



# Sustainable Transportation In the 21st Century



Teacher's Guide  
2014–2015





# Sustainable Transportation in the 21<sup>st</sup> Century

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Dear Teacher,

Thank you for participating in the Garrett Morgan Symposium on Sustainable Transportation. MTI realizes that this is an additional activity in your already full curriculum, so we appreciate your efforts.

This learning module is an overview of sustainable transportation issues. You are not expected to do additional research or preparation other than reviewing the workbook and reading its lesson plans. Also, your competition project is not required to follow examples in the workbook. The book is intended only to help your team understand basic concepts of sustainable transportation.

Part I of the Student Workbook can be completed in five to six class sessions. However, your particular class and teaching methods may require more or less time.

For the competition project, you can have students work in small groups or together as a class. If your class works on more than one project, please select the best one for presentation at the video-conference. The class with the best project, as determined by the competition judges, will be invited to send a teacher, student, and parent to the MTI banquet in June 2015 in San Jose, Calif. MTI will pay the cost of travel, hotel, banquet, and a stipend for meals.

The winning classroom also will receive \$500, plus an additional \$500 generously contributed by two of MTI's Trustees, Nuria Fernandez and Will Kempton. Second place will win \$300, and third place will win \$200. The top three teams also will receive plaques. All students who participate on the presentation teams will receive certificates.

The videoconference date will be sometime around mid-March, depending on the Secretary of Transportation's schedule. We also avoid spring breaks and state testing dates for the schools. During the video-conference, students will have the opportunity to ask questions of transportation experts and the other teams. We expect the Secretary of Transportation or a representative to attend, along with other transportation leaders. Your sponsor organization will provide details about the logistics.

We hope that you and your class enjoy this unit. Please let us know if you have suggestions or feedback.

Thank you again...



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# Teacher's Guide Contents

Overall Objectives and Learning Outcomes	4
<b>Lesson 1</b> What Do You Know about Transportation?	5
<b>Lesson 2</b> Transportation History: News and Dates	7
<b>Lesson 3</b> Current Issues	12
<b>Lesson 4</b> Transportation Energy Sources and Fuels	14
<b>Lesson 5</b> Sustainable Transportation	18
<b>Lesson 6</b> Transportation Jobs and Professions	21
<b>Optional Social Activism Lessons:</b> Good News in Sustainable Transportation	24
Pipeline Perils: Real World Problem Solving	25
<b>Competition Guidelines and Rules</b>	26

# Overall Objectives and Learning Outcomes

## **Goals – Students Will:**

- Analyze issues surrounding transportation needs in the community;
- Identify the need for sustainable transportation in the context of current dependence on fossil fuels;
- Become more aware of personal responsibility to societal needs and environmental resources;
- Gain some understanding of the science and technology behind current and future modes of transportation;
- Understand what gains have been made in these areas and relate them to everyday living;
- Understand what it means to be an active citizen;
- Identify and describe transportation professions.

## **Skills Used, Developed and Assessed:**

- **Critical Reading:** Students will read passages and answer questions.
- **Logical Reasoning with Charts:** Students will complete and interpret charts to determine best alternatives.
- **Problem Solving:** Students will evaluate current problems and explore possible solutions.
- **Critical Thinking:** Students will come up with new ideas and compare and contrast alternatives to determine the best choices.
- **Writing:** Students will write a paper in which they choose a career in transportation and tell why they would make that choice based on the work tasks, educational requirements, rewards, challenges, and drawbacks of that career.
- **Research Documentation:** Students will maintain the workbook and summarize findings.
- **Presentation and Public Speaking:** Students will present their ideas, research and opinions.
- **Group Work:** Students will work in groups to complete assignments and/or worksheets.
- **Social Activism:** Students may write letters based on what they have learned and propose solutions to problems they identify.

# What do you know about transportation?

**Description:** This lesson will help the students become aware of various forms of transportation. Students will focus on why transportation is needed, the different modes of transportation, and various energy sources for propulsion.

**Lesson Time:** One class period.

**Objectives:** Students will draw lines connecting the many uses, modes, energy sources, and effects of transportation. Students will state how transportation affects their lives.

**Student Activity:** During this lesson, students will complete several lists in their student workbook, participate in small group or class brainstorming, and class discussion.

**Materials:** Student Workbook

**Instructional Activity:** The teacher may start the brainstorming session by writing these questions on the board:

- What are the different energy sources for transportation?
- Why do people need transportation?
- What are the different modes of transportation?

