activity 2

### ACTIVITY SHEET 1 WORD UNSCRAMBLE

**DIRECTIONS:** Unscramble the words in capital letters in each of the statements below. Write the unscrambled words in the appropriate blanks that follow.

#### AIR POLLUTANTS OF OPEN BURNING

- NBOARC DEOMONXI is a colorless, odorless gas which prevents oxygen from being absorbed by the blood and lungs.  
\_\_\_\_\_
- RGNEONTI DIXEO combines with volatile organic compounds to produce ground-level ozone (also contributes to acid rain). Ozone causes lung damage to humans and animals, and harms crops and other vegetation.  
\_\_\_\_\_
- FURLUS DEDIXOI - is a toxic air pollutant that causes acid rain, which in turn causes fish kills, deforestation and destruction of crops and property.  
\_\_\_\_\_
- Many types of volatile organic compounds (VOCs) also result from trash burning. Some of the more common toxic ones include:
  - NIXOID \_\_\_\_\_
  - ALDEYHALMROF \_\_\_\_\_
  - NYLIV EDIROLHC \_\_\_\_\_
  - benz[a]pyrene \_\_\_\_\_
 some of these cause mutations and cancer in humans.
- Heavy metals, such as AEDL , also can escape from burn barrels. Repeated exposure to just small amounts of these toxins can permanently damage nerve and heart muscle tissue, especially in fetuses and children.  
\_\_\_\_\_



# TEACHER MATERIALS

## LESSON 5 ACTIVITY 2



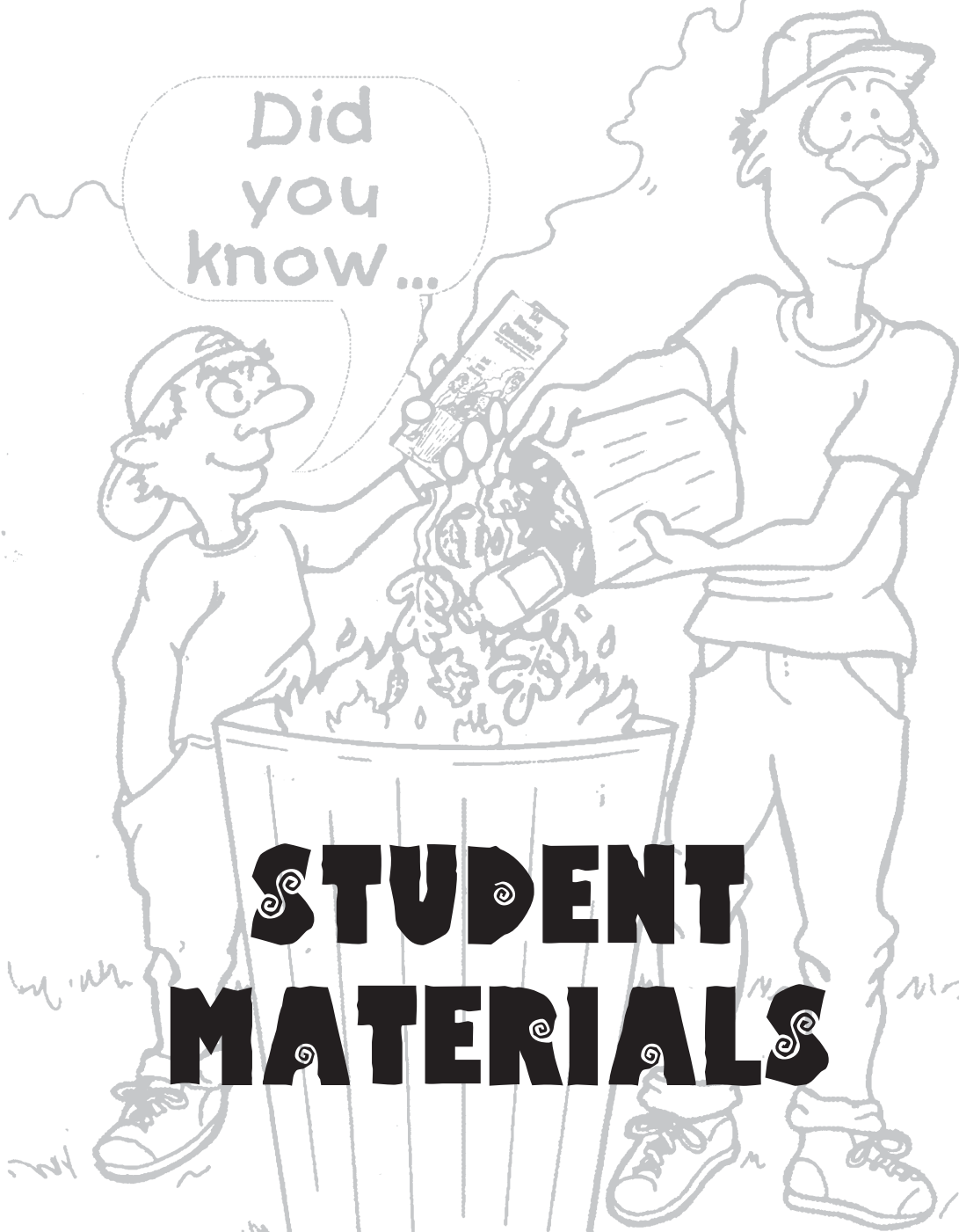
# WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

