CHAPTER 1

INTRODUCTION TO TRANSPORTATION AND THE ENVIRONMENT

ESSENTIAL QUESTIONS

▲ **What forms of transportation do people use most in this community?**

▲ **How do different forms of transportation effect us and the world around us?**

OBJECTIVES

The students will:

- Collect and record transportation data from daily experience.
- Analyze and compare personal transportation habits to those of the class.
- Classify components of a technological system in this case a transportation system.
- Compare environmental costs and benefits of various forms of transportation.

ACTIVITIES

PERSONAL TRANSPORTATION LOG

Time: Homework, minimum 1 hour over 3-4 days, ideally spanning 1 week. Personal transportation log analysis, 30 minutes in-class.

TRANSPORTATION SYSTEMS

Time: 45 minutes in-class.

STUDENT PREREQUISITES

- An understanding of percentages. Or this lesson can be used to reinforce a lesson on percentages.
- An understanding of energy and work.

STANDARDS

Technology: Understand a technological system.

Geography: Recognize consequences of technological advances on the environment.

Mathematics: Collect data; construct, read charts, practical application of percentages.

Language Arts: Group discussion, research.

History: Recognize the importance of individual choices and actions.

TEACHING NOTES

Few of us think about how we transport ourselves from one place to another, but the choices we make have definite impacts upon our society and the environment.

- In this lesson students will focus their attention on their own transportation choices and patterns by keeping a Personal Transportation Log.
- By doing simple calculations and by constructing a class chart, the students will be able to make comparisons between their own transportation habits and those of the class.
- Students will begin to consider the social and environmental costs and benefits associated with different modes of travel.
- This information will serve as the basis for later lessons, during which the exploration of transportation issues continues.
- Students will be evaluated on individual, small group, and whole class work by completing Personal Transportation Logs, worksheets, and by participation in class discussions.

BACKGROUND INFORMATION

Transportation is the process of moving people and products from one place to another. Where once human beings could get from point A to point B only by walking, we can now choose from many options. We even transport ourselves for recreation and exercise.

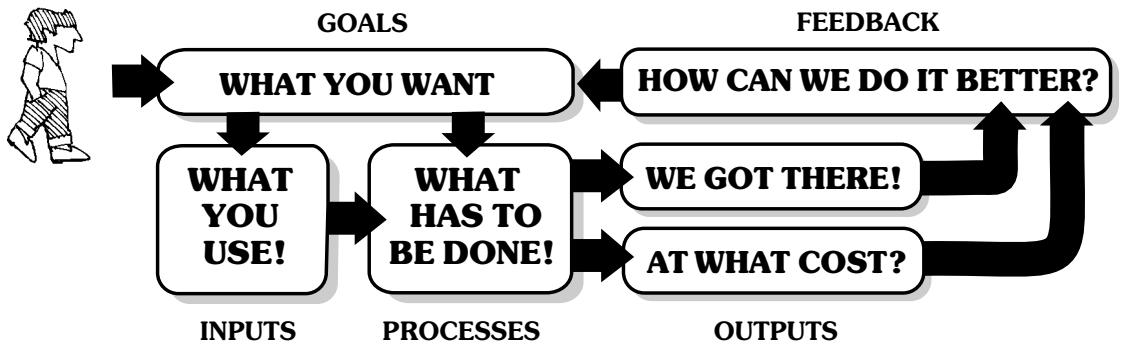
Moving things from here to there can be thought of as a transportation system. **A system includes: a goal, input, process, output and feedback.** The simplest transportation system is the act of walking to a destination – say to a river to get a drink of water. In this case the **goal** is to move oneself to the river. The **input** needed to do this includes a living body supplied with adequate food, water, and oxygen along with knowledge of how to get to the river. In this case the transportation **process** is to convert the food, water and oxygen into the energy needed to get to the river and then decide on what route to take and walk. The **output** is getting to the river, along with sweat, heat, and exhaled carbon dioxide and other gases. In this case let's imagine that our person chose to hike over a hill to get to the river. The **feedback** may be that the hill was too steep and that, in the future, this person will decide to take a path around the hill to get to the river. The transportation system is redesigned to meet a revised goal – to move oneself to the river using less effort.