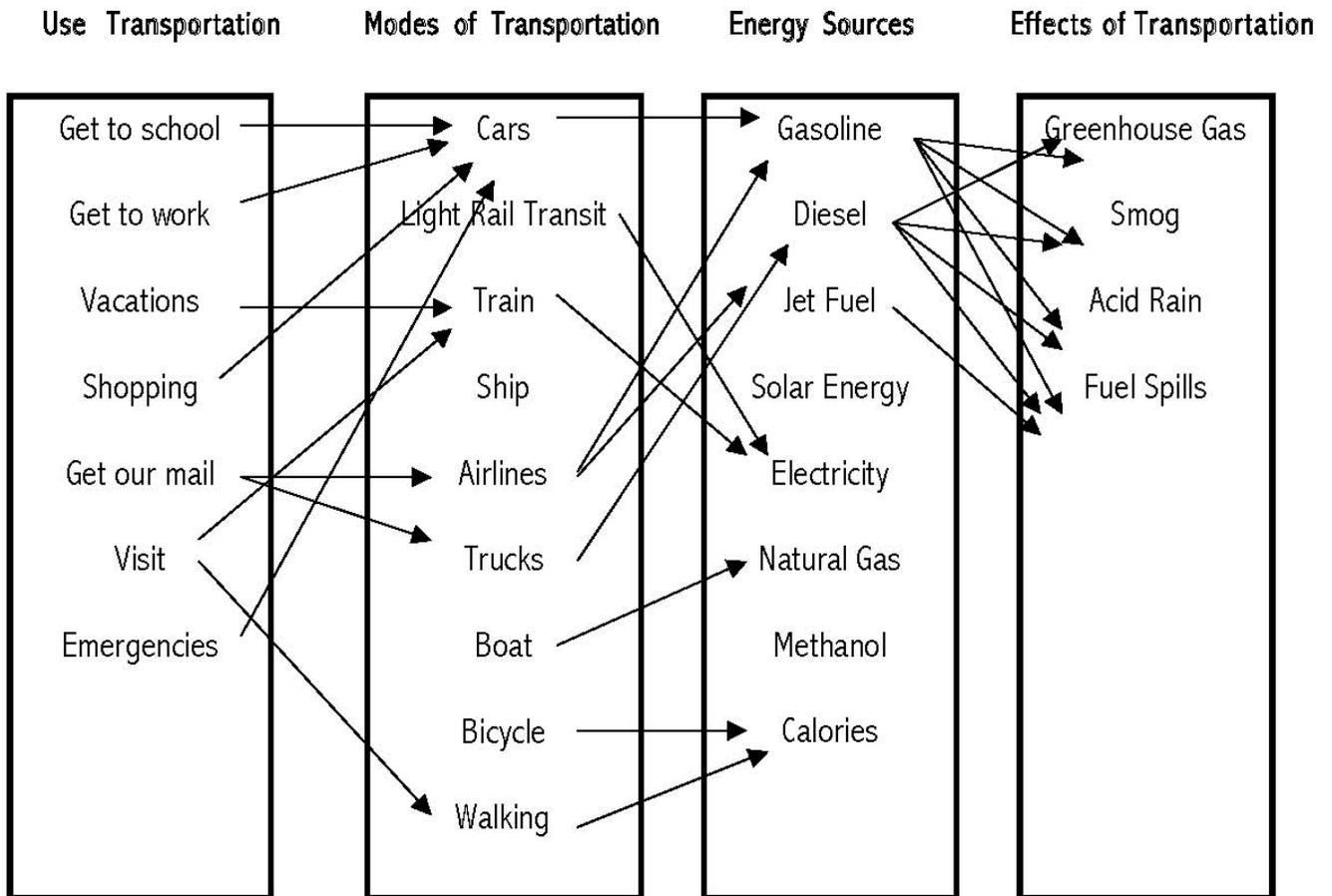
As students respond, they will compile lists with direction from the teacher. It may be best to focus on one question at a time. The teacher may guide students to consider transportation issues that they might not think of.

For example, how does the US Postal Service use transportation, and how do shipping companies, grocery stores, and the military use transportation? Also consider transportation systems of the past and unusual transportation energy sources and modes such as trams, pedal planes, and electric cars. Have students consider all the different modes of public transportation such as light rail, buses, subways, and so on.

After the four lists are compiled have students link the different reasons for using transportation with the various modes and energy sources of transportation. Teachers can help illustrate these relationships by drawing lines connecting the various related reasons, modes and energy sources. See completed worksheet below.

**Assessment:** Ask the students about the different forms of transportation and evaluate student worksheets.

### Example of Completed Worksheet



# Transportation History: News and Dates

**Description:** This lesson will help develop students' awareness of social, environmental, and economic costs of our transportation systems' dependence on fossil fuels.

**Objectives:** Increase student awareness of the social, environmental and economic costs of our dependence on fossil fuel. Help students recognize the need for developing transportation technology that reduces these costs. Students will analyze information and infer winners and losers in our reliance on fossil fuel. Students should understand that the automobile is part of our culture.

**Time Frame:** One or two class periods

**Student Activity:** During this lesson, students will read the events aloud and create a timeline for the events they believe are most important. Students should be encouraged to look at the economic, social, and environmental costs of the event.

Students can complete the timeline at home or in class. After students complete the timeline, have them write a sentence or two about why they believe the events they selected are important.

**Materials:** Student workbook

**Teacher Support Facts:** You may find it useful to begin the discussion by asking how many students have ridden in a car. How many times? 100? 1000? 10,000? More? Other questions: Do you want a car? Do you think your parents would give up their car?

The following facts illustrate how the automobile is central to American culture. These facts may be interesting to share with students:

- According to a poll done in the 1960s, 40% of all marriage proposals occurred in automobiles.
- The 1960s was an era of drive-in and drive-ups, not only for food and movies. The first drive-in church opened in San Bernardino, California. Texas offered drive-up registration for college students, and 90% of Americans take vacations by car.
- Things had not changed too much by 2001, when a radio poll showed that more than 30% of men buy gifts for their cars on Valentine's Day!

