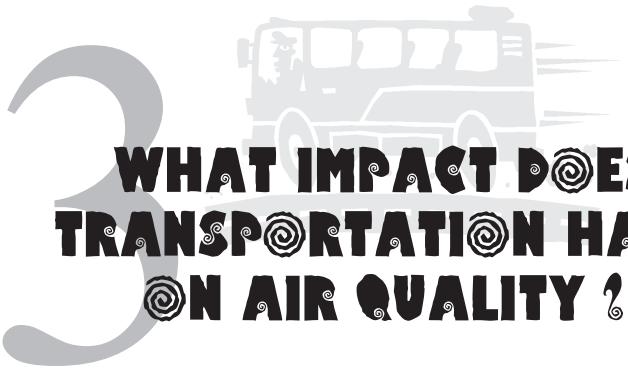
GRADES: 7-11
SUBJECTS: Science, Social Studies, Geography, Health, Civics, Government, Environmental Science
TIME: 4 Hours; @ 2 3/4 Blocks or 5 1/3 Periods
STATE STANDARDS:
Civics Standard 3 - Citizenship, P.I. C.416 - Grades 9-11
Civics Standard 4 - Participation, P.I. C.418; - Grades 9-11; 8.409 Grade 8
Geography Standard 1 - Maps, P.I.s G.402, G.404 - Grades 9-11; 8.421 - Grade 8
Geography Standard 2 - Environment, P.I.s G.407, G.408 - Grades 9-11; 7.423, 8.422, 8.423, - Grades 7-8
History Standard 1 - Chronology, P.I.s H.401, H.402, H.403 - Grades 9-11; 7.428, 8.427, 8.428 - Grade 7-8
History Standard 2 - Analysis, P.I. H.405 - Grades 9-11; 7.429, 8.430 - Grades 7-8
History Standard 3- Interpretation, P.I. H.408 - Grades 9-11
Science Standard 8 - Ecology (Interaction of Humans Within Ecosystems) 8.31, 8.33; P.I. 9.75 - Grades 9-11



3 WHAT IMPACT DOES TRANSPORTATION HAVE ON AIR QUALITY ?

OVERVIEW OF THE LESSON

Scope and Purpose of the Lesson:

This lesson is a series of activities that help students understand that America's transportation system contributes to a large portion of the nation's environmental problems. Students will describe the pollution reduction choices related to personal transportation needs.

♦ **Topics Addressed:**

American car culture
Renewable and nonrenewable resources
Historic effects of the automobile on American society
Motor vehicles and air pollution
Four major air pollutants emitted by motor vehicles
Pollution reduction choices
American dependence on autos

Synopsis of the Lesson:

This lesson contains six activities that use a variety of instructional strategies and is organized around the question of "What Impact Does Transportation Have On Air Quality?"

LEARNING OBJECTIVES

Students will be able to:
- ♦ Describe the historic effects of the automobile on American society.
- ♦ Contrast American dependence on autos with that of the world as a whole.
- ♦ State the percentage of air pollution in the U.S. attributable to motor vehicles.
- ♦ List four pollutants emitted by motor vehicles.
- ♦ Describe four pollution reduction choices related to personal transportation needs.
- ♦ Explain the difference between a renewable and a nonrenewable resource.
- ♦ Describe the American car culture.

BACKGROUND

America's transportation system contributes to a large portion of the nation's environmental problems, ranging from air pollution and toxic wastes to oil spills and uncontrolled urban sprawl. Collectively, private cars are a prime contributor to global warming and air pollution.

Emissions from an individual car are generally low, relative to the smokestack image many people associate with air pollution. But across the country, the personal automobile is the single greatest polluter, as emissions from millions of vehicles on the road add up. Driving a private car is probably a typical citizen's most "polluting" daily activity.

The emissions that come out of a vehicle depend greatly on many factors—the age of the car, how well maintained it is, and the fuel that goes into it. Consequently, programs to control air toxics pollution have centered around changing fuel composition as well as around improving vehicle technology or performance. One of the first, and most successful, programs has been the removal of lead from gasoline. The lead phase out began in the mid-1970s. It was complete on January 1, 1996 when lead was banned from gasoline. The removal of lead from gasoline has essentially eliminated mobile source emissions of this highly toxic substance.

More recent fuel and emission control system changes have been instituted. First, limits have been placed on gasoline volatility. Volatility is a measure of how easily a liquid evaporates. Some toxics such as benzene are present in gasoline and get into the air when gasoline evaporates.

Another measure to cut emissions from cars was the idea of reformulated gasoline. The 1990 Clean Air Act required reformulated gasoline to be introduced in the nation's most polluted cities beginning in 1995. From 1995-1999, these gasoline's must provide a minimum 15% reduction in air toxics emissions over typical 1990 gasoline. This increases to a 20% minimum reduction beginning in the year 2000.

Regulations limiting the amount of sulfur in diesel fuel took effect in 1993. Today's lower-sulfur diesel fuels are important in reducing emissions of particulate matter and other air toxics from diesel-fueled buses and trucks.

The 1990 Clean Air Act set specific emission standards for hydrocarbons and for diesel particulate matter. Air toxics are found in both of these pollutant categories. As vehicle manufacturers develop technologies to comply with the hydrocarbon and/or particulate standards (e.g., more efficient catalytic converters), air toxics will be reduced as well. Requirements under the Clean Air Act for testing carbon monoxide emissions at cold temperatures will also have an indirect but important effect in reducing air toxics emissions in the critical first moments of vehicle operation.

From a pollution perspective, what matters most is not new vehicle emission standards but actual emission from vehicles on the road. The Clean Air Act establishes several programs to make sure vehicle emission controls are functioning properly in actual use. These include requirements for periodic emission inspections and for computerized diagnostic systems that alert drivers and mechanics to malfunctioning emission controls

In summary, the many vehicle and fuel changes in the last 25 years have greatly reduced air toxics emissions from highway vehicles. New cars today are capable of emitting 90% less air toxics on a per-mile basis than the uncontrolled models of 1970 counterparts. Overall air toxics emissions will continue to decrease throughout the next century as older vehicles leave the fleet and as new regulatory programs take effect. However, the number of vehicles on the road and the number of miles they travel is continuing to grow. Without additional controls, growth in vehicle travel will offset progress in reducing air toxics by early in the next century.