Many aspects of today's transportation systems are actually outputs from other complex systems. Gasoline comes from oil that must be extracted, transported to refineries, and processed. This system itself relies on political, economic, and military systems that ensure companies maintain access to foreign oil. The refined gasoline must then be transported to local gas stations. Vehicles also need to be manufactured. To manufacture them, minerals need to be extracted from the earth and processed into useable forms. The finished vehicles need to be transported from one location to another. Consider too, the infrastructure necessary, (bridges, roads, railways etc.), creative processes of designing vehicles to carry people and goods, marketing schemes, road systems, and traffic rules for organization and safety.

As you can see, identifying all the components of a technology system can be challenging and confusing. The important point is for students to begin to see the larger picture of the pieces that need to be in place for a technology system to work, in this case a transportation system. **Use the following examples to help students understand parameters for defining a transportation technology system with regard to goals, input, process, output, and feedback.**

GOALS: A primary goal of any transportation system is to move products and people from point A to point B. Today, we can add recreation as another goal for some transportation systems. Less obvious, but just as important, goals of transportation systems are that they be low cost, get us to our destinations on-schedule and in a timely fashion, be safe, and be comfortable. Increasingly, many people would also like our transportation systems to be as close to pollution-free as possible and be independent of foreign-controlled resources, such as Middle East oil.

INPUTS: Gasoline, cars, minivans, roads, bridges, and drivers are all inputs into the United State's most popular transportation system – get-



ting around in family vehicles. Each of these inputs relies on additional complex systems such as: 1) mining metals and processing petroleum, 2) designing, manufacturing and transporting gasoline, cars, and trucks, 3) designing and building roads and bridges, and 4) staffing teachers, police, and the court system to train and monitor drivers for a safe transportation system. We can also add automotive repair, financial, insurance, and medical systems needed to maintain both cars and drivers.

PROCESSES: Converting fuel into motion is the most basic process of any transportation system. But other processes are important to maintain a safe, low cost, low pollution, timely transportation system. Safely driving the family car depends on systems that enforce traffic rules, educate drivers, and maintain roadways. Financial systems are needed to finance the purchase of new cars. Emissions regulations are needed to prevent too much pollution.

OUTPUTS: Moving products or people from one place to another are the central output of any transportation system. But many systems have unwanted outputs as well. Pollution, time spent stuck in traffic, spending money on insurance, fuel and car maintenance are a few examples.

FEEDBACK: How well is your transportation system working? Do you get to school on time or are you often stuck in traffic? Is your old car or bicycle still comfortable and safe? Do you spend too much money on insurance and car maintenance? Are there alternative transportation systems, or can you modify your current system in order to provide yourself with more of the desired outputs and less of the unwanted ones? Feedback enables you to evaluate the system and modify your goals.

Today, people travel much more than in the past. Whether by rockets or rollerblades, energy of one form or another is required, and these different forms of energy affect our environment in different ways. As this unit progresses, **students will become aware of the ways they move themselves around, what forms of energy they use, and the impact of their transportation choices on the environment.** Students will learn that the burning of fossil fuels plays a major role in polluting our air and changing the world's climate. **They should also realize that there are alternatives that are better for the environment.**

Forms of travel relying on human power have a relatively minimal impact on the environment. The energy required comes from the food the travellers eat. Because more food can be grown on the same land, food is a renewable energy source. In contrast, fossil fuels are not renewable in that it took millions of years to create them.

The invention of the automobile has had an enormous impact on the world. Although it offers amazing individual freedom, it has costs. ***Consider:***

- **Mining and manufacturing**
- **Changing our communities:** urban sprawl, suburbia, paving significant amounts of land, families spread far and wide; less contact with neighbors.
- **Pollution:** air (emissions); water (run-off, oil leaks, and spills); land (mining, landfills); noise; global climate change
- **Health and safety:** pollution; accidents (high death rate); road rage.

Any form of transportation that relies on fossil fuels contributes to many of these problems, but vanpools, buses, and trains are generally far more efficient and less polluting.

It is also possible to build vehicles that don't use fossil fuels, but instead use cleaner fuels, such as alcohol and methane, or even wind and sun. Electric vehicles are a growing reality and, even when plugged in to today's fossil fuel powered electric grid, they produce roughly half the pollution of a comparable internal combustion engine vehicle. Also, the pollution is shifted from cities, people, and roadsides to the power plant. If the power plant relies on renewable energy sources such as sun, wind, hydro, or geothermal, then emissions for the entire system are reduced much more dramatically.