- When the automobile was first introduced in the early 1900s, people thought it would make our environment cleaner and transportation easier. After all, there would be no more horse manure to step in, and fewer people would ride streetcars. People thought that having a car would mean freedom to go where and when you wanted. Today, more than 100 years later, we are faced with many problems created by so many automobiles. Having our own cars does give us freedom; we can come and go as we like. But have you ever been stuck in traffic, seen smog, or heard people talk about gas prices? Have you ever run out of gas? Many costs are associated with the automobile.

**Instructional Activity:** Ask students to begin reading the events listed in the workbook. After each event is read aloud, ask students who benefited and what costs or problems may have developed from that event. No prior knowledge is required; students should be encouraged to infer the different answers based on the reading or their knowledge. You may want the students to record comments in spaces provided adjacent to the events whether the event represents economic, social, environmental costs or advances in technology. Many may address all of these issues. Encourage them to list alternatives or remediation in the “possible solution” column.

**Or**

Divide students into small groups and allow each group to select the five events that they believe are most important. Have the groups present their findings to the class. Is there an event that all groups selected? Use this event as a take-off point for an in-depth class discussion.

**Assessment:** Participation in class discussion and completion of worksheet.

# Transportation History: News and Dates

After each event, comments have been included to assist you in guiding the discussion. Consider the comments a starting point. You may or may not decide to use them.

June 27, 1652 -- The first traffic law is passed in New Amsterdam (New York City). It said, "... to prevent accidents (we) do hereby ordain that no wagons, carts or sleighs shall be run, rode or driven at a gallop within this city of New Amsterdam, ... on the penalty of two pounds Flemish for the first (violation)." (So many people use the road that laws are needed to control them. What would happen if more people used mass transit?)

August 9, 1803 – Robert Fulton creates a steamboat that operates up the River Seine in Paris, moving 3-4 miles per hour upstream. (What was different about a steamboat? How did it benefit people?)

May 3, 1869 -- Passenger traffic begins on the first pneumatic subway invented by Alfred Ely Beach. The Beach Pneumatic Underground Railway of New York City includes a 312 foot-long circular tube, 9 feet in diameter. The cars carry 22 passengers and are propelled by a blast of air from a rotary blower. (Social benefit: More mass transit, creates more mobility for people. Economic Costs: Government pays)

January 2, 1900 -- The first electric bus appears on 5th Avenue in New York City. It seats eight people inside and four outside. The fare is five cents. (Social Benefit: People don't have to take cabs or own their own means of transportation to get to work. Economic costs: government pays for mass transit systems)

October 27, 1904 – The New York City Subway is the first rapid transit underground and underwater railway in the world. It runs from City Hall to West 145th St. About 111,881 people pay 5¢ each to ride for 26 minutes on the express train and 46 minutes on the local train. (Do New York and other cities still use subways? What is the advantage?)

April 7, 1913 --The first electrically propelled ship of the US Navy, the USS Jupiter, is commissioned. (Environmental Cost: When this ship was built, electricity was often created by burning coal, which causes a lot of pollution. But the technology had future environmental benefits. Today we can create energy using cleaner energy sources. Social Benefit: Navy is more effective and better able to protect the US.)

November 20, 1923 -- Garrett Morgan is granted a patent for inventing the first practical traffic signal. (Cars were so common that they needed regulation. At that time, horses, people, wagons, and other vehicles used the roadways at the same time.)

March 29, 1927 -- The first automobile to exceed 200 mph is the "Mystery Sunbeam" driven by Major Henry O'Neil de Hane Segrave at Daytona Beach FL. He hits 203.79 mph. (Social Benefit: People can drive fast in car races instead of on the roads; entertainment for people. Social Cost: People become fascinated by cars with bigger, faster engines. Environmental Cost: Bigger engines use more fuel and create more pollution.)

September 3, 1931 -- An experimental electric passenger train designed by Thomas Edison is used on the Lackawanna Railroad between Hoboken and Montclair, NJ. (More people could travel, so the cost per person was less.)

July 16, 1935 – The first parking meter, called The Black Maria, is installed in Oklahoma City OK. (Cities saw cars as a way to generate revenue.)

February 20, 1941 – The first jeep is introduced for military use. (Do we still drive jeeps today? Why do some people like them better than cars?)

June 29, 1956 – President Eisenhower signs a bill that creates the first interstate highway in the US. The system is not completed until 1990. (These highways were created for military use. Eisenhower thought that if the US were attacked, military vehicles could not move efficiently on smaller two-lane roads. He copied the German autobahn.)

August 25, 1959 – An early modern type of magnetic levitation (maglev) train is described in a US Patent by G.R. Polgreen. (How do magnets allow trains to hover and to move?)

April 12, 1961 – The first human spaceflight is Vostok 1, on which cosmonaut Yuri Gagarin of the USSR makes one orbit around Earth. (Will space travel be practical for humans? What kinds of space technology can we use for vehicles on Earth?)