## Lesson 5 Activity 2

### ANSWER KEY TO ACTIVITY SHEET 1 WORD UNSCRAMBLE

#### AIR POLLUTANTS OF OPEN BURNING

1. CARBON MONOXIDE
2. NITROGEN OXIDE
3. SULFUR DIOXIDE
4. DIOXIN  
FORMALDEHYDE  
VINYL CHLORIDE
5. LEAD



# LESSON 5 ACTIVITY 3



# WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

## Lesson 5 Activity 3

### ACTIVITY SHEET 2

#### Reasons People Continue to Burn

**DIRECTIONS:** From the items listed below, select the word that best completes each statement. Write the term in the appropriate blank.

convenient  
free  
mulching  
decompose

TV  
radio  
landfill

dangers  
videos  
illegal

composted  
mass mailings  
educated

#### Reasons People Continue to Burn Trash

Why do people continue to burn trash in spite of the health risks and environmental impact?

1. First and foremost it's \_\_\_\_\_ and \_\_\_\_\_.
2. In addition, many do not know or believe the \_\_\_\_\_ involved.
3. Still others are not aware that open burning is \_\_\_\_\_.

#### Innovative Approaches to Open Burning

What are some of the innovative approaches being tried to get people to stop open burning?

4. An \_\_\_\_\_ public is one obvious answer.
5. Some of the innovative approaches being tried by the Department of Natural Resources and Environmental Control to educate the public is through \_\_\_\_\_.
6. Another is to get wide exposure on \_\_\_\_\_.
7. Another way is to get a spot on local \_\_\_\_\_.
8. Another method is to produce educational \_\_\_\_\_ for school students.