ACTIVITY 1.A

PERSONAL TRANSPORTATION LOG

OUTCOMES

Students should be able to:

- Describe the different modes of transportation used in their community.
- Identify the types of transportation they personally use and compare this to the community at large.

TIME REQUIRED

- Homework, minimum 1 hour over 3-4 days, ideally spanning 1 week.
- Personal transportation log analysis, 30 minutes in-class.

MATERIALS

- Worksheets and Log for each student.
- Local map with mileage scale.
- String to measure mileage.

TEACHER PREPARATION

Assemble materials.

Establish small groups.

Prepare class chart 1.

ACTIVITY OVERVIEW

Students will come to understand their own transportation choices and patterns by keeping a Personal Transportation Log. By analyzing their own and their classmates' transportation habits, students will begin to realize how their behavior compares to that of others in their community. This information will serve as the basis for later lessons during which the exploration of transportation issues continues.

ACTIVITY

Discuss with the class,

"What are some ways you use to move yourselves from place to place?" (Cars, bikes, rollerblades, walking, school buses...etc.). These are all "modes" of transportation.

"Which mode do you use most often?" Have the students make predictions after considering all modes available to them. What percentages of their transportation needs do car, bicycle, and walking, etc. meet? For example: (30% car, 30% school bus, 15% walking, 25% bicycling).

For homework, ask students to collect data regarding their own transportation habits. Pass out and review the **Personal Transportation Log** so students are clear about what is expected. This assignment might extend over a weekend or cover an entire week. Try to include at least one school day.

To complete the log the students will need to include: the date, purpose of the trip, where they started and finished that particular trip, and the number of miles traveled. They may use a local map with a scale, and string, to help them make that estimate. This information will be used during the first lesson. Students will also refer back to this log in later lessons.

Transportation Log Review Questions:

Once students have completed their Personal Transportation Logs, discuss with them:

- What did you notice, realize, have trouble with?
- What modes of travel did you use? (Make a list of all modes).
- What were the modes you used most? The least?
- Do you think your data reflects a typical weekend/week of travel?
- How accurate were your predictions?

PERSONAL TRANSPORTATION LOG ANALYSIS

Hand out the Personal Transportation Log Analysis worksheet. Using this to guide them, have students calculate their number of miles traveled per mode, and the percentages of each.

Meanwhile, make a large class chart of all modes of travel mentioned above. *See sample chart below.* Have students work in small groups to pool their numbers before recording them on the class chart. After the chart is complete, have each group calculate class totals per mode of travel, and the percentages of each mode. Finally have each student group construct a bar graph indicating the relative use of the different modes. Have student groups share results. The students should be able to see identical results.

TEACHER LED DISCUSSION

Go over the review questions once more, but this time, ask students to focus on the class chart they just created. You may also want to ask:

Are there other modes used but not mentioned? Think of other times of the year.

Do you think the class percentages represent the percentages of an average American? Why or why not?

While discussing the results of the class's transportation logs, introduce the concept of transportation systems (technology systems). Introduce background information that will help them complete the **Technology Systems Worksheet**.

SAMPLE CLASS CHART

TRAVEL MODE	CAR WITH ONE PASSENGER AND ONE DRIVER	BICYCLE	WALK/RUN	CAR WITH MORE THAN ONE PASSENGER	BUS
NUMBER OF MILES TRAVELED BY EACH STUDENT GROUP					
TOTAL MILES TRAVELED					
PERCENTAGE OF ALL MILES TRAVELED					

STUDENT WORKSHEET 1.1

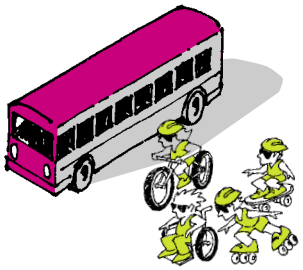
Personal Transportation Log

Sheet # _____ Name: _____

Use this chart to record all of the trips you take transporting yourself from one place to another. You will use this information in class.

DATE	PURPOSE OF TRIP	DESTINATION	DISTANCE	MODE OF TRAVEL (If by car, include number of passengers in car)
		TO: FROM:		
		TO: FROM:		
		TO: FROM:		
		TO: FROM:		
		TO: FROM:		
		TO: FROM:		

Personal Transportation Log Analysis



Name: _____

1. LIST ALL TRAVEL MODES YOU USED.
2. TOTAL THE NUMBER OF MILES TRAVELED FOR EACH MODE.
3. TOTAL ALL THE MILES TRAVELED.
4. DETERMINE THE PERCENTAGE OF TOTAL MILES FOR EACH MODE.