January 28, 1969 -- An oil well blows out on a Union Oil Company drilling platform five miles off the coast of Santa Barbara, CA. The beaches are covered with oil. (Takes away the beauty of our coastline, birds and animals are harmed.)

December 31, 1973 -- President Nixon announces stand-by gasoline rationing in light of the Arab oil embargo. Gas stations voluntarily close on Sundays. (Do you think we depend too much on foreign oil? What can we use instead?)

June 28, 1979 -- OPEC raises prices on crude oil again. The price of a barrel increases 50% since a year earlier. (Who pays when oil prices go up? Who makes the money?)

July 15, 1979 -- President Carter announces a massive six-point effort to reduce American dependence on foreign oil, including alternative energy development. (Why do you think President Carter did this? See above.)

March 24, 1989 -- Exxon Valdez oil tanker runs aground in Alaska, spilling 232,000 barrels of oil. Only 25% of migratory salmon population returns the following season. Thousands of otters and birds are poisoned. Many die. (Environmental, economic costs; most of the clean-up was paid for out of a “Super Fund” which oil companies pay into.)

July 19, 2006 – The Tesla Roadster is introduced at the Santa Monica CA airport at a 350-person invitation-only event. It costs more than \$100,000. (What are the benefits of electric cars? How can they be improved?)

April 16, 2009 – President Obama unveiled his administration's blueprint for a national network of high-speed passenger trains. (What are benefits of a high-speed train?)

December 26, 2009 – China introduced the world's fastest train, with average speeds of 217 miles per hour. (Do you think you will ride a high-speed train someday?)

May 13, 2013 – The *New York Times* runs a story about young people leading a trend toward driving less and taking transit instead. (Do you think this will continue? Why?)

# Your Transportation History Timeline

In the space below, select five transportation events and create your own timeline based on the readings in the workbook and other sources. After you have created your timeline, write a sentence or two on each event you selected.

Date/Event	Why is it important?	If negative impact, possible solution?
<div style="border: 1px solid black; height: 20px; width: 100%;"></div> <div style="border: 1px solid black; height: 60px; width: 100%;"></div>	<p>Answers will vary. Include social, environmental, and economic costs/benefits of event. As long as students give reasonable explanation, any answers are acceptable.</p>	<div style="border: 1px solid black; height: 100px; width: 100%;"></div>
<div style="border: 1px solid black; height: 20px; width: 100%;"></div> <div style="border: 1px solid black; height: 60px; width: 100%;"></div>	<div style="border: 1px solid black; height: 100px; width: 100%;"></div>	<div style="border: 1px solid black; height: 100px; width: 100%;"></div>
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# Current Issues

**Description:** This lesson will help students to think critically about the problems associated with our reliance on fossil fuels. Students are introduced to the concept of acid rain.

**Time Frame:** One class period for discussion and answering questions.

**Objectives:** Recognize that acid rain is a consequence of our dependence on fossil fuels. Be able to summarize broad social, economic, and environmental costs associated with this dependence. Understand what acid rain is, what it does, and how it is formed.

**Student Activity:** During this lesson, students will answer questions in the workbook and participate in class discussion.

**Materials:** Student workbook.

**Instructional Activity:** Have students read pages seven and eight. The optional acid rain experiment requires chalk and vinegar. It may help students understand acid rain damage more fully. The teacher can lead a discussion that recalls various economic, environmental and social costs in the News and Dates section. Teachers may want to look at the completed worksheet to guide the discussion. The following may also be useful in guiding the discussion:

When experts in transportation consider transportation alternatives, they use the “Three E’s” Economic, Environment, and Equity to help them evaluate options. Introducing this concept now will help in later discussions and in the capstone lesson.

“Environment” refers to the impact the system has on the environment. Does it use clean fuels? Does fuel production impact the environment in other ways?

“Equity” refers to the system’s ability to address people’s needs. Does it address many people’s needs? Is it available to all people or only to certain classes of people?

“Economic” refers to financial impacts. Does the system make us depend on foreign fuel sources? Does it require extensive or expensive government regulation?

**Assessment:** Participation in discussion and completion of workbook questions.

# Problems with Fossil Fuel

Based on your discussions and previous reading, identify and explain five problems that are associated with using fossil fuel for transportation.

Answers will vary. They may include some of the following:

**Social Costs:** If this was brought up during class discussion – creation of those who “have” and those who “have not” – the very rich and poor in many OPEC participating countries; the Gulf War; the expense of cars; not everyone can afford them; pipelines explode and kill people; people kidnapped to work on ships; dangers to coal miners.

**Technology:** Unable to deal with fumes from gasoline or to clean up fuel spills completely. New technology is developed slowly because we are comfortable with the ease and convenience of using fossil fuels.

**Economic Issues:** Cost of Gas. Not everyone can afford a car. Limited supply of resources and inability to control prices; embargoes; creation of very rich and poor (OPEC provides a good example of this); costs to taxpayers for the government to regulate automotive, oil industries and pollution.

**Environmental Costs:** Pollution; ruining landscape; the way oil derricks look; killing wildlife; radiation and disposal problems associated nuclear power; limited supply; and strip mining. Using fossil fuels causes acid rain.

