LESSON PLAN

Introduction to Transportation

Objectives:

Students will collect and record transportation data from daily experiences, analyze and compare personal transportation habits with those of their classmates, classify components of a technological system—in this case a transportation system—and compare environmental costs and benefits of various forms of transportation.

Prerequisites:

For homework, ask students to collect data about their own transportation habits. Review the Personal Transportation Log found on page 6 so students understand what information to record. This assignment may 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 trip.
- the number of miles traveled.(may use a local map with a scale, and string, to help them make an estimate.

This information will be used during the first lesson. Students will also refer to this log in later lessons.

Duration:

45-minute class (could extend to a second day)

Materials:

- Worksheets and Personal Transportation Log templates for each student.
- Local map with mileage scale.
- String to measure mileage.
- Transportation Systems handout (one per student).
- Calculators (optional).

Introduction:

TEACHER BACKGROUND

Transportation is the process of moving people and products from one place to another. Moving things from here to there can be thought of as a transportation system. A system includes a goal, input, processes, output, and feedback. The simplest transportation system is the act of walking to a destination— for example, 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 example, the transportation process is to convert the food, water, and oxygen into the energy needed to get to the river, then decide what route to take and walk. The output is getting to the river, along with sweat, heat, and exhaled carbon dioxide and other gases. The transportation system can be redesigned to meet a revised goal—to move oneself to the river using less effort. See for a visual representation of the process.

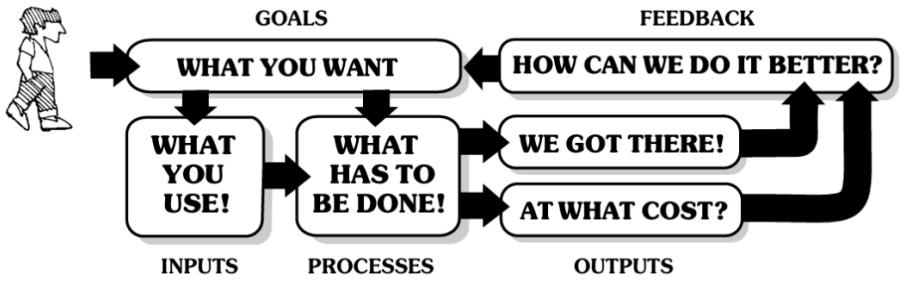


Figure 1

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 seeing 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 the components of a transportation technology system:

- **GOALS:** A primary goal of any transportation system is to move products and people from point A to point B. Today, recreation can also be considered a goal for some transportation systems. Less obvious, but just as important, are goals such as keeping costs low, getting people to their destinations on time, ensuring safety, and providing comfort. Increasingly, many people want transportation systems to be as close to pollution-free as possible.
- **INPUTS:** Gasoline, cars, minivans, roads, bridges, and drivers are all inputs. 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) supporting teachers, police, and the court system to train and monitor drivers for a safe transportation system. Automotive repair, financial, insurance, and medical systems are also needed to support both vehicles 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, and timely transportation system. Safely driving the family car depends on systems that enforce traffic rules, educate drivers, and maintain roadways.
- **OUTPUTS:** Moving products or people from one place to another is the primary output of any transportation system. However, many transportation systems have unwanted outputs as well. Pollution, time spent stuck in traffic, and the costs of insurance, fuel, and vehicle maintenance are a few examples.
- **FEEDBACK:** How well is your transportation system working? Do you get to your destination on time or are you often stuck in traffic? Is your car or bicycle still comfortable and safe? Are there alternative transportation systems, or can you modify your current system to achieve 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. Energy of one form or another is required, and these different forms of energy affect our environment in different ways. Students will become aware of how they travel, what forms of energy they use, and the impact their transportation choices have on the environment. Students will learn that the burning of fossil fuels plays a role in polluting our air and changing the world's climate. They should also recognize that there are alternatives that are better for the environment.