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 Class Discussion should take about **10 minutes**.

1. **WARM UP, MIND SET OR ANTICIPATORY SET -** Make a list of all the ways you used energy since you got out of bed this morning. Give students **2 to 3 minutes** to respond in writing.

2. CLASS DISCUSSION - Have the class brainstorm their responses to the Mind Set as you write them on the board. You may need to remind them of food, refrigerator, heat or light.

3. When the list is complete, ask students to identify the source of energy for each activity (e.g. lights-electricity, hot water-oil, gas, electricity, solar, etc.). This activity should take about **7 minutes**.

4. CATEGORIZING ACTIVITY - In this activity, students will use the information from the warm-up and categorize it into renewable energy and nonrenewable. List two categories on the board: renewable energy and nonrenewable energy. Give the students a few minutes to categorize the sources of energy as either renewable or nonrenewable energy sources. Before they start this activity

explain to the class that renewable energy is energy that is replaced in a short period of time, usually within the average person's lifetime. Nonrenewable energy is energy that has a longer replacement period, longer than a person's lifetime. Examples of renewable energy are solar, wind, hydropower, food, wood, methanol from garbage, manure, and geothermal. Examples of non-renewable energy are coal, oil, natural gas and uranium. To sum up this activity, ask students to estimate what percent of the total U.S. energy comes from nonrenewable sources (In 1993, it was approximately 93%).

5. It is important that students understand that all tasks do not use the same amount of energy, e.g. electric fans use far less energy than air conditioners. Transportation may be on their list only once and electricity many times, yet transportation uses 27% of total U.S. energy and 81% of U.S. oil consumption, while electricity consumes approximately 40% of total U.S. energy, and 3.4% of the U.S. oil consumption. This activity should take about **10 minutes.**

6. LESSON OBJECTIVES - The lesson objectives should be presented on an overhead or on the chalk board. These should be read to the class **(2 minutes).**

7. Personal Transportation Chart - Students should be given a copy of the **Personal Transportation Chart** and **Student Worksheet #4** to complete for homework (See Activity 5 Student Materials). Students will be keeping a log of their own transportation choices for one week. Emphasize that in collecting data on their transportation habits, students are simply collecting data and will *not* be graded or judged on their habits. In this assignment, the "correct" answer is simply the most accurate, complete data.

ACTIVITY 1: Cooperative Group Activity:

1. Description/Overview of Activity:
This lesson gives students a close up view and understanding of nonrenewable energy sources and how long each will last.

2. Materials Needed:
Handout #1
Student Worksheet #1

3. Performance Indicators of the Activity:
Geography P.I. G.402, G.404, G.407; 8.421
Science P.I. 9.75
History P.I. H.402; 7.428, 8.427

4. Preparation for Activity:
Divide the students into Cooperative Learning Groups of 4 students per group. Make copies of Handout #1 and Student worksheet #1.

5. Activity Outline and Directions to the Teacher:

STEP 1: Divide the students into Cooperative Learning Groups of 4 students per group. Give students **Handout #1** and **Student Worksheet #1**. Explain the information is in quads (A quad is a quadrillion BTUs). Total energy consumption for the world in 1993 was approximately 350 quads. Have the students calculate time left for each of the nonrenewable sources and to use the information to complete Student Worksheet #1. (**15 minutes**)

STEP 2: CLASS DISCUSSION - Use the information on **Handout #1** and the questions from **Student Worksheet #1** as a basis for a class discussion as a follow up activity to the cooperative group work. Have each group share their answers and opinions. (**15 minutes**)

ACTIVITY 2: Transportation IQ Quiz

1. Description/Overview of Activity:
In this activity the students will take a Transportation IQ Quiz. This will not count as part of students grade.

2. Materials Needed:
Handout #2

3. Performance Indicators of the Activity:
Geography P.I. G.402, G.407, G.408; 8.422, 8.423
Science P.I. 9.75
History P.I. H.401; 8.428,

4. Preparation for Activity:
Make copies of Handout #2 and give each student a copy.

5. Activity Outline and Directions to the Teacher:

STEP 1: Tell students they are now going to take a quiz to determine their **Transportation IQ.** Give each student a copy of **Handout #2**. 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.

STEP 2; When students are finished with the quiz they should exchange papers with another student. Go over the answers and explanations as the students correct the quiz (Answer sheet is included in the teachers packet). Students will return the quiz when finished. On the board write the three categories and corresponding scores 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) Poorly informed? (20 minutes)**

ACTIVITY 3: Reading

1. Description/Overview of Activity:
The purpose of this activity is to give the students a better background and understanding of the American car culture.

2. Materials Needed:
Reading #1
Student Worksheet #2

3. Performance Indicators of the Activity:
Geography P.I. G.408; 8.423
History P.I. H.401, H.402; 8.427, 8.428

4. Preparation for Activity:
Make copies of Reading #1 and Student Worksheet #2. Students should be divided into cooperative learning groups of four each and arranged heterogeneously according to gender, race, and ability.

5. Activity Outline and Directions to the Teacher:

STEP 1: Students will now complete **Reading #1** to get a better background and understanding of the American car culture. Give the students **Reading #1** and **Student Worksheet #2** and ask them to complete both the reading and the worksheet individually (**15 minutes**).

STEP 2: COOPERATIVE GROUPS - Students should now move into their cooperative groups and briefly compare and go over their answers to the Student Worksheet #2 (**5 minutes**).

STEP 3: CLASS DISCUSSION - Bring the class back together and briefly discuss answers to Student Worksheet #2. Answer key is located in the Teacher Materials (**10 minutes**).

ACTIVITY 4: Cooperative Learning Activity

1. Description/Overview of Activity:
Students will work in cooperative groups to complete Reading #2 and Student Worksheet #3. In this activity students will learn about the impact of autos on the environment.