# Transportation Energy Sources and Fuels

**Description:** This lesson will help make the students aware of different energy sources and fuels. Although not all sources are listed, there are enough options for student to gain a comprehensive understanding of the various fuel sources.

**Time Frame:** One or two class periods for reading and answering questions and for completing two charts. Parts of the lesson can be assigned as homework and discussed in class more fully.

**Objective:** Recognize different energy sources. Associate everyday energy use with the original sources. Explain what makes a fuel source renewable or non-renewable. Students should be able to compare and contrast the pros and cons of various fuel sources. They should be encouraged to incorporate social, economic and environmental costs associated with the different fuels.

**Student Activity:** During this lesson, students answer questions and complete charts in the workbook.

**Materials:** Student workbook

**Instructional Activity:** Read section on fuel sources (pages 13-17 in student workbook). Lead class discussion using information provided in the student workbook and completed worksheets in this guide. Worksheets can be completed as a class, in pairs, or in small groups. If the worksheets are completed in pairs or groups, results can be compared as a class.

Many local governments have electric cars. Teachers can call their city manager's office and perhaps arrange to have one driven out to the school. Car dealerships also sell electric cars.

**Assessment:** Participation in discussion and completion of worksheets.

# Energy Questions

Assess what you have learned by answering the following questions:

1. Can you name five renewable energy sources?

Answers will vary. Geothermal, solar, wind, food, fuel cells, lighting, calories

2. Can you name three ways we produce electricity from renewable energy sources?

Answers will vary. Expect students to support choices with facts. Wind energy turns turbines to generate power; biomass fuels are heated to create ethanol or create gas through anaerobic digestion; solar creates heat that moves the electrons in the photovoltaic cell to create electricity; geothermal uses hot water to create steam to turn turbines.

3. Can you name three non-renewable energy sources?

Answers could include uranium, coal, gas, oil, and jet or diesel fuels.

4. Why do you think we use non-renewable fuel sources?

Students may need help with this question. Power plants that use renewable resources are more expensive to build than those that run on fossil fuels. Oil and gas are readily available. Cars with combustion engines run on gas. People make money selling oil and gas; if we use power from the sun, no one makes money on the raw energy source

5. What types of fuels are made from biomass?

Ethanol or Methane

6. What produces acid rain?

Burning fossil fuels

# Evaluating Fuel Sources

Below is a table you are to complete. On the left side, complete all the types of fuels and energy sources that you know about. Evaluate each fuel source against the criteria listed on the top. You can use a three-point scale with one being the worst and three the best. These answers are subjective. Teachers may find it useful to create the list of fuels first, then to allow students to choose “best and worst” in each area. After the best and worst have been determined, students can fill in those sources that fall in between. Students can add up the numbers for each fuel source to determine overall best and worst. The highest number is the best and the lowest is the worst.

Fuel Source Evaluation Table

	Pollution	Renewability	Current Availability	Health & Safety
Coal	1	1	2	1
Geothermal (Electricity)	3	3	2	3
Biomass (Electricity)	2	2	2	2
Fuel Cells	1	1	2	3
Calories (food)	2	2	1	2
Solar (Electricity)	3	3	2	3
Methane (Natural Gas or Biomass)	2	2	3	2
Ethanol	2	2	2	2
Gas	1	3	2	3
Uranium	1	3	1	1
Lightning	1	1	3	?

## Evaluating Transportation Modes

This table is similar to the first except the students should write down all the transportation modes they know. Evaluate each transportation mode with the same three-point scale. This assignment is also subjective. It may be useful to complete the chart by having students list the modes first. You may want them to include the energy source for the mode they are suggesting so it can be more fully analyzed. Then have the students select the best and worst modes (can be more than one) for the different categories. After the matrix is completed, you may want to have students add up values for each mode to help them rank from best to worst.

### Transportation Evaluation Table

	Speed	Convenience	Cost	Access	Pollution	Fuel Efficiency
Bus (Gas)	1 (many stops)	1 (Depends)	2	2 (depends)	2 (Better than car)	2 (Better than car)
Bus (Fuel Cell)	1 (many stops)	1 (Depends)	2	2 (depends)	3 (Much better than gas fueled bus)	3 (Great miles per gallon)
Car /Van pool (Gas)	2 (better than bus)	2	3	2	1 1/2 (Better than car, not as good as bus)	1 1/2 (Better than car, not as good as bus)
Bike	1	3	3	2 (many people can't afford a bike)	3	3
Commercial plane or jet.	3+	1 (have to drive to and park at airport)	1 (Planes and tickets are very expensive)	3 (many people can't afford)	2 (Use fossil fuel, but many people can ride in a plane)	2
Personal electric car (Solar self contained)	2 (Not as fast as combustion engine)	1	2 (many people can not afford)	2 (Becoming more available)	3- (Very little but still needs to use some fossil fuel as back up)	3
Subway (Electricity generated from coal)	2	2 (generally used by people in cities)	2	2- (Limited travel areas, not as good as a bus)	2 (Could be 3 if it used a clean renewable power source)	3 (very efficient if full of people, not as efficient if not full.)