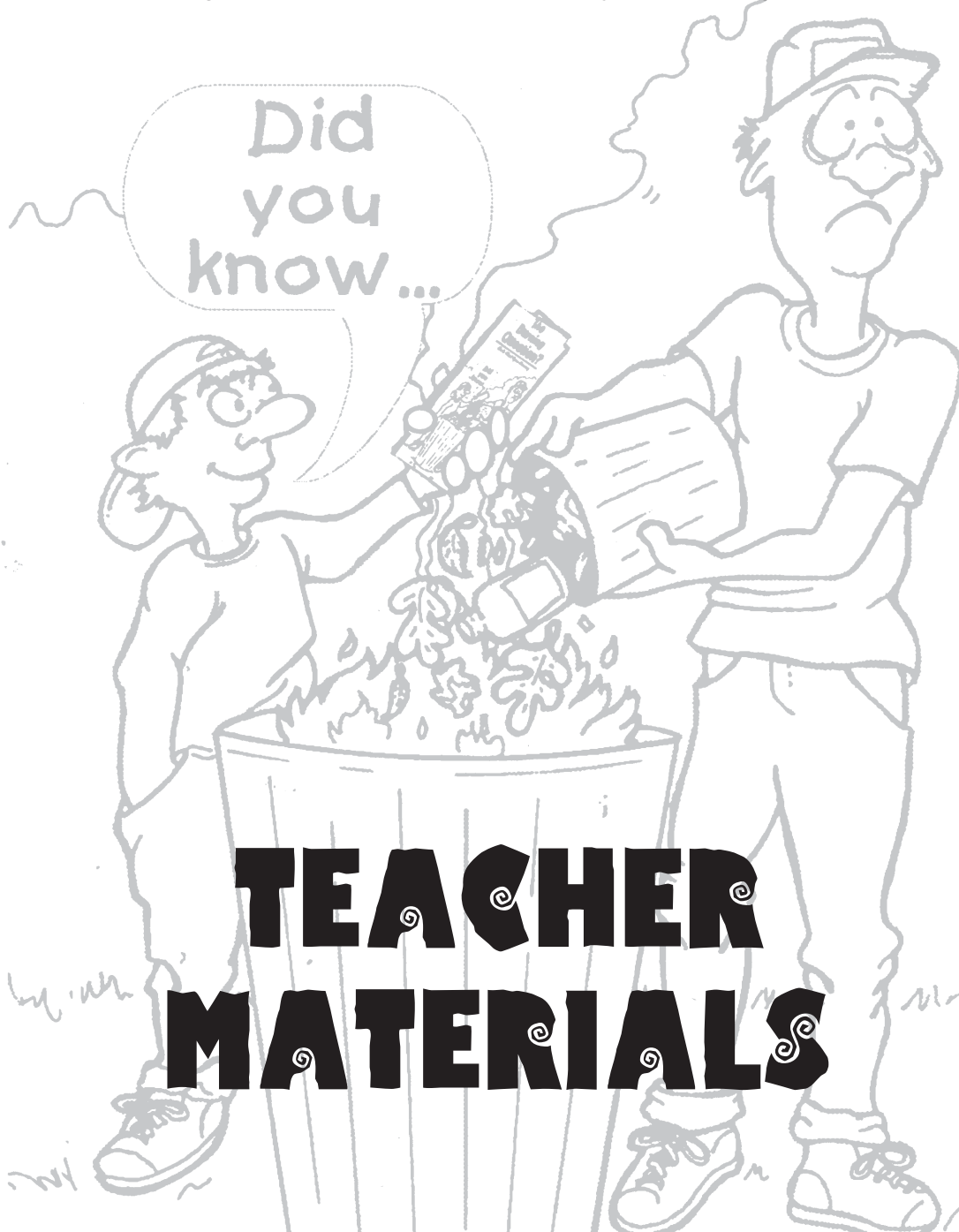
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## Open Burning Alternatives

What are some of the alternatives to open burning?

9. Brush, leaves and grass clippings could be \_\_\_\_\_.
10. Brush and leaves could be left to \_\_\_\_\_.
11. \_\_\_\_\_ is another alternative for grass clippings.
12. Newspapers could be \_\_\_\_\_.
13. Using a licensed \_\_\_\_\_ is an acceptable alternative for your trash.





# TEACHER MATERIALS

## LESSON 5 ACTIVITY 3



## WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

### Lesson 5 Activity 3

### ANSWER KEY TO ACTIVITY SHEET 2 Reasons People Continue to Burn

Why do people continue to burn trash in spite of the health risks and environmental impact?

1. First and foremost it's **FREE** and **CONVENIENT**.
2. In addition, many do not know or believe the **DANGERS** involved.
3. Still others are not aware that open burning is **ILLEGAL**.