2. Materials Needed:
Reading #2
Student Worksheet #3

3. Performance Indicators of the Activity:
Geography P.I. G.407, G.408; 7.423, 8.423
Science P.I. 9.75
History P.I. H.401, H.402; 7.429, 8.427

4. Preparation for Activity:
Make copies of Reading #2 and Student Worksheet #3. Divide the class into cooperative learning groups of 4 each and arrange each heterogeneously according to gender, race, and ability.

5. Activity Outline and Directions to the Teacher:

STEP 1: Students should move back into their cooperative groups for Reading #2. Students should be given **Reading #2** and **Student Worksheet #3 -** Autos and the Environment. Groups should complete the reading individually and then answer the Worksheet as a group (**15 minutes**).

STEP 2: CLASS DISCUSSION - Bring the class back together and briefly discuss answers to Student Worksheet #3. Answer key is located in the Teacher Materials (**10 minutes**).

ACTIVITY 5: Personal Transportation Activity

1. Description/Overview of Activity:
This is an activity that students completed as a seven day assignment at the beginning of the lesson. Students were to keep a Personal Transportation Chart for seven days and complete Student Worksheet #4.

2. Materials Needed:
Personal Transportation Chart
Student Worksheet #4
Handout #3

3. Performance Indicators of the Activity:
Geography P.I. G.407; 7.423, 8.423
Science P.I. 9.75
History P.I. H.402, H.405; 7.429, 8.427

4. Preparation for Activity:
Make copies of Personal Transportation Chart, Handout #3, and Student Worksheet #4. These should be given to the student at the beginning of the lesson. Tell students that they will be keeping a seven day record of their personal transportation for an activity at the end of the lesson. Divide the class into cooperative learning groups of 4 each and arrange each heterogeneously according to gender, race, and ability.

5. Activity Outline and Directions to the Teacher:

STEP 1: Students should have their Personal Transportation Charts completed after keeping a log for 7 days. Students will move into their cooperative learning groups of

four students each and complete Student Worksheet #4. Give each group a copy of Handout #3 to use in answering the questions in Student Worksheet #4. It is recommended that you require the students to do the math with this lesson. Understanding the measurable impact that their personal behavior can have on air quality will help students develop and understand that they personally (not just government or industry) have an effect on the quality of our air **(20 minutes).**

STEP 2: CLASS DISCUSSION - Have each team share their answers to Worksheet #4 with the entire class and discuss transportation choices individuals can make to improve our air quality in Delaware. (see Handout #3) **(15 minutes).**

ACTIVITY 6: Culminating Activity - Editorial

1. Description/Overview of Activity:
Students individually will write an editorial or letter to the editor suggesting a governmental policy in Delaware that could help cut down on air pollution coming from mobile sources.

2. Materials Needed:
Students should use all the materials in this lesson as reference materials.
Scoring Rubric
Handout #4 - student instructions

3. Performance Indicators of the Activity:
Civics P.I. C.416, C.418; 8.409
Geography P.I. G.407; 7.423, 8.423
History P.I. H.403, H.405, H.408; 7.428; 7.429, 8.428, 8.430
Science P.I. 9.75

4. Preparation for Activity:
Photocopy Handout #4 and Scoring Rubric

5. Activity Outline and Directions to the Teacher:

STEP 1: Give each student a copy of Handout #4 and Scoring Rubric. Explain to students that this is the culminating activity for Lesson 3 and that they will receive a grade based on the rubric.

STEP 2: Students should be taken to the library to allow for research on transportation and policies relating to air pollution **(30 minutes).**

STEP 3: Students will write their editorials in class starting with a rough draft which will be checked by the teacher before the final draft will be written. A few editorials from local newspapers might be helpful as examples for the students as to the proper format to use **(45 minutes).**

CONCLUSION

1. Refer the class back to the learning objectives to be sure they have mastered the material from Lesson 3.

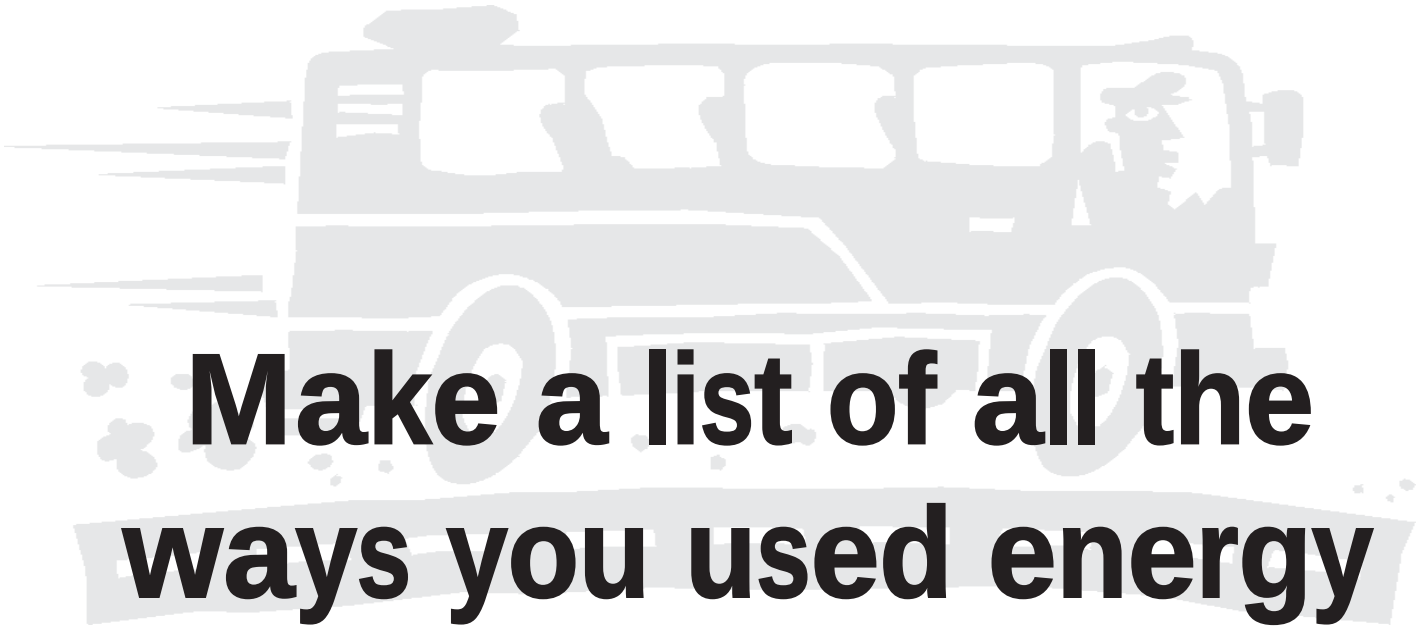
EXTENDED ACTIVITIES

1. POSITION PAPER - Students working in Cooperative Learning Groups will prepare a position paper on changing attitudes and habits with respect to transportation and how the government as well as individual citizens can help clean up the air we breathe. This in turn may influence the decision of a legislator or government official.