# Sustainable Transportation

**Description:** This lesson is the “crowning achievement” of the module. The concepts covered in this lesson address the issues that the students’ project or research should address. The lesson requires students to bring together previous lessons and think critically about the many choices, benefits, and costs associated with sustainable transportation. In this lesson, students will be introduced to the definition of sustainable transportation

**Time Frame:** One class period

**Objectives:** Analyze, compare, and contrast the various options and characteristics of sustainable transportation. Understand the definition of sustainable transportation.

**Student Activity:** Students will complete two charts that analyze the options and characteristics of sustainable transportation.

**Materials:** Student workbook

**Instructional Activity:** Read pages 21-23 in the student workbook. Students should be encouraged to draw on the knowledge previously learned about transportation and creatively apply it to their perceptions of sustainable transportation. The teacher may find it useful to look at the completed worksheets on pages 16 and 17 in this guide to help the discussion or to develop a different approach to this final capstone lesson.

**Assessment:** Completion of worksheets and participation in class discussion

# Characteristics of Sustainable Transportation

Use the worksheet below to identify and explain six desirable characteristics of sustainable transportation. Answers will vary but should tie into the sustainable transportation definition.

Characteristic                      Why is it desirable?

Fast	So people will want to use it and can be used for many purposes, like emergencies or going to school and work. It should be faster than driving so people will be encouraged to use it.
Convenient	So people will be able to go when and where they want. Mass transit should be convenient to homes and business so people don't have walk long distances. Some people can't walk and sometimes the weather is bad.
Efficient	So it doesn't use too much fuel and uses some renewable fuel sources. This could also mean that the system is faster than a driving in traffic in a car.
Non-polluting and cares for the Earth	So we can have clean air to breathe and don't leave future generations with pollution, messy clean-ups or disposal problems.
Fair/ affordable	So people who need transportation will have access to it, and many people can afford to get where they need to go.
Safe for people and animals.	So people and employees don't get hurt using or working around the system or the fuel required to operate it. If it is a mass transit or high-speed system, it must have fences or barriers so animals and people don't get hurt or killed by the people carriers.

# Assessing Sustainable Transportation Options

List four sustainable transportation modes and determine several positive and negative attributes for each mode. Encourage students to think creatively and critically. They should specify both a mode and an energy source. Students need not list only systems they know. They should be encouraged to think of new transportation configurations. You may want to remind students of earlier discussions to support their thinking

Travel Mode

Positive Attributes

Negative Attributes

Mass transit underground system that runs only on renewable energy	Non-polluting, many people can ride them, very efficient, cheap. Once power plants are built, fuel will be cheap. It keeps many animals and people safe from being hit by the people carriers.	Generally not as fast and convenient as your own car. Technology is not yet widely available, renewable energy power plants are expensive to build. Doesn't provide emergency transportation. It is expensive to dig the tunnels for the people carriers.
Mass transit systems that run on a combination of renewable energy and fossil fuels.	We have the technology, many people can ride them, and they are efficient and relatively cheap—compared to owning your own car. Systems that run on both fossil and renewable fuel reduce dependence on fossil fuels.	Generally not as fast and convenient as your own car. Renewable energy power plants are expensive to build. Still some dependence on fossil fuels.
Commuter Air Planes	Very fast, could be less expensive than private planes, no traffic jams. Technology is available	Very expensive, most people couldn't afford to travel this way. Uses a lot of fossil fuel. Many airports are not big enough to support this.
Express Electric Overhead Tram System	Could be fun at first. Some people would like the views, does not contribute to traffic jams, could be faster than your own car. Might work well in certain kinds of small communities.	Might not look good if we had many of these. Trams might have to be small and hold only a few people so they wouldn't be that efficient. Wires might interfere with planes or birds.

# Transportation Jobs and Professions

**Description:** This lesson will help students learn about careers and professions in transportation that they may consider for themselves.

**Time Frame:** One class period with homework.

## Objectives:

- List and define transportation careers by their work tasks, educational requirements, rewards, challenges, and drawbacks.
- Write a paper in which you choose a transportation career and tell why you would make that choice for yourself based on the work tasks, educational requirements, rewards, challenges, and drawbacks of that career.

**Student Activity:** During class, students research and complete a matrix of the educational requirements, rewards, challenges, and drawbacks of selected transportation careers. Then students would write a paper in which they choose a transportation career and tell why they would choose that career based on the work tasks, educational requirements, rewards, challenges, and drawbacks.

**Materials:** Completed student workbook matrix of selected transportation careers. The following web sites are useful for students to conduct research on these careers:  
<http://www.careeroverview.com/transportation-careers.html> (some transportation careers)  
<http://bit.ly/1BCoGys> (some transportation careers and requirements)  
<http://www.fhwa.dot.gov/wit/page1.htm> (women in transportation story)  
<http://blackinventor.com/garrett-morgan/> (Garret Morgan story)

**Instructional Activity:** Begin class with discussion and questions that contribute to student understanding of transportation career possibilities.

- Ask students: What is a career?
- Define career: An occupation or profession requiring special training. It becomes a person's life's work.
- Ask students: What are your parents' careers?
- Respond to student answers by connecting some of their parents' professions with transportation. Almost all careers face transportation issues related to their work (E.g., firefighters drive large fire trucks through traffic to save lives. Nurses travel to and from hospitals at all hours of the day. Lawyers, judges, and legislators make decisions about whether transportation meets people's needs today without compromising the needs of future generations.