#### Answers to Open Burning

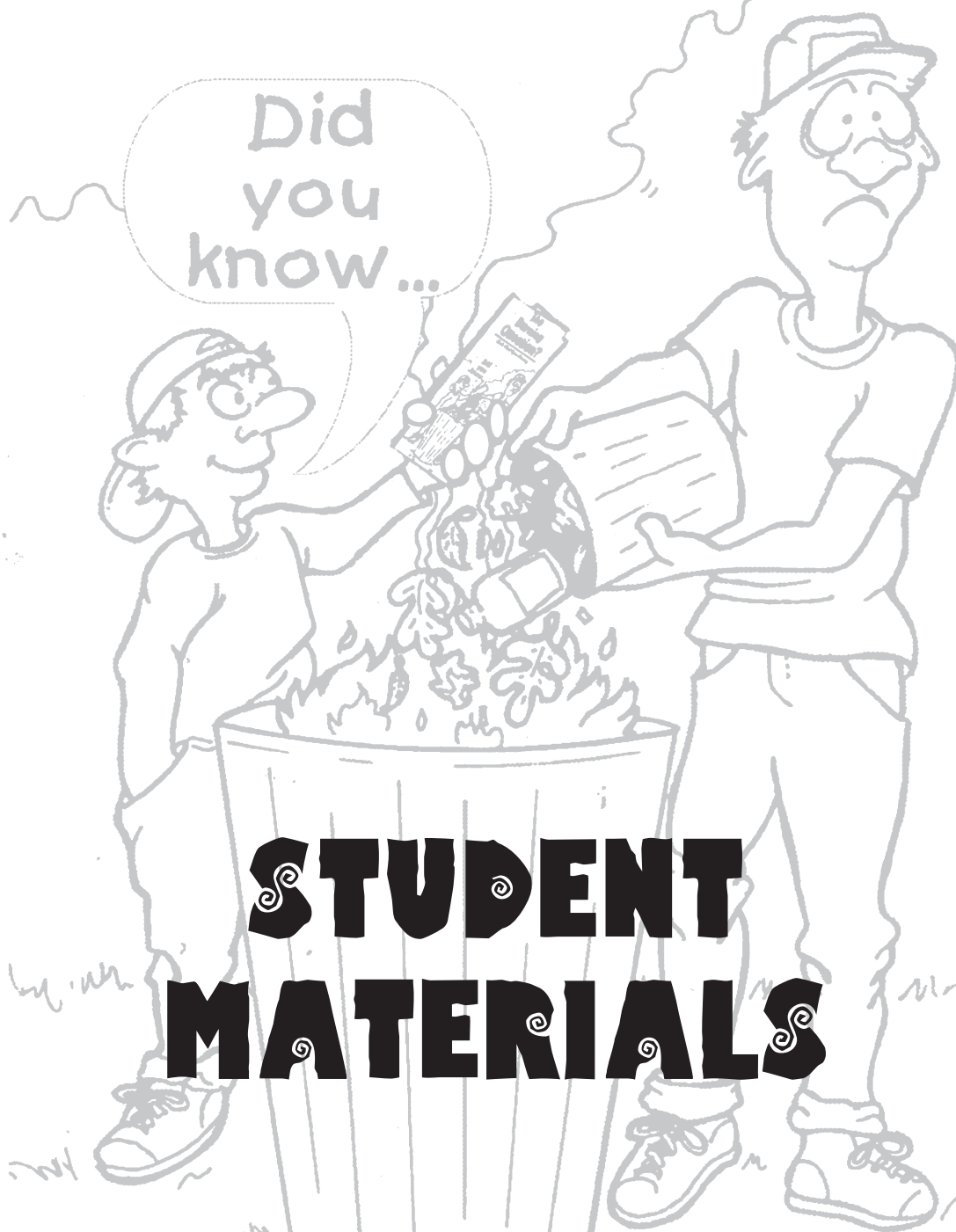
What are some of the innovative approaches being tried to get people to stop open burning?

4. An **EDUCATED** public is one obvious answer.
5. Some of the innovative approaches being tried by the Department of Natural Resources and Environmental Control to educate the public is through **MASS MAILINGS**.
6. Another is to get wide exposure on **TV**.
7. Another way is to get a spot on local **RADIO**.
8. Another method is to produce educational **VIDEOS** for school children.

#### Open Burning Alternatives

What are some of the alternatives to open burning?

9. Brush, leaves and grass clippings could be **COMPOSTED**.
10. Brush and leaves could be left to **DECOMPOSE**.
11. **MULCHING** is another alternative for grass clippings
12. Newspapers could be **RECYCLED**.
13. Using a licensed **LANDFILL** is an acceptable alternative for your trash.



# STUDENT MATERIALS

## LESSON 5 ACTIVITY 4



## WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY



Lesson 5 Activity 4

### HANDOUT 1 COMPOST RECIPE

First, you must set-up an outside area or “bin” for your compost to live. You should choose an area that has good drainage. Compost bins are not necessary to make good compost, but they can help if compost piles are not adequately contained, decomposition will not proceed quickly and your pile may invite unwanted pests.