1. MODE OF TRAVEL	2. TOTAL # MILES PER MODE	4. PERCENTAGE OF TOTAL MILES TRAVELED

3. _____ TOTAL # MILES TRAVELED. 100%

CLASS STATISTICS

1. MODE OF TRAVEL	2. NUMBER OF CLASS MILES PER MODE	4. PERCENTAGE OF TOTAL MILES TRAVELED

3. _____ TOTAL # MILES TRAVELED. 100%

ACTIVITY 1.B

TRANSPORTATION SYSTEMS

OUTCOMES

Students should be able to:

- Describe how all transportation modes are part of transportation *systems*.
- Compare transportation modes in terms of the amount of energy, materials, pathways, and safety mechanisms they each require.
- Identify unwanted side effects of various transportation modes.
- Select transportation modes so as to reduce unwanted side effects.

TIME REQUIRED

- 60 minute discussion and worksheet. The "feedback" section makes a good homework assignment.

MATERIALS

- Completed Personal Transportation Logs (Activity #1 Homework)
- Technology Systems Worksheet (one per student)
- Calculators (optional)

TEACHER PREPARATION

Read the teacher background information.

Assemble materials.

ACTIVITY OVERVIEW

Students will come to understand how each mode of transportation they use relies on a broad array of pathways, fuels, materials, and safety measures. By comparing various modes of transportation, they will realize that each mode has desirable and undesirable side effects. By examining these side effects, they will be able to identify transportation modes that can get them where they want to go with fewer undesirable side effects.

ACTIVITY

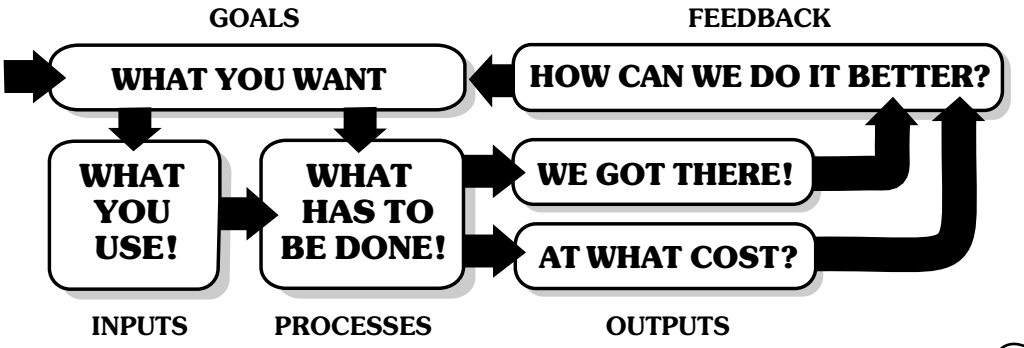
Hand out the student Transportation System Information Sheet. As a class discuss the meaning of "goal," "input," "process," "output," and "feedback" as they relate to transportation systems. Provide examples from the teacher background information, such as inputs needed for various transportation modes. Discuss energy sources, materials needed to build vehicles and pathways, and the systems we have in place to ensure human safety. Give examples of processes used to convert energy into motion. Discuss briefly what goals we may have for our transportation systems and some of the unwanted side effects that these systems produce. Have students complete the worksheets in small working groups.

Hand out the Technology Systems Worksheet. In small working groups, have students complete two worksheets, one for each of two modes of travel. The "feedback" section makes a good homework assignment.

Suggested Review Questions:

- What are the outputs (costs and benefits) of different travel modes? Different fuels?
- How have different transportation modes affected our lives, community, and environment?
- Since the car was invented what are some ways auto manufacturers have changed cars to (1) reduce things we don't like about them and (2) increase things we do like about them.
- How do you think people will transport themselves in 50, 100, and 1000 years?

Transportation System Information



WHAT YOU WANT

GOALS: What you want to get out of using a transportation system.

A primary goal of any transportation system is to move products and people from point A to point B. Today, another common goal is recreation. Less obvious goals are to be low cost, safe, comfortable, and to get us places promptly and on-schedule. Many people also want systems to be as pollution-free as possible and be independent of foreign-controlled resources, such as Middle East oil.