- Briefly review with students the transportation career possibilities from the web sites above, biographies, and other sources.
- Ask students: What transportation careers interest you? At your age, it would be very understandable not to know what you want to be, so you may be uncertain. Who is uncertain what career you want to pursue? Tell students they now have an opportunity to discover transportation career possibilities that will help them in their future work.
- Direct students to research transportation careers and professions from the web sites above and other sources, and direct them to choose a career about which they want to learn more. Assign students to make that choice based on the work tasks, educational requirements, rewards, challenges, and drawbacks of that career.
- Assign students to write a paper in which they choose a transportation career and tell why they would make that choice based on the work tasks, educational requirements, rewards, challenges, and drawbacks.

**Assessment:** Students could be evaluated on the career matrix of the work tasks, educational requirements, rewards, challenges, and drawbacks of selected transportation professions. Students also can be evaluated on the written career choice paper in which they choose a transportation profession and provide specific supporting details for their choice.

# Career Matrix

Research three transportation careers from web sites and other sources. For each career, write at least one work task, educational requirement, reward, challenge, and drawback of that career.

<b>Transportation Career</b>	<b>Work Tasks</b>	<b>Education</b>	<b>Rewards</b>	<b>Challenges</b>
Highway engineer	Plans highways and other roads	College degree with specialty in engineering. License. Continuing education to maintain skills.	Helps traffic move. Helps people get from one place to another. Can see things they've planned.	Must be exact with math and science. Mistakes can cause problems for many people.
Airline pilot	Controls and flies airplane	Extensive, specialized, technical flight school training and FAA licensing	Provides important service. Prestige. Good salaries	Responsible for people's lives during long travel with related fatigue

# Career Choice Paper

Write a paper in which you choose a transportation career and tell why you would make that choice for yourself based on the work tasks, educational requirements, rewards, challenges, and drawbacks of that career.

## Optional Lesson

### Social Activism

**Description:** This lesson will raise student awareness of how they can influence the way we use energy. They will write a letter to a newspaper, to a legislator, or to a business. Their letter will highlight a particular issue related to sustainable transportation (benefits of alternative energy sources, effects of air pollution, recommendations for policy changes, etc.). The letters should state the problem, discuss the effects, and offer a solution. Or perhaps the letters could praise a company or legislator for helping to control the negative effects of pollution. Tell how it will affect their generation.

**Time Frame:** One class period for writing letters. This lesson could be assigned as homework, perhaps with parent involvement. Discuss the student letters in class.

**Objective:** Help students recognize themselves as active citizens who are aware of and interested in the future. Students will support (through letters) organizations that use sustainable transportation or that share technology and information with other organizations or businesses.

**Student Activity:** During this lesson, students draft a letter.

**Materials:** Completed student workbook for reference, and newspaper articles, or other sources.

**Instructional Activity:** Discuss what an active citizen is and why it is important. Encourage students to revisit the completed workbook section on modes and make additional links with the new information. Students should be encouraged to use supporting facts that they have learned from prior lessons and the articles. Letters could be proofed or edited in groups or by the teacher.

**Assessment:** Can be class discussion and/or completion of letter. Students could be graded on their use of supporting facts that they have learned from prior lessons, articles, and class or group discussion.

## Optional Lesson

# Real-World Problem Solving

**Description:** This is a critical reading assignment. The class should find two news articles. The first article should look at some kind of transportation legislation or policy, and the second should look at the reactions of people who must live with the legislation in their community. This could involve high-speed rail, carpool lanes, new highway tolls, bicycle lanes, a new freeway that may remove some homes, etc. Look for things that will affect your own local community so the students can think about how the outcome will affect their lives.

**Time Frame:** One to two class periods, or combination of homework and class time.

**Objective:** Students are to read the articles and determine the main issues on each side of the argument. Students should explain and justify why the legislation or policy is or is not necessary and how the outcome will affect the community or certain neighborhoods. What are the advantages and disadvantages to certain communities or groups of people? Is anyone on either side being unreasonable? What would happen if the legislation or policy did not pass? Is it more important to bring benefits to a large number of people, or to make sure that a smaller number of people are not inconvenienced?

**Student Activity:** After students have finished discussing the articles, they are to write letters. Let them decide to whom they wish to mail the letter (for example: the newspaper; local, state or federal legislators; the president; Department of Energy, etc.). Encourage students to use information they have learned from previous lessons and to propose solutions in their letters based on that new insight.

**Materials:** Student Workbook and copies of articles from newspapers or magazines.

**Instructional Activity:** The articles can either be read aloud in class or assigned as homework. Articles and letters could be discussed in class. Students can write a single letter as a class, divide into groups, or write the letters individually. Letters could be proofed and edited in groups or by the teacher.

**Assessment:** Class discussion, completed letter, and/or student presentation of his/her letter to classmates.

# The Competition

It is not necessary to create a project based exclusively on material in this workbook. These exercises simply provide insight into transportation, energy sources, environmental effects, career choices, etc. Your project should incorporate any aspect of sustainable transportation, but you can be as creative as you like.

