STEM Careers Coalition™

CLASSROOM ACTIVITY

Farm to Table

OBJECTIVE

Students will be able to:

- **Compare and contrast** the efficiency of freight transportation for ships, trucks, trains, and airplanes.
- **Assess** how the freight transportation choices differ regarding speed, cost, and environmental impact.

OVERVIEW

In this activity, students will discover that petroleum is a part of their diet, directly and indirectly. Students will examine food labels to determine where each food was produced. Working in small groups, they will measure the distance on a map, calculate the amount of time and fuel it takes to get the food from where it was produced to their school. They will evaluate the data they collect and determine the most effective transportation option. They will summarize their findings by drawing a transportation map for each food item from place of production to their school.

NATIONAL STANDARDS

Next Generation Science Standards

- MS-PS1-3 Structures & Properties of Matter
  Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

ITEA/ITEEA Standards for Technological Literacy

- Standard 2. Students will develop an understanding of the core concepts of technology.
  S. Trade-off is a decision process recognizing the need for careful compromises among competing factors.
- Standard 5. Students will develop an understanding of the effects of technology on the environment.
  F. Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another.
- Standard 6. Students will develop an understanding of the role of society in the development and use of technology.
  G. Meeting societal expectations is the driving force behind the acceptance and use of products and systems.
- Standard 18. Students will develop an understanding of and be able to select and use transportation technologies.
  F. Transporting people and goods involves a combination of individuals and vehicles.

BACKGROUND

Freight transportation is the commercial transport of goods. Most of the food we purchase is grown in rural areas and transported to urban areas where it is manufactured into products we consume every day. The production and movement of food reflects an increasingly interconnected world of business to meet social needs and expectations. Rail, truck, ship, and air are the four main means of transporting cargo in the industrialized world. Each method has its benefits and drawbacks. Current infrastructure, time, and cost of fuel are all variables that contribute to the mode of transportation selected. Freight shipment is typically calculated by the ton; therefore, this activity focuses on shipping tons of food products.

KEY VOCABULARY

- Freight transportation
- Fuel efficiency
- Infrastructure

MATERIALS

- Online mapping tools such as Google or Yahoo to calculate distance and the Free Map Tools website, which can be particularly helpful if determining any overseas distances http://www.freemaptools.com/measuredistance.htm
    - A variety of food labels
    - Student Handout—*Transportation of Food to Table*

TEACHER PREPARATION

- Copies of *Transportation of Food to Table* handout for each student

PROCEDURE

1. To introduce the lesson, ask students to generate a list of all the foods they ate in the last 24 hours. Invite students to share some of the items they wrote on their lists. Ask students if they know where their foods were produced. Many of them will not know how to answer this question with certainty.
2. Explain to students that they will work with a partner to complete the activity. One student will act as the environmental, health, and safety worker and the other will act as the project manager in petroleum. Have them read the description of each career and what their responsibilities will be throughout the activity. Each partner will select a role based on their personal strengths.
3. Invite the students to select one food label each. These labels will serve as the food they will be using to complete the activity. Ask students to examine the labels to determine where each food was produced. Have students label these cities on the map found on their *Transportation of Food to Table* handout. Students may need to use an internet resource (Google maps) to locate and label the cities on their map.
4. Ask students to determine the distance (in miles) between the cities they marked on their map and their school using an internet resource (Google maps).
5. Have students brainstorm at least 3 different ways each food can get from the cities of production to their school. Ask them to select the most efficient way to transport each food. Ask them if their food is perishable. Does this change their selection? Invite students to share their thoughts.
6. Explain to students that to be efficient, we need the food to travel as fast as possible using the least amount of fuel. Provide students time to calculate the number of hours it would take to transport their food via truck, train, ship, and plane. Consider modeling the first calculation to help students understand the math. Then, have students calculate how many gallons of fuel would be necessary to transport one ton of their food via truck, train, ship, and plane.
7. Students should work with their partner to graph their data for both total hours of transportation and total gallons of fuel used for each food item. Have them answer the analysis questions and compare their answers to another group to identify any trends.
8. Explain to the students that while it would be great to select the most efficient mode of transportation, we also must consider that the infrastructure needed may not always be available. For example, boats cannot travel on land, trains need railroad tracks, and planes need airports. Using the map and data table, have students select the modes of transportation that would be the most efficient and realistic ways to transport their food products from the city it was produced to their school.
9. Finally, have students outline their delivery method on the map annotating the type of transportation selected each step of the way.
10. To close the lesson, invite a few groups to share their map of transportation with the class, provide their reasoning for each mode selected, and share how their career's perspective helped them accomplish the task together.

EXTENSION

As a mathematical extension of this activity, have students calculate how many barrels of crude oil would be required to transport their items using the mode(s) of transportation they selected. A standard 42-gallon crude oil barrel contains approximately 45 gallons of refined crude oil products per barrel. Trains and trucks use diesel fuel, ships use residual fuel, and planes use jet fuel. Provide students with the following table to help with their calculations.

Residual Fuel	1 gallon/barrel
Diesel Fuel	11 gallons/barrel
Jet Fuel	4 gallons/barrel

ENVIRONMENTAL, HEALTH, & SAFETY WORKER

OVERVIEW

Environmental, Health, and Safety Workers' primary goal is to protect employees, customers, and the environment. They accomplish this by inspecting all parts of a company's workspace to make sure it complies with health, safety, and environmental regulations. They help prevent safety problems in the workplace by recommending changes to protect workers and by providing important safety training programs. When an accident occurs, Environmental, Health, and Safety Workers investigate the incident and help develop new protocols to prevent it from happening again.