WHAT YOU USE!

Inputs: The materials and people needed to make a transportation system work.

Gasoline, cars, minivans, sport utility vehicles, roads, bridges, and drivers are all inputs to the most popular transportation system in the United States – getting around in family vehicles. Each of these inputs rely on additional complex systems such as: 1) mining metals and processing petroleum, 2) designing, manufacturing and transporting gasoline, cars, and trucks, 3) designing and building roads and bridges, and 4) staffing teachers, police, and the court system to train and monitor drivers for a safe transportation system. We can also add automotive repair, financial, insurance, and medical systems needed to maintain both cars and drivers.

WHAT HAS TO BE DONE!

Processes: Actions that are needed to make a transportation system work.

Converting fuel into motion is the most basic process of any transportation system. But other processes are important to maintain a safe, low cost, low pollution, timely transportation system. Safely driving the family car depends on enforced traffic rules, educated drivers, and maintained roadways. We need financial systems to help purchase new cars and emission regulations to prevent pollution.

WE GOT THERE!

AT WHAT COST?

Outputs: The results, whether intended or not, of using a transportation system.

Moving products or people from one place to another is the most basic output of any transportation system. But many systems have unwanted outputs as well. Pollution, time spent stuck in traffic, money spent on insurance, and car maintenance are a few examples.

HOW CAN WE DO IT BETTER?

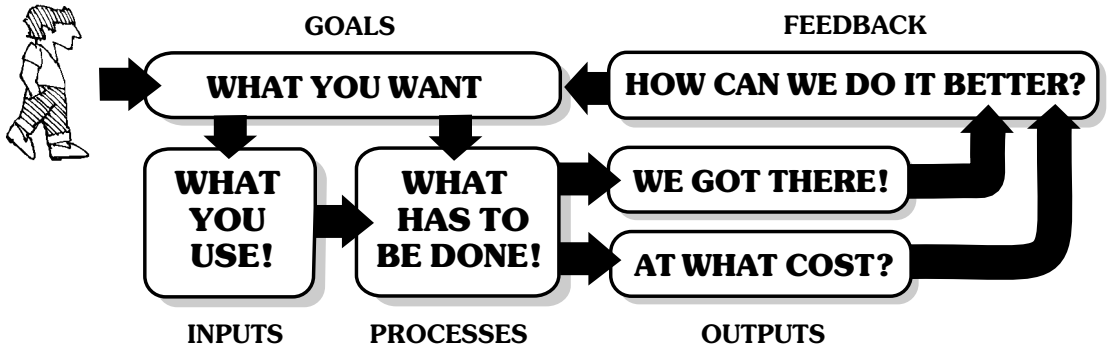
Feedback: Deciding how to adjust how you get around or choosing a new way so you are more pleased with the outputs.

How well is your transportation system working? Do you get to school on time? Are you often stuck in traffic? Do you dislike the pollution emitted by cars? Are there other transportation systems, or can you modify your current system in order to provide more desired outputs and less unwanted ones? Feedback enables you to evaluate and adjust your goals.

Technology Systems Worksheet

Name: _____

Look back at your Personal Transportation Log. Complete one worksheet for each of two trips. Use a different travel mode for each trip.



TRANSPORTATION MODE _____

1. GOALS: Circle all that apply.

Moving People Moving Objects Recreation Other _____

2. INPUTS: Briefly describe those that apply. What is needed for this transportation mode? Briefly describe where each input comes from.

Energy/Fuel: _____

_____

Goods/Materials: _____

_____

Pathways: _____

_____

Safety Measures: _____

_____

3.PROCESSES: What needs to happen for transportation to take place?

_____

_____

_____

Technology Systems Worksheet, page 2

4. OUTPUTS: List what happened, intended and unintended, as a result of the process?

Things you wanted to happen: _____

_____

_____

_____

Things you wish didn't happen: _____

_____

_____

_____

5. FEEDBACK: For this trip, consider other travel modes you could you have used to get where you wanted to go. Name one other mode that could have gotten you where you wanted to go without some of the unwanted side effects you listed under #4 above? Briefly describe this alternative technology system.

Revised goal: _____

Alternative travel mode: _____

Inputs needed: _____

_____

_____

_____

Processes to be used: _____

_____

_____

_____

Outputs (intended and unintended, as a result of the process): _____

_____

_____

_____

_____