- ◆ **Find a spot with good drainage away from direct sunlight**
- ◆ **Start with a layer of course material like twigs, straw or leaves**
- ◆ **Add a layer of dry grass clippings and leaves (preferably chopped), mixed with kitchen waste like egg shells, fruit and vegetable scraps, coffee grounds or tea bags.**
- ◆ **Cover with a one-inch layer of soil and enough water so the soil is as moist as a damp sponge**

Add more materials as they become available, taking care not to make any one layer of the same type of material thicker than six inches. Turn the mixture on a regular basis (weekly or bi-weekly) to provide air space. You can also poke the mixture to create pores. Keep the pile moist but not soggy. Your compost pile will naturally heat up and decrease in volume as the material inside decomposes. Once the pile is established, you may want to add food scraps in the center of the pile, folding the scraps down and to the inside. When the material inside turns dark brown and crumbly, it is ready for use. Remove the material from the bottom of the pile. If you wish, screen the compost to remove items not totally decomposed and place these items back into the pile for a second try.

You may choose different types of materials from the YES list to use in your compost pile. This will provide a good carbon/nitrogen mix and allow the compost pile to decompose more readily.



**YES**

**NO**

**From the Garden:**

- Mulched leaves
- Dry grass
- Tree/shrub trimmings
- Garden plants
- Weeds
- Old potting soil
- Soft plant stems

**From the Kitchen:**

- Fruit scraps
- Vegetable trimmings
- Egg shells (crushed)
- Tea bags
- Coffee grounds and filters

**Other:**

- Shredded paper
- Tissues, paper towels
- Shredded cardboard
- Paperboard

- Meat Scraps
- Bones
- Fish
- Dairy products
- Oils, grease
- Sauces
- Plastics
- Metals
- Glass
- Stone
- Pet waste, kitty litter
- Diseased plants
- Painted or treated wood

By composting, you are creating conditions which speed up the natural process of decomposition. The compost pile acts like an oven. It's easy because the real work is done by soil organisms, bacteria, mold, fungi, beetles, centipedes, and earthworms, to name a few. These helpers decompose complex organic compounds into simpler substances, making a rich, organic soil-like material called humus. This material helps replenish the earth and adds nutrients to the soil which helps plants grow.





High School and Middle School Air Quality Education Program



# WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

## Lesson 5 Activity 4

### ACTIVITY SHEET 3 GROUP ROLE PLAY ACTIVITY

**DIRECTIONS:** Imagine that you are employees of the Department of Natural Resources and Environmental Control (DNREC) working for the Director of the Division of Air and Waste Management. Using Handout #1, Compost Recipe, describe a strategy you might use to influence public opinion to use composting as an alternative to open burning. Be as specific as possible. For example, if you would use a TV time spot, describe the arguments you would present to the public. Be sure you read and understand Handout #1 in order to answer questions from the public. Use an additional sheet of paper to write your strategy, if necessary. Your group will do an oral presentation to the entire class (10 minute presentation). This presentation will be graded according to the Scoring Rubric #1.

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# WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