For transcripts of previous competitions, along with their project descriptions, go to [www.transweb.sjsu.edu](http://www.transweb.sjsu.edu). Click on “Education” and then on “Garrett Morgan Program.” Scroll down to the PDF links. These transcripts will show what other competition teams have done, and they may give you good ideas for your own project.

Each classroom team that completes a project may enter that project into the competition. Up to two teams per school are permitted. If a large number of teams participate, we may ask the teacher to make the first judging and then send the best entry to the competition. A written description of the project entries must be mailed to:

Director of Communications  
Mineta Transportation Institute  
210 North Fourth Street  
Fourth Floor  
San Jose, California 95112

Project descriptions must be received at the Mineta Transportation Institute (MTI) by 5pm Friday, February 6, 2015 or postmarked by midnight on that date. Include photographs that show the display and/or prototype, if you wish.

The video conference for the top entries will take place around mid-March 2015, the exact date depending on the schedule for US Secretary of Transportation, who will attend the meeting. We also avoid spring break or state testing dates for each school. We likely will not have a firm date until early February 2015 because the Secretary’s office must plan room for Cabinet meetings and official travel. Winners will be notified within a week following the competition.

MTI will provide transportation and up to two nights’ lodging for the Awards Banquet on Saturday, June 20, 2015 for the first place student team leader, the team teacher, and one parent or guardian. If desired, a teacher and two students may attend instead.

The winning team will receive \$500 for its classroom, plus an additional \$500 generously contributed by two of MTI’s Trustees, Nuria Fernandez and Will Kempton. Second-place team will receive \$300, and third-place team will receive \$200. Top three teams also will receive a plaque. All participating students will receive a certificate. The decision of the judges is final.

# Types of Projects

By completing a team project, you can apply what you have learned in this unit and use your imagination to develop innovative sustainable transportation solutions. Each team can include up to five students in your class.

Your project should be based on a vehicle and/or a system of transportation or an idea for solving part(s) of the sustainable transportation problem. Below are some suggestions, but you may think of others. For ideas, go to the Garrett Morgan page on the MTI web site and download the transcripts from previous competitions: Go to [www.transweb.sjsu.edu](http://www.transweb.sjsu.edu). Click on “Education” and then “Garrett Morgan Program.” Scroll down to the PDF links.

## Science & Technology

**Project.** Develop your own transportation system or mode. This can be a new car, a better bus, or a transportation plan for an entire city or one just for friends. You can describe your idea in writing and with pictures, drawings, graphs, and/or models. In the past, many teams have created vehicles that use solar or wind power. We encourage you to think beyond these types of fuel and come up with something new. Imagination counts!

## Social Science

**Legislation.** If you were mayor, governor, or president, what laws do you think would help make better transportation systems? Write some local, state, or federal legislation that will promote sustainable transportation. After you write the legislation, explain why it will be beneficial. What problems still remain to be solved? Use slides, graphs, or other visual aids.

**Research Study.** Document current sustainable transportation practices in your community. The project can include any transportation mode, method, or anything that encourages sustainable transportation where you live. Are those practices successful? How can they be improved? What problems are still not being addressed? What particular groups of people are not being served? How would you serve them better?



## Project Format

**Legislation Requirements:** Papers proposing new legislation must be at least five double-spaced pages. You may include pictures, charts, graphs and references to make the paper no more than ten pages. Be prepared to present your paper with PowerPoint slides or models.

**Display Requirements:** If you wish to make a project display, your description and graphics must be mounted on a self-standing poster board. You can build a model to enhance your illustrations. Be sure the model is large enough to be clearly visible on a video conference screen.

**Video Requirements:** You may create a video up to two minutes to support your project. This could be an advertisement, a demonstration, examples of current technology, etc.

**PowerPoint Requirements:** PowerPoints are popular for these projects. Be sure your text is clear. Do not crowd too many words on a slide. Use no more than ten slides.

**Time Limit:** Your project presentation must be 8-10 minutes.

## Judging Criteria

The competition will have 3-4 impartial judges who will have no personal interest in the outcome. They will award a maximum of 130 points (plus extra credit on the Q&A) based on several criteria, including:

- Is the presentation, PowerPoint, or paper clearly done?
- Is the project sustainable and will it be positive for the environment?
- Do the students speak clearly and knowledgeably?
- Do the students ask and answer questions intelligently?
- Does the team work well together and are they prepared?

## Hints

- Judges like presentations that are enthusiastic and clear.
- Practice several times! Judges can tell when you haven't practiced.
- Have other students challenge your idea so you can learn how to defend it.
- Speak clearly and slowly. The judges want to hear you.
- Have fun. Everyone is really interested in your project!

# Videoconference

After the projects are completed, you should select a team to present its project during the videoconference. **Your team will receive extra points for asking and answering questions of the other competing teams. The team also will be able to ask questions of the Secretary of Transportation and other transportation leaders.** Here is a form that you can photocopy. Take several copies to the broadcast. As each team makes its presentation, your students should write down the questions they want to ask.

Videoconference Questions
<b>Question for which team?</b>
_____
_____
<b>What is your question?</b>
_____
_____
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_____
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