OVERHEAD TRANSPARENCIES

INTRODUCTION TO LESSON 3

OVERHEAD TRANSPARENCY: WARM-UP



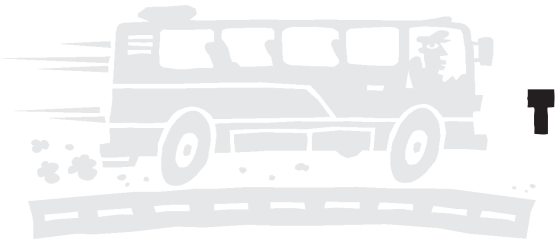
Make a list of all the ways you used energy since you got out of bed this morning.

OVERHEAD TRANSPARENCY:
LESSON 3 OBJECTIVES

- **Describe the historic effects of the automobile on American communities.**
- **Contrast American dependence on autos with that of the world as a whole.**
- **State the percentage of air pollution in the U.S. attributable to motor vehicles.**
- **List four pollutants emitted by motor vehicles**
- **Describe four pollution reduction choices related to personal transportation needs.**
- **Explain the difference between a renewable and a nonrenewable resource.**
- **Describe the American car culture.**

STUDENT MATERIALS

Lesson 3 Activity 1



WHAT IMPACT DOES TRANSPORTATION HAVE ON AIR QUALITY?

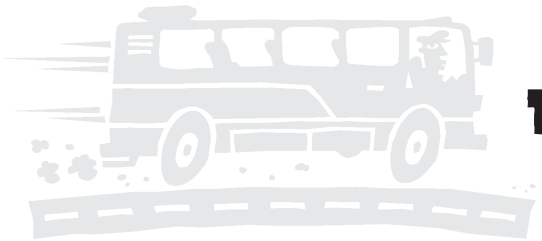
Handout 1
Nonrenewable Energy Sources
Lesson 3 Activity 1

DIRECTIONS: Non-renewable energy sources will run out—but, when? Figure it out for yourself. Complete the table below by writing in your estimate of the amount of time in years remaining for each of the non-renewable energy sources listed.

ENERGY SOURCE	ESTIMATED AMOUNT REMAINING AT PRESENT RATES OF CONSUMPTION * (QUADS)	ANNUAL AMOUNTS USED (QUADS)	TIME LEFT (YEARS)
Petroleum	9145.5 (World) 430.0 (U.S.)	136.5 (World) 17.20 (U.S.)	_____ _____
Natural Gas	9470.0 (World) 577.59 (U.S.)	77.0 (World) 19.25 (U.S.)	_____ _____
Coal	20930.0	91.0	_____
Uranium	630.0 (World) 60.0 (U.S.)	21.0 (World) 2.0 (U.S.)	_____ _____

* Quad is a quadrillion BTUs

Source: US Department of Energy



WHAT IMPACT DOES TRANSPORTATION HAVE ON AIR QUALITY?

Student Worksheet 1
Nonrenewable Energy Sources
Lesson 3 Activity 1

Directions: Use information from Handout 1 to answer the questions below. Most questions have no single right answer. You may wish to select a group recorder to write out your best answers and report them to the entire class.

1. How old will you be when the oil is gone? _____

2. How will your life change when the world reaches the end of its oil supply? _____
_____

3. What will happen to the rates of consumption of the remaining fuels when one runs out? _____
_____
_____

4. What would happen if suddenly all people on Earth had the lifestyle of Americans? _____
_____
_____

5. What can be done to extend the time for non-renewables? _____
_____

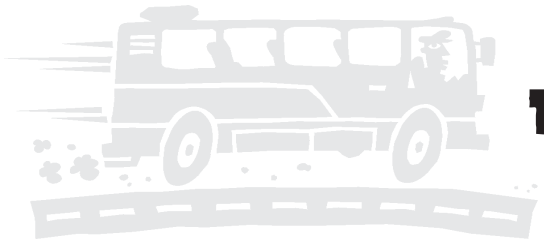
6. What will happen if the population increases? _____
_____

7. What will replace oil and the other non-renewables in doing the world's work? _____
_____
_____

8. What needs to be done to speed the replacement of non-renewables with renewables? _____
_____
_____

TEACHER MATERIALS

Lesson 3 Activity 1



WHAT IMPACT DOES TRANSPORTATION HAVE ON AIR QUALITY?

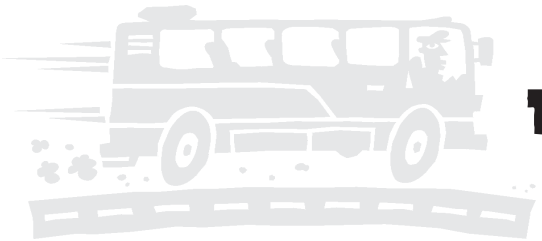
Handout 1
Nonrenewable Energy Sources
Lesson 3 Activity 1

DIRECTIONS: Non-renewable energy sources will run out—but, when? Figure it out for yourself. Complete the table below by writing in your estimate of the amount of time in years remaining for each of the non-renewable energy sources listed.