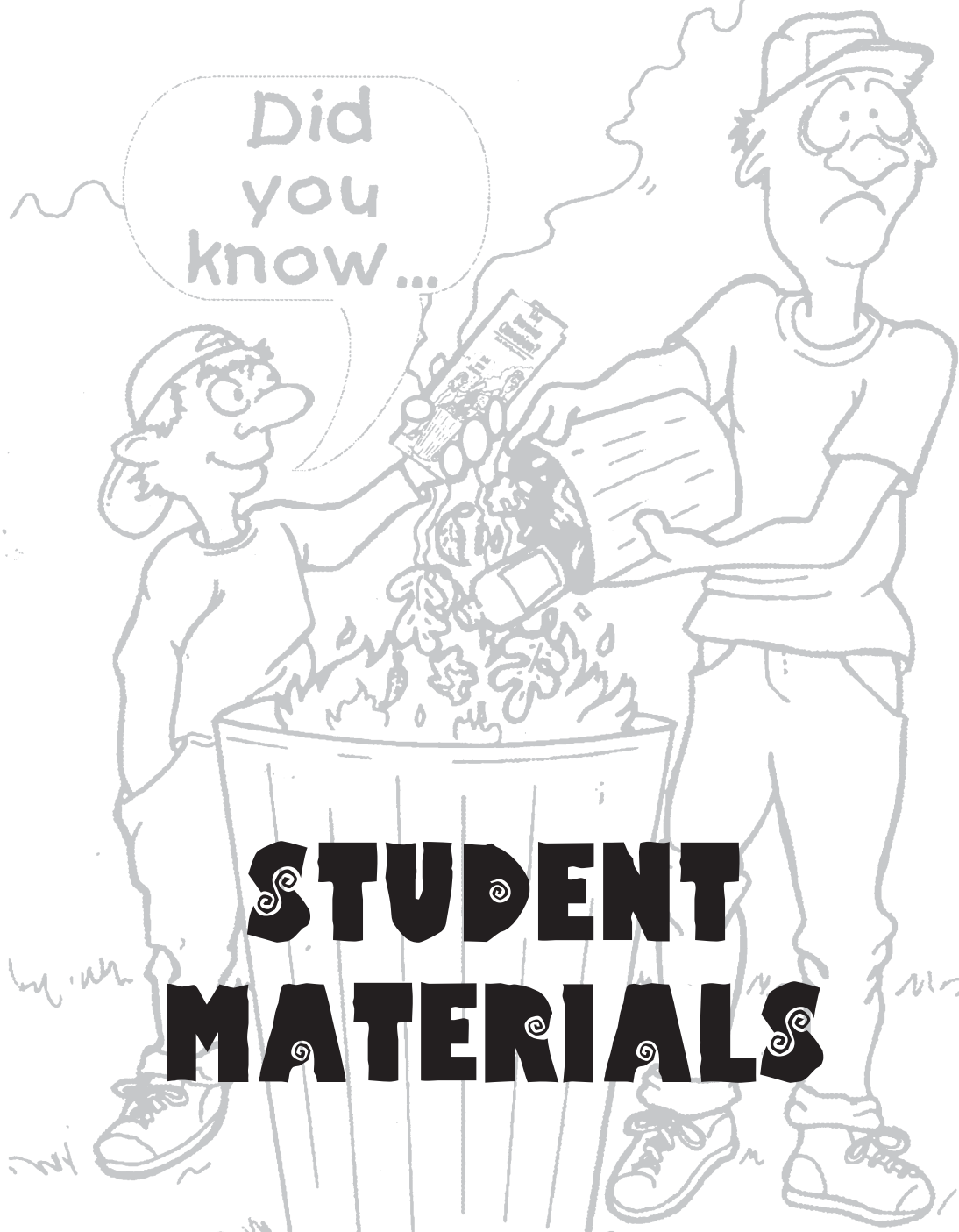
## Lesson 5 Activity 4

### SCORING RUBRIC 1 ROLE PLAY ACTIVITY

- 4 – The oral presentation is clear and convincing
- 3 – The oral presentation is clear and somewhat convincing
- 2 – The oral presentation is vague and somewhat convincing
- 1 – The oral presentation is vague and not convincing

	0	1	2	3	4	
1. Explanation of Compost Recipe <b>P.I. C.416</b>	_____	_____	_____	_____	_____	x 5 = _____
2. Reasons for not burning trash <b>P.I. 9.75 (Science); C.416; G.402; G.408</b>	_____	_____	_____	_____	_____	x 5 = _____
3. Arguments to use composting <b>P.I. C.419; G.404; 9.75</b>	_____	_____	_____	_____	_____	x 5 = _____
4. Supporting details <b>P.I. G.404; 9.75</b>	_____	_____	_____	_____	_____	x 5 = _____
5. Use of visual aids <b>P.I. G.404</b>	_____	_____	_____	_____	_____	x 5 = _____

GRADE \_\_\_\_\_



# STUDENT MATERIALS

## LESSON 5 ACTIVITY 5





# WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

## Lesson 5 Activity 5 ACTIVITY SHEET 4 DEBATE

**ORGANIZING A DEBATE:** Should the public be permitted to open burn?

**DIRECTIONS:** People are divided over the issue of open burning. Take a stand. Use the form below to organize your arguments for a debate.

1. State your opinion regarding open burning. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. List the arguments you would use to convince others to share your view. Number the arguments in order of importance.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. List the arguments you think an opponent would likely use. Next to each argument, explain how you would refute it.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. Summarize your viewpoint.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



# Proton Dan Explores Open Air Refuse Burning



# WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

## Lesson 5

### STUDENT WORKSHEET 2 PROTON DAN EXPLORES OPEN AIR REFUSE BURNING (optional video)

**DIRECTIONS:** This is a **viewing guide** to accompany the video on Open Burning. Students should answer the questions as they watch the video.