Forms of travel that rely on human power have a relatively small impact on the environment. The energy required comes from food travelers eat. Because more food can be grown on the same land, food is a renewable energy source. In contrast, fossil fuels are not renewable because they take millions of years to form. Any mode of transportation that relies on fossil fuels contributes to problems including pollution, and health and safety concerns. 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 energy sources such as wind and solar power. Electric vehicles are a growing reality and, even when connected to today's fossil fuel-powered electric grid, they produce roughly half the pollution of a comparable internal combustion engine vehicle. Additionally, the pollution they produce is shifted from cities, people, and roadsides to the power plant. If the power plant relies on renewable energy sources such as solar, wind, hydroelectric, or geothermal energy, emissions from the entire system are reduced much more dramatically.

LESSON INTRODUCTION

Discuss with the class, "What are some ways you use to move yourselves from place to place?" (Cars, bikes, rollerblades, walking, school buses...etc.). Explain these are all modes of transportation. Introduce the Modes of Transportation anchor chart (**Figure 2)** and explain that modes of transportation can travel by air, land, and water.

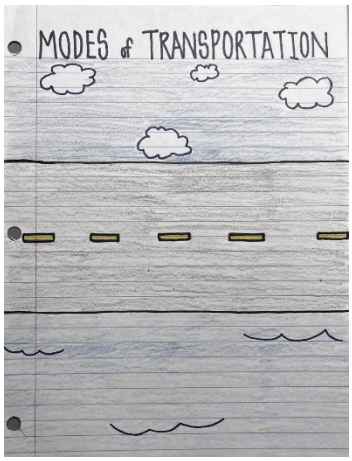


Figure 2

Ask "Which mode do you use most often?" Have students respond and, if needed, refer to the Personal Transportation Log they received at least one week before this lesson.

After students consider all modes available to them, ask, "What percentage of your transportation needs are met by each mode of transportation?" (For example: 30% cars, 30% school bus, 15% walking, 25% bicycling).

Using the Personal Transportation Logs, discuss the following questions

- What modes of travel did you use? (Add each response to the anchor chart.)
- What were the modes you used most? The least?
- Do you think your data reflects a typical weekend/week of travel?

Hand out the Personal Transportation Log Analysis worksheet. Have students calculate the number of miles they traveled per mode, and the percentage for each. Meanwhile, make a large class chart (**Figure 3**) of all modes of travel mentioned above.

Have students work in small groups to combine their numbers before recording them on the class chart. After the chart is complete, each group should calculate class totals per mode of travel, and the percentage for each mode. Finally, each student group should construct a bar graph indicating the relative use of the different modes. Have each group share its results. The students should arrive at identical results.

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					

Figure 3

Now, looking over the class chart that students filled out, go over the previous questions once more. 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?

Tell students they will use this information to think about alternative modes of transportation. Provide examples from the Teacher Background section, such as the 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. Briefly discuss the goals of transportation systems and some of the unwanted side effects they produce.

Have students complete the worksheets in small groups. Hand out the Transportation Systems handout. Have each small group complete two worksheets, one for each of two modes of travel.

The “feedback” section makes a good homework assignment.

Suggested review questions:

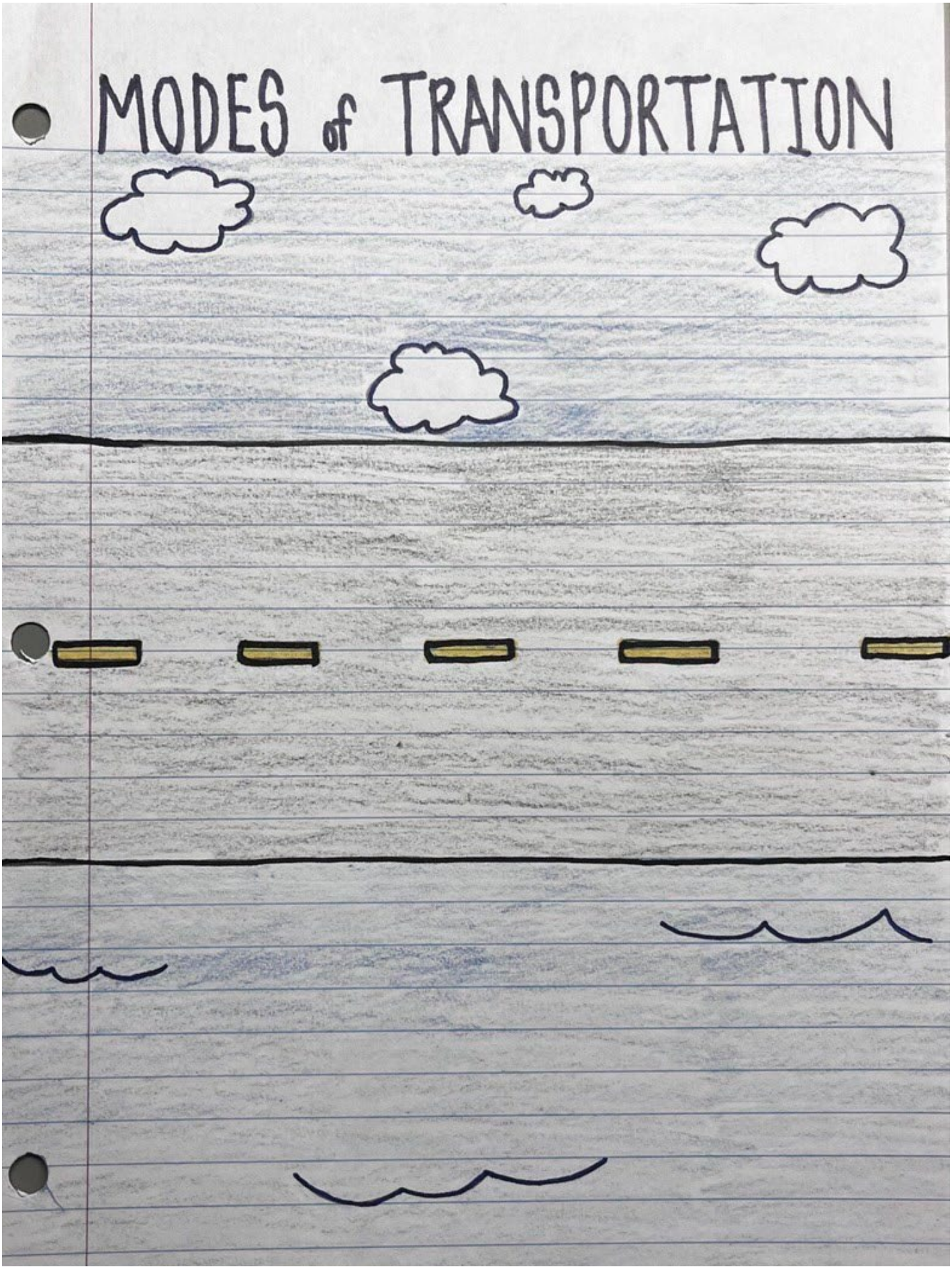
- What are the outputs (costs and benefits) of different modes of transportation?
- What different fuels do they use?
- How have different modes of transportation affected our lives, communities, and environment?
- Since the car was invented, what are some ways auto manufacturers have changed cars to:
    - reduce things we don’t like about them?
    - increase things we do like about them?
- How do you think people will travel in 50, 100, and 1,000 years?

Glossary

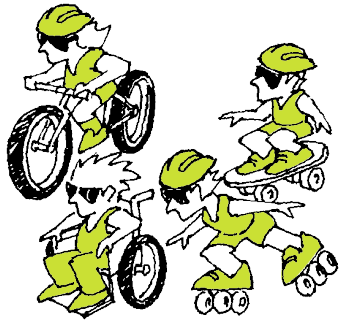
- **Goals** – Something to achieve or work toward.
- **Inputs** – The raw materials, data, or energy that go into a system so it can do its job.
- **Processes** – The steps taken to achieve a goal.
- **Outputs** – Products created or produced through the process of achieving a goal.
- **Feedback** – Information sent back to the system's control center about how it is performing.

Applicable TEKS

6th Grade - Section 112.16.b.6.11A
8th Grade - Section 112.16.b.8.11A,B


MODES of TRANSPORTATION

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%