ENERGY SOURCE	ESTIMATED AMOUNT REMAINING AT PRESENT RATES OF CONSUMPTION * (QUADS)	ANNUAL AMOUNTS USED (QUADS)	TIME LEFT (YEARS)
Petroleum	9145.5 (World) 430.0 (U.S.)	136.5 (World) 17.20 (U.S.)	67 25
Natural Gas	9470.0 (World) 577.59 (U.S.)	77.0 (World) 19.25 (U.S.)	123 30
Coal	20930.0	91.0	230
Uranium	630.0 (World) 60.0 (U.S.)	21.0 (World) 2.0 (U.S.)	30 30

* Quad is a quadrillion BTUs

Source: US Department of Energy



WHAT IMPACT DOES TRANSPORTATION HAVE ON AIR QUALITY?

Student Worksheet 1
Nonrenewable Energy Sources
Lesson 3 Activity 1
ANSWER KEY

1. How old will you be when the oil is gone? **Answers will vary. All should recognize that petroleum will run out in the Y.S. in their lifetime—before the age of 50.**

2. How will your life change when the world reaches the end of its oil supply? **Answers will vary. Students should recognize the energy-dependent American lifestyle and without oil we will need to find another source of energy to survive. Since 81% of all oil consumed in the U.S. is used for transportation, the most drastic changes will be in transportation.**

3. What will happen to the rates of consumption of the remaining fuels when one runs out? **The students should recognize the importance of supply and demand. When one runs out the demand for others will increase and their rate of consumption will increase and thus run out sooner.**

4. What would happen if suddenly all people on earth had the lifestyle of Americans? **Demand for the remaining fuels would increase and the rate of consumption would increase and the time remaining until they would run out would drastically decrease.**

5. What can be done to extend the time for non-renewables? **Individuals must conserve as much as possible and countries should start to explore alternative fuels and modes of transportation.**

6. What will happen if the population increases? **This will also increase demand and consumption and decrease the time until fossil fuels will run out.**

7. What will replace oil and the other non-renewables in doing the world's work? **Answers will vary. Students should brainstorm all possibilities.**

8. What needs to be done to speed the replacement of non-renewables with renewables? **The government as well as private industry must get involved in R & D (research and development) of renewables and alternative energy sources and modes of transportation.**

STUDENT MATERIALS

Lesson 3 Activity 2

WHAT IMPACT DOES TRANSPORTATION HAVE ON AIR QUALITY ?

Lesson 3 Activity 2
HANDOUT 2

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

1. Only 8% of the world's population owns a car. In the U.S. 89% of all households own one or more cars.	True	False
2. Oil will run out during your lifetime.	True	False
3. Only 21% of the oil used in the U.S. is used for transportation.	True	False
4. Less than 50% of the oil used in the U.S. is imported.	True	False
5. Imported oil accounts for 35% of the trade deficit.	True	False
6. In cities, pollution caused by transportation often reaches 80-90%.	True	False
7. 50% of all Americans live in areas that violate federal clean air standards.	True	False
8. Renewable energy technologies cut the trade deficit, create jobs, and clean the environment.	True	False
9. About one third of Delaware's ozone-forming pollutants come from motor vehicles (cars, trucks,etc.).	True	False
10. Motor vehicles produce two types of emissions: evaporative emissions and exhaust pollutants.	True	False
11. 10% to 20% of all cars on the road at any one time cause the bulk of air pollution from motor vehicles.	True	False
12. Despite dramatic success in reducing pollution from motor vehicles over the past 20 years, cars remain the largest single contributor to air pollution in many urban areas.	True	False

13. A well-maintained 10-year old car cannot be cleaner than a poorly maintained 5-year old car.	True	False
14. Private automobiles are a prime contributor to global warming and air pollution.	True	False
15. On the average, new cars use less fuel and produce much less pollution than older cars.	True	False
16. Emissions from a poorly maintained car are about 29 times that of a properly functioning car.	True	False
17. Starting your car when the engine is cold does not produce as much pollution as when it is warm.	True	False
18. Automobiles, through the burning of fossil fuels, are the main producers of CO_2 (carbon dioxide).	True	False
19. Annually, trees absorb over 50% of the CO_2 produced by burning fossil fuels.	True	False
20. If every car carried two people instead of one to the same place, 40 million gallons of gas would be saved every day.	True	False

TEACHER MATERIALS

Lesson 3 Activity 2

WHAT IMPACT DOES TRANSPORTATION HAVE ON AIR QUALITY ?

Lesson 3 Activity 2
HANDOUT 2

1.	**True**	This is true, only 8% of the people in the world own a car.
2.	**True**	Oil will run out probably before most students are 50 years old, according to the U.S. Information Association.
3.	**False**	81% of the oil used in the U.S. is used for transportation.
4.	**False**	Over 50% of the oil used in the U.S. is imported.
5.	**True**	35% of the U.S. trade deficit is due to imported oil.
6.	**True**	In many cities in the U.S., 80-90% of the pollution is caused by transportation.
7.	**False**	Two-thirds of all Americans live in areas that violate federal clean air standards.
8.	**True**	Technologies used to develop renewable energy does cut the trade deficit (by cutting the amount of imported oil), creates many jobs, and produces a cleaner environment.
9.	**False**	60 to 70% of the ozone in Delaware is generated from automobiles.
10.	**True**	All motor vehicles produce both evaporative emissions and exhaust pollutants.
11.	**True**	These are the older cars or poorly maintained cars.
12.	**True**	Car emissions have been cut over the past 20 years but still remain the largest single contributor to air pollution.
13.	**False**	A well-maintained 10-year old car can be cleaner than a poorly maintained 5-year old car.
14.	**True**	Private automobiles are a major contributor to global warming.
15.	**True**	New cars use less fuel because of the newer emission controls on them.
16.	**True**	This is true because a properly maintained car will pollute much less.
17.	**False**	Starting your car when the engine is cold produces more than twice as much pollution as when it is warm.
18.	**True**	Automobiles are the main producers of CO_2 and greenhouse gases that contribute to global warming.
19.	**False**	Annually, trees absorb 30% of the CO_2 produced by burning fossil fuels.
20.	**True**	This is a true statement and the reason we must do more ridesharing and carpooling.