1. The term refuse in the video includes the following items:

- a) \_\_\_\_\_
- b) \_\_\_\_\_
- c) \_\_\_\_\_
- d) \_\_\_\_\_
- e) \_\_\_\_\_

2. Refuse and trash burning is both \_\_\_\_\_ and \_\_\_\_\_.

3. Open burning is especially harmful to the \_\_\_\_\_, \_\_\_\_\_, and people with \_\_\_\_\_.

4. \_\_\_\_\_% of rural Americans use burn barrels or burn in open piles.

5. Open burning produces a lot of smoke—also known as \_\_\_\_\_.

6. A small amount of refuse can produce a lot of particulates. Some studies show that \_\_\_\_\_ U.S. residents per year may die prematurely.

7. Since most trash contains some plastics or other manmade materials, open burning emits all sorts of toxic chemicals. List these chemicals from the video:

- |          |          |
|----------|----------|
| a) _____ | f) _____ |
| b) _____ | g) _____ |
| c) _____ | h) _____ |
| d) _____ | i) _____ |
| e) _____ |          |

8. These toxic chemicals can kill \_\_\_\_\_ and other wildlife, damage \_\_\_\_\_ and forests, and cause \_\_\_\_\_ and permanent damage to humans.

9. Some chemicals released in burning refuse combines with chemicals in the air to form \_\_\_\_\_ which causes lung damage and contributes to \_\_\_\_\_, haze and reduced visibility.



10. List three reasons people continue to open burn:

- a) \_\_\_\_\_
- b) \_\_\_\_\_
- c) \_\_\_\_\_

11. List three other ways people can get rid of refuse:

- a) \_\_\_\_\_
- b) \_\_\_\_\_
- c) \_\_\_\_\_

12. Recycling one aluminum can conserves enough energy to run a television for \_\_\_\_\_ hours.

13. Composting turns organic material back into \_\_\_\_\_.

14. Landfills are designed to be self-contained. List three alternatives for run off:

- a) \_\_\_\_\_
- b) \_\_\_\_\_
- c) \_\_\_\_\_

15. There are \_\_\_\_\_ sanitary landfills in the State of Delaware (one in each county) at:

- a) \_\_\_\_\_
- b) \_\_\_\_\_
- c) \_\_\_\_\_



# WHAT IMPACT DOES OPEN BURNING HAVE ON AIR QUALITY

## Lesson 5

### Answer Sheet for Student Worksheet 2

#### Proton Dan Explores Open Air Refuse Burning (optional video)

**DIRECTIONS:** This is a viewing guide to accompany the video on Open Burning. Students should answer the questions as they watch the video.

- The term refuse in the video includes the following items:
  - Yard waste and trash
  - Grass clippings
  - Leaves
  - Tires
  - Dangerous chemicals
- Refuse and trash burning are both: **illegal** and **harmful to people**.
- Open burning is especially harmful to the **young, elderly** and people with **asthma**.
- 40 - 60%** of rural Americans use burn barrels or burn in open piles.
- Open burning produces a lot of smoke - also known as: **particulates**.
- A small amount of refuse can produce a lot of particulates. Some studies show that **60,000** U.S. residents per year may die prematurely.
- Since most trash contains some plastics or other manmade materials, open burning emits all sorts of toxic chemicals. List these chemicals from the video:
  - Sulfur Dioxide
  - Carbon Monoxide
  - Nitrogen Oxides
  - Hydrogen Chloride
  - Vinyl Chloride
  - Formaldehyde
  - Dioxin
  - Benz[a]pyrene
  - Acids
- These toxic chemicals can kill **fish** and other wildlife, damage **crops** and forests, and cause **cancer** and permanent damage to humans.
- Some chemicals released in burning refuse combines with chemicals in the air to form **ozone** which causes lung damage and contributes to **smog**, haze and reduced visibility.



- 
10. List three reasons people continue to open burn:
- It is free**
  - People do not know about the dangers**
  - People do not know burning is illegal**
11. List three other ways people can get rid of refuse:
- Recycling**
  - Composting**
  - Landfills**
12. Recycling one aluminum can conserves enough energy to run a television for **three** hours.
13. Composting turns organic material back into **dirt**.
14. Landfills are designed to be self-contained. List three alternatives for run off:
- Can be treated**
  - Can be recycled**
  - Gases can be collected and captured**
15. There are **three** sanitary landfills in the State of Delaware, one in each county at:
- Cherry Island**
  - Sandtown**
  - Jones Crossroads**