YOUR ROLE

- Analyze situations and provide suggestions for improvement.
- Graph the data for both total hours of transportation and total gallons of fuel used for each food item transported.
- Collaborate with other groups to compare your data, graphs, and analysis to discover other perspectives to consider.
- Make the final decision on the most efficient mode(s) of transportation for each product.

PETROLEUM PROJECT MANAGER

OVERVIEW

Project Managers are responsible for overseeing every step of a project, from inception all the way through to completion. A Petroleum Project Manager will specifically oversee projects in the petroleum field. Projects requiring the expertise of Petroleum Project Managers are varied and could include oil drilling and well completion projects that extract petroleum from below Earth's surface, well intervention projects that try to prolong the life of oil wells, solar energy, and environmental projects that focus on environmental health. Petroleum Project Managers may focus on one large project or several at the same time. No matter what, they work with everyone involved in the project to make sure all its moving pieces stay on track, on time, and on budget!

YOUR ROLE

- Keep the team organized and pay attention to details.
- Locate and determine distances between cities using an internet resource.
- Review all mathematical calculations before continuing to the next step.
- Outline the delivery method on the map annotating the type of transportation selected each step of the way.

TRANSPORTATION OF FOOD TO TABLE

Step 1: Select Your Foods

Food #1 _____ Place of Production _____ Total Miles #1 _____

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Step 2: Possible Transportation Methods

Look at a map of the United States and brainstorm at least 3 different ways each food can get from the place of production to your school.

Food #1 _____

Food #2 _____

a) What do you think would be the most efficient way to transport the food? Why do you think this is the most efficient?

b) Are any of these food items perishable? How will this affect your decision to select a mode of transportation?

Step 3: Calculate Efficiency

To be efficient, we need the food to travel as fast as possible using the least amount of fuel.

Truck

a) A freight-liner truck can average 55 miles per hour. How many hours would it take to transport your food?

(total miles/55 miles per hour) Food #1 _____ Food #2 _____

b) A fully loaded truck can travel 140 miles per gallon of fuel per ton of cargo. Assuming it is a fully loaded truck, how many gallons of fuel is needed to transport one ton of your food?

(total miles/140 miles per hour) Food #1 _____ Food #2 _____

Train

a) A freight train can average 40 miles per hour. How many hours would it take to transport your food?

(total miles/40 miles per hour) Food #1 _____ Food #2 _____

b) A fully loaded freight train can travel 468 miles per gallon of fuel per ton of cargo. Assuming it is a fully loaded freight train, how many gallons of fuel is needed to transport one ton of your food?

(total miles/468 miles per gallon of fuel) Food #1 _____ Food #2 _____

Ship

a) A cargo ship can average 20 nautical miles per hour. How many hours would it take to transport your food?

(total miles/20 nautical miles per hour) Food #1 _____ Food #2 _____

b) A fully loaded cargo ship can travel 576 miles per gallon of fuel per ton of cargo. Assuming it is a fully loaded ship, how many gallons of fuel is needed to transport one ton of your food?

(total miles/576 miles per gallon of fuel) Food #1 _____ Food #2 _____

TRANSPORTATION OF FOOD TO TABLE

Plane

a) A freight plane can average 560 miles per hour. How many hours would it take to transport your food? (total miles/560 miles per hour) Food #1 _____ Food #2 _____

b) A fully loaded freight plane travels 4.5 miles per gallon of fuel per ton of cargo. Assuming it is a fully loaded plane, how many gallons of fuel is needed to transport one ton of your food? (total miles/4.5 miles per gallon of fuel) Food #1 _____ Food #2 _____

Step 4: Organize Your Data

1. How many hours would it take to transport your food?

2. How many gallons of fuel would it take to transport your food?

Step 5: Analyze Your Data

1. What is the fastest method to transport your food?
2. Which method of transportation requires the least amount of fuel?
3. Which method of transportation is the best combination of speed and fuel efficiency?

Step 6: Consider Infrastructure

While it would be great to select the most efficient mode of transportation, we also must consider that the infrastructure needed may not always be available. For example: boats cannot travel on land, trains need railroad tracks, and planes need airports.

The map and data table below shows the infrastructure surrounding some major cities in the United States.

City	Truck	Train	Ship	Plane	City	Truck	Train	Ship	Plane
Seattle, WA	x	x	x	x	Minneapolis, MN	x	x		x
SF/Oakland, CA	x	x	x	x	Memphis, TN	x	x		x
Los Angeles, CA	x	x	x	x	Houston, TX	x	x	x	x
Salt Lake City, UT	x	x		x	New Orleans, LA	x	x	x	x
Denver, CO	x	x		x	New York, NY	x	x	x	x
El Paso, TX	x	x		x	Baltimore, MD	x	x	x	x
Chicago, IL	x	x		x	Miami, FL	x	x	x	x

Step 7: Draw Your Conclusion

Select the modes of transportation that would be the most efficient way to transport your food product to your school. Outline your delivery method on the map, and annotate the type of transportation, speed, and total fuel consumed each step of the way.