Score - 10 or more correct - well informed

17 or more - informed

Less than 17 - poorly informed

STUDENT MATERIALS

Lesson 3 Activity 3

AMERICA AND THE CAR CULTURE

Lesson 3 Activity 3

Reading 1

The first machine to travel under its own power was invented in 1770 by a French army officer, who built a three-wheeled steam tractor for hauling cannons. For over a hundred years after that, European and American inventors developed a variety of three-and four-wheeled carriages powered by steam, electricity, and gasoline.

In the early 1900s, American companies pioneered the use of assembly lines to mass-produce automobiles. In 1916, Henry Ford set up such an efficient assembly line that he was able to sell autos at a far lower price than other makers. In the 1920s, middle-class families began to own cars. The amazing new machines proved very attractive. Along with status, automobile ownership delivered fast transit at the convenience of the owner.

In the 1930s, 40s and 50s, mass transportation systems in over 45 American cities were systematically dismantled by the auto industry. More than 100 electric trolley lines in over 45 cities were bought out and closed down by a company called National City Lines, which was backed by General Motors, Phillips Petroleum, Standard Oil, Mack Truck, Firestone Tire, and other auto industry groups. For this effort to replace electric public transportation systems with buses and cars, GM and the other companies were convicted of conspiracy in Federal court.

Before cars became common, many Americans walked or used public transportation to get to work, school, and elsewhere. By the 1950s most American families owned a car. Also in the 1950s, the suburban, single-family house became the most popular kind of home. From then on, new housing in the U.S. was designed on the assumption that residents would mostly use cars to get around. New developments provided parking and roads, but seldom offered walking and bicycle paths, convenient shopping opportunities within walking distance, or planned access to public transportation.

So dependence on cars changed neighborhoods and cities. Along with more roads, highways, and parking lots came shopping malls and drive-through windows. Communities were increasingly designed to serve cars. Cities were no longer compact. They sprawled ever larger, reinforcing and increasing dependence on cars.

At first, cars were a great convenience and time saver, but as city design and growth patterns shifted to accommodate cars, the time savings were offset by urban sprawl. Now, in the average American city over 40% of the land is devoted to cars. Even people who choose not to use a car are affected by the number of cars and the "car culture".

In only a few American cities do public transportation systems compete with the auto in providing convenient travel. Many communities in Europe, even large modern cities, depend much less on private vehicles. Ribbon-like parks with sidewalks and even entire streets are set aside to make walking pleasant and convenient. Public transportation is quick, clean, and easy to use.

The U.S. produces, imports, and uses more cars than any other country in the world. There are over 135 million cars and 180 million motor vehicles in the U.S. The number of personal vehicles went from one car for every 5.3 people in 1927 to one car for every 1.7 people in 1994. With 4% of the world population, Americans own 48% of the world's cars.

Our attitudes toward cars reflect their influence in our daily lives. To many people, a personal vehicle is a status symbol. In some families, young teens look forward to having a driver's license, and access to the family car is considered part of growing up. In many communities, these young teens expect to have their own car when they become sixteen years old. Access to or ownership of a car is taken as symbolic of personal freedom and "the good life."

So, both the American landscape and the everyday lives of Americans have been altered by the widespread use of private vehicles. Now, people are likely to live farther from where they work or go to school than in the past. Both children and adults are more likely to engage in recreational activities away from home. As people get into the habit of using personal vehicles and as time passes, they become more and more dependent on them. Then it takes a special effort to get used to other forms of transportation.

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

AMERICA AND THE CAR CULTURE

Lesson 3 Activity 3

1. The first machine to travel under its own power was invented in 1770 by a French army officer, who built a three-wheeled steam tractor for hauling _____.

2. List the three energy sources used by a variety of three-and four-wheeled carriages invented over the last hundred years:
   a) _____
   b) _____
   c) _____

3. Which country in the early 1900s pioneered the use of assembly lines to mass-produce automobiles?
   _____

4. In 1916, _____ set up an efficient assembly line for autos.

5. Who dismantled the mass transportation systems that were established in America in the 1930s, 40s, and 50s?
   _____

6. What decade witnessed most American families owning cars? _____

7. Describe the results of our dependence on cars: _____
   _____
   _____
   _____

8. The U.S. has _____ percent of the world's population but own _____ percent of the world's cars.

9. Describe the American attitudes toward cars: _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____

TEACHER MATERIALS

Lesson 3 Activity 3

AMERICA AND THE CAR CULTURE

Answer Key Student Worksheet 2
Lesson 3 Activity 3

1. The first machine to travel under its own power was invented in 1770 by a French army officer, who built a three-wheeled steam tractor for hauling **cannons.**

2. List the three energy sources used by a variety of three-and four-wheeled carriages invented over the last hundred years:
   a) **steam**
   b) **electricity**
   c) **gasoline**

3. Which country had companies in the early 1900s that pioneered the use of assembly lines to mass-produce automobiles? **American companies**

4. In 1916, **Henry Ford** set up an efficient assembly line for autos.

5. Who dismantled the mass transportation systems that were established in America in the 1930s, 40s, and 50s? **Dismantled by the auto industry**

6. What decade witnessed most American families owning cars? **1950s**

7. Describe the results of our dependence on cars: **Changed neighborhoods and cities. Along with more roads, highways, and parking lots came shopping malls and drive-through windows. Communities were increasingly designed to serve cars. Cities were no longer compact. They sprawled ever larger, reinforcing and increasing dependence on cars. City design and growth patterns shifted to accommodate cars, the time savings were offset by urban sprawl. Now, in the average American city over 40% of the land is devoted to cars. Now, people are likely to live farther from where they work or go to school than in the past. Both children and adults are more likely to engage in recreational activities away from home. As people get into the habit of using personal vehicles and as time passes, they become more and more dependent on them.**

8. The U.S. has **4** percent of the world's population but owns **48** percent of the world's cars.

9. Describe the American attitudes toward cars: **To many people, a personal vehicle is a status symbol. In some families, young teens look forward to having a driver's license, and access to the family car is considered part of growing up. In many communities, these young teens expect to have their own car when they become sixteen years old. Access to or ownership of a car is taken as symbolic of personal freedom and "the good life."**

STUDENT MATERIALS

Lesson 3 Activity 4

AUTO AND THE ENVIRONMENT

Lesson 3 Activity 4

Reading 2

Besides the effects on our communities, motor vehicles play a big role in many environmental problems. The metals to make cars and the gas to run them must be mined and processed, and each mine, smelter, and refinery uses energy, creates pollution, and has other environmental impacts. Just transporting the supplies for our cars has impacts too, such as when an oil spill causes large-scale water pollution. Although an oil spill may occur in the ocean far from where we live, that oil is being transported for our cars.

And every time we use a car, its negative environmental impacts continue. Water pollution occurs when rain washed oil, antifreeze, brake fluid, etc. off the streets and into waterways. Cars are also a source of toxic waste, such as from car batteries, and create noise pollution. Using cars means paving land for roadways and parking. Finally, when a car is no longer useful, it becomes part of our solid waste problem.

Of course, motor vehicles are also a major source of air pollution. The average car emits one pound of pollution for every 25 miles it is driven. Cars emit four major pollutants: carbon monoxide, nitrogen oxides, particulate matter, and volatile organic compounds (or hydrocarbons). These all cause health and environmental problems.

Motor vehicles produce more than half of all air pollution in the United States. Each year, American cars spew out 41.4 million tons of carbon monoxide, 8.3 million tons of nitrogen oxides, 7 million tons of hydrocarbons (HCS), and 1.7 million tons of particulate matter. Passenger cars also cause 20 to 30% of carbon dioxide pollution in the U.S. Although carbon dioxide isn't a criteria pollutant, many scientists think it is the primary gas creating the Greenhouse Effect, the gradual warming of Earth's atmosphere.

The United Nations Environment Programme and World Health Organization estimate that air pollution from cars is a serious problem in over half of the world's cities. The American Lung Association estimates that in the U.S., 60,000 to 120,000 people die each year because of exposure to air pollution from cars. The American Lung Association also estimates medical costs due to auto air pollution at 93 billion dollars per year.

New air quality and fuel-efficiency standards are not always implemented when the technology for them becomes available. Historically, the American auto manufacturers' lobby has resisted new, stricter standards. Their main concern has been that the cost of new cars would increase and that car sales could thus decrease.

Sometimes our lawmakers have debated auto air pollution legislation for years before passing it. And legislation that has been passed is not always strictly enforced. Still, much progress has been made. Technology has given us more sophisticated engines, emission control devices, and fuels, so that both our cars and our fuels pollute less. On a per-vehicle basis, auto emissions are much less now than they were when the Clean Air Act became law. In fact, 1995 model cars averaged 90% cleaner emissions than 1970 model cars. Yet due to the number of cars on the road, the amount of air pollution from motor vehicles is still overwhelming.

Why is auto air pollution still a big deal? For starters, the U.S. population has grown as a steady pace. Plus, the percentage of American families that own a car, or that own more than one car, has increased as well. So there are many more cars on the road.

Besides that, Americans drive more often. The average number of miles driven per person has increased dramatically. This is true in Delaware, too. Because our population is growing at a fast pace, pollution prevention efforts made to date are not enough. To offset the growing number of people and cars, everyone needs to make an extra effort to protect the quality of the air we breathe.

In Delaware, over 50% of our air pollution is from motor vehicles. So if we're going to improve Delaware's air quality, transportation is a critical issue. The bottom line is that everyone who uses transportation—all of us, that is—can contribute to the problem or the solution. Although there are many ways to reduce the pollution produced by a car, our best bet is to become less dependent on cars. The best pollution solution is also the simplest solution: Drive less. Walk there, bus there, bike there, or rideshare.

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

AUTO AND THE ENVIRONMENT

Student Worksheet 3
Lesson 3 Activity 4

1. Besides the effects on our communities, describe the role played by motor vehicles in many environmental problems.
   _____
   _____
   _____
   _____
   _____

2. The average car emits _____ of pollution for every _____ miles it is driven.

3. List the four major pollutants that cars emit:
   a) _____
   b) _____
   c) _____
   d) _____

4. Motor vehicles produce more than _____ of all air pollution in the United States.

5. Each year, American cars spew out:
   a) _____ million tons of carbon monoxide
   b) _____ million tons of nitrogen oxides
   c) _____ million tons of hydrocarbons
   d) _____ million tons of particulate matter

6. How many people in the U.S. die each year from air pollution from cars according to the American Lung Association?
   _____
   _____
   _____

7. Explain why new air quality and fuel-efficiency standards are not always implemented when the technology for them becomes available. _____
   _____

8. Compare the emissions of a 1995 model car with those of 1970 models. _____
   _____

9. Describe why auto air pollution is still a big deal. _____
   _____
   _____
   _____
   _____

TEACHER MATERIALS

Lesson 3 Activity 4

AUTO AND THE ENVIRONMENT

Answer Key Student Worksheet 3
Lesson 3 Activity 4

1. Besides the effects on our communities, describe the role played by motor vehicles in many environmental problems. **Motor vehicles play a big role in many environmental problems. The metals to make cars and the gas to run them must be mined and processed, and each mine, smelter, and refinery uses energy, creates pollution, and has other environmental impacts. Just transporting the supplies for our cars has impacts too, such as when an oil spill causes large-scale water pollution.**

2. The average car emits **one pound** of pollution for every **25** miles it is driven.

3. List the four major pollutants that cars emit:
   a) **Carbon monoxide**
   b) **Nitrogen oxides**
   c) **Particulate matter**
   d) **Volatile organic compounds**

4. Motor vehicles produce more than **half** of all air pollution in the United States.

5. Each year, American cars spew out:
   a) **41.4** million tons of carbon monoxide
   b) **8.3** million tons of nitrogen oxides
   c) **7.0** million tons of hydrocarbons
   d) **1.7** million tons of particulate matter

6. How many people in the U.S. die each year from air pollution from cars according to the American Lung Association? **60,000 to 120,000**

7. Explain why new air quality and fuel-efficiency standards are not always implemented when the technology for them becomes available. **Historically, the American auto manufacturers' lobby has resisted new, stricter standards. Their main concern has been that the cost of new cars would increase and that car sales could thus decrease.**

8. Compare the emissions of a 1995 model car with those of 1970 models. **1995 model cars averaged 90% cleaner emissions than 1970 model cars.**

9. Describe why auto air pollution is still a big deal. **For starters, the U.S. population has grown at a steady pace. Plus, the percentage of American families that own a car, or that own more than one car, has increased as well. So there are many more cars on the road. Besides that, Americans drive more often. The average number of miles driven per person has increased dramatically. This is true in Delaware, too. Because our population is growing at a fast pace, pollution prevention efforts made to date are not enough.**

STUDENT MATERIALS

Lesson 3 Activity 5

AMERICA AND THE CAR CULTURE

Student Worksheet 4
Lesson 3 Activity 5

What Impact Does Transportation Have On Air Quality?

Personal Transportation

Name: _____ Date: _____
Class: _____ Period or Block: _____

Problem: Are transportation choices a significant contributor to Delaware's air pollution? Is it possible for individuals to have an effect on air quality?

Materials: Personal Transportation Chart.

Procedure:
1. For a period of seven (7) days, you will collect data on the miles that you travel and the modes of transportation that you normally use. On the Personal Transportation Chart, make an entry for every trip that you make away from your home. (You will *not* be graded or judged according to your travel habits.) The "correct" answer is simply the most accurate data.

2. After seven days, total the various columns on your chart. Meet with your group to analyze your data and answer the questions below:

Observations and analysis:
1. What mode of transportation was used most often by the members of your team?

_____

2. List all the modes of transportation used by your team or group.

_____

_____

3. Analyze your teams' transportation use by answering these questions:
   a. How many miles did you personally travel overall? _____ miles
   b. How many miles did members of your team travel overall? _____ auto miles
   c. How many miles did members of your team travel overall? _____ total miles
   d. How many miles did members of your team travel by auto? _____ total auto miles
   e. What was the average number of auto miles traveled by members of your team?
      _____ total auto miles (divided by) _____ people in team = _____ miles/person
   f. What was the average number of auto miles traveled by members of your team?
      _____ total auto miles (divided by) _____ people in team = _____ auto miles/person
   g. What was the total amount of air pollution produced by your personal auto travel?
      (remember that for every 25 miles we drive puts one pound of pollution in the air)
      _____ auto miles (divided by) 25 (miles/pound) = _____ pounds of pollution

h. If your auto usage was typical for everyone at your school, how many pounds of air pollution would your student body produce each year?
_____ students x _____ pounds of pollution/week x 52 weeks = _____ pounds of pollution.

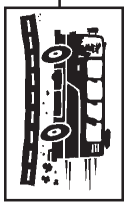
4. Study Handout #3 and discuss these pollution-reduction ideas with your team. List ten (10) of these ideas related to your teams' recent personal transportation choices. These could include using alternative modes of transportation as well as reducing pollution from a car used for transportation.

(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
(7) _____
(8) _____
(9) _____
(10) _____

Personal Transportation Chart

	Date	Purpose of Travel	Distance	*Auto	**Auto	Bus	Walk	Bike	Other
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
		Totals							

*Indicates an auto with 1 person ** Indicates a carpool



WHAT IMPACT DOES TRANSPORTATION HAVE ON AIR QUALITY ?

Handout 3
Lesson 3 Activity 5
POLLUTION-REDUCTION IDEAS

Personal Transportation Choices:

1. Walk
2. Bicycle
3. Skateboard or skate
4. Ride the bus
5. Carpool
6. Combine auto trips (consolidate errands into one) so that you make less "cold starts" in addition to reducing mileage
7. Skip a trip and relax at home instead
8. Drive a fuel-efficient car
9. Drive at a moderate, steady speed
10. Avoid quick stops and starts
11. Obey posted highway speed limits
12. Turn off your engine during major traffic jams, at train crossings, or during other long waits
13. Don't use drive-up windows
14. Avoid letting a car idle for over 60 seconds
15. Don't "top off" the tank when you refuel
16. Never rev a car engine
17. Avoid using auto air conditioning
18. Make sure the car gets regular tune-ups
19. Keep a car well-maintained between tune-ups with frequent oil and filter changes, a clean air filter, etc.
20. Keep tires properly inflated, balanced, and rotated
21. Use radial tires
22. Travel light by taking unused items that create extra weight out of the car
23. When purchasing another car or new car, be sure to choose one that is fuel efficient
24. Have your car repaired and re-tested when needed
25. Drive your newest car when going on a trip
26. Park in the shade to avoid evaporative emissions from your sun-heated gas tank while parked
27. Fuel up at night during ozone season (refueling during cooler periods of the day can prevent gas fumes from heating up and creating ozone)

STUDENT MATERIALS

Lesson 3 Activity 6

WHAT IMPACT DOES TRANSPORTATION HAVE ON AIR QUALITY ?

Lesson 3 Activity 6
HANDOUT 4

TRANSPORTATION ISSUE

STUDENT EDITORIAL DIRECTIONS

DESCRIPTION: You will apply what you have learned in this Transportation 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 one page (typed - double spaced) editorial suggesting a governmental policy in Delaware that could help cut down on air pollution coming from mobile sources.

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 present government policies 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 air pollution problem from mobile sources. In other words, a well developed position.

5. In a concluding paragraph, explain the effects of your policy on air quality and the sacrifices everyone must make.

6. Be sure to examine the scoring rubric that will be used to evaluate and grade your position paper.

WHAT IMPACT DOES TRANSPORTATION HAVE ON AIR QUALITY

Scoring Rubric for Student Editorial
Lesson 3 Activity 6

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

	0	1	2	3	4	
1. Description of policy **P.I. H.403; 7.428, 8.428**	_____	_____	_____	_____	_____	x 5 = _____
2. Supporting details **P.I. H.408**	_____	_____	_____	_____	_____	x 5 = _____
3. Evidence of research **P.I. H.405; 7.429, 8.430**	_____	_____	_____	_____	_____	x 5 = _____
4. Well developed position **P.I. C.416**	_____	_____	_____	_____	_____	x 5 = _____
5. Course of Action and influence **P.I. C.418; 8.409** **P.I. G.407; 7.423, 8.423** **P.I. 9.75 (Science)**	_____	_____	_____	_____	_____	x 5 = _____

GRADE _____