The FUTURES Channel®

MOVIE GUIDE

MOVIE NUMBER 5005

The New York City Subway System

The Movie:

The New York City subway moves millions of people every day, thanks to the skills of a team of remarkable people. Featured: Carlo Perciballi, chief train mechanic, New York Metropolitan Transit Authority; Audrey Toppins, Train Dispatcher, New York Metropolitan Transit Authority; Tommy D'Alto, Director of Schedules, New York Metropolitan Transit Authority. *(Movie length: 2:18)*

Background:

Subways are the most efficient form of transportation known to man (with the exception of walking or riding a bicycle). Yet about 99% of the traveling done by people in the United States is done in personal vehicles—cars, SUV's and trucks.

Of the other 1%—the travel that we do on buses, trains, and subways—more of it occurs in New York City than any other place in the country: about 1.3 billion passengers per year, or 3-1/2 million people a day, traveling on over 700 miles of track.

Curriculum Connections:

Fractions

1

Children can ride the New York City Subway for free if they are with their parents. These numbers represent the number of children getting on the subway at 63rd and Lexington for five days. All numbers are rounded to the nearest hundred.

	Monday	Tuesday	Wednesday	Thursday	Friday
Number of passengers	5400	4800	6800	6000	4500
Number of children	400	300	500	400	300

On which day were children the highest fraction of the total number of passengers? The lowest?

Percents

2

The New York City Subway system has about 1.3 billion riders per year. If 60% of them pay full fare of $2.00 per ride, and 40% get 6 rides for the price of 5 by buying a metro ticket, what is the total amount paid per year by passengers?

Percents, Exponents (scientific notation) 3

About 43% of all energy used in the United States is used for transportation, and only about 11% is used in homes. Energy can be measured in units called “British Thermal Units” (BTU’s). 8 gallons of gasoline has about a million British Thermal Units worth of energy.

If Americans used 7×10^{12} BTU’s for residential purposes in the year 2000, how many BTU’s did they use for transportation?

Geometry (volume) 4

A New York City subway car is 8 feet tall, 60 feet long, and 9 feet wide. Make some measurements to find the volume of an average adult (treat the legs, arms, and torso as cylinders).

a) How many adults could you fit into a car if you left absolutely no space between the bodies?

b) Suppose there are 75 people in a car. What percent of the total possible number of adults (from question a) is this?

Measurement, Decimals 5

The amount of use of a subway is measured in “passenger-miles”. For example, if there are 50 people in a subway car that travels 4 miles, that counts as 200 passenger-miles. If there are 3 people in an automobile on a trip of 10 miles, that would be 30 passenger-miles.

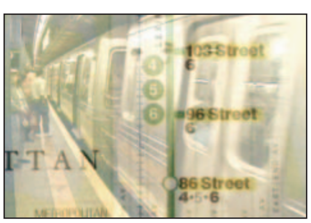
This table compares the energy use by subways, buses and personal vehicles:

	Gallons of gasoline per mile	Gallons of gasoline per passenger-mile
Bus	0.331	0.035
Subway	0.433	0.013
Personal vehicles	0.051	0.042

a) If it requires 0.013 gallons of gasoline’s worth of energy to produce one passenger-mile of transportation on a subway, how many passenger-miles are produced by 1 gallon of gasoline’s worth of energy?

b) Use a ratio to compare the efficiency of personal vehicles and subway trains. Is it closer to 2:1, 3:1, 4:1 or 5:1?

c) Why do you think subways are so much more efficient than buses?



Algebra (functions) 6

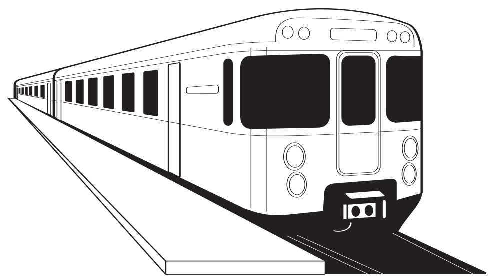
This table shows the number of people using public transportation in the U.S. for the past 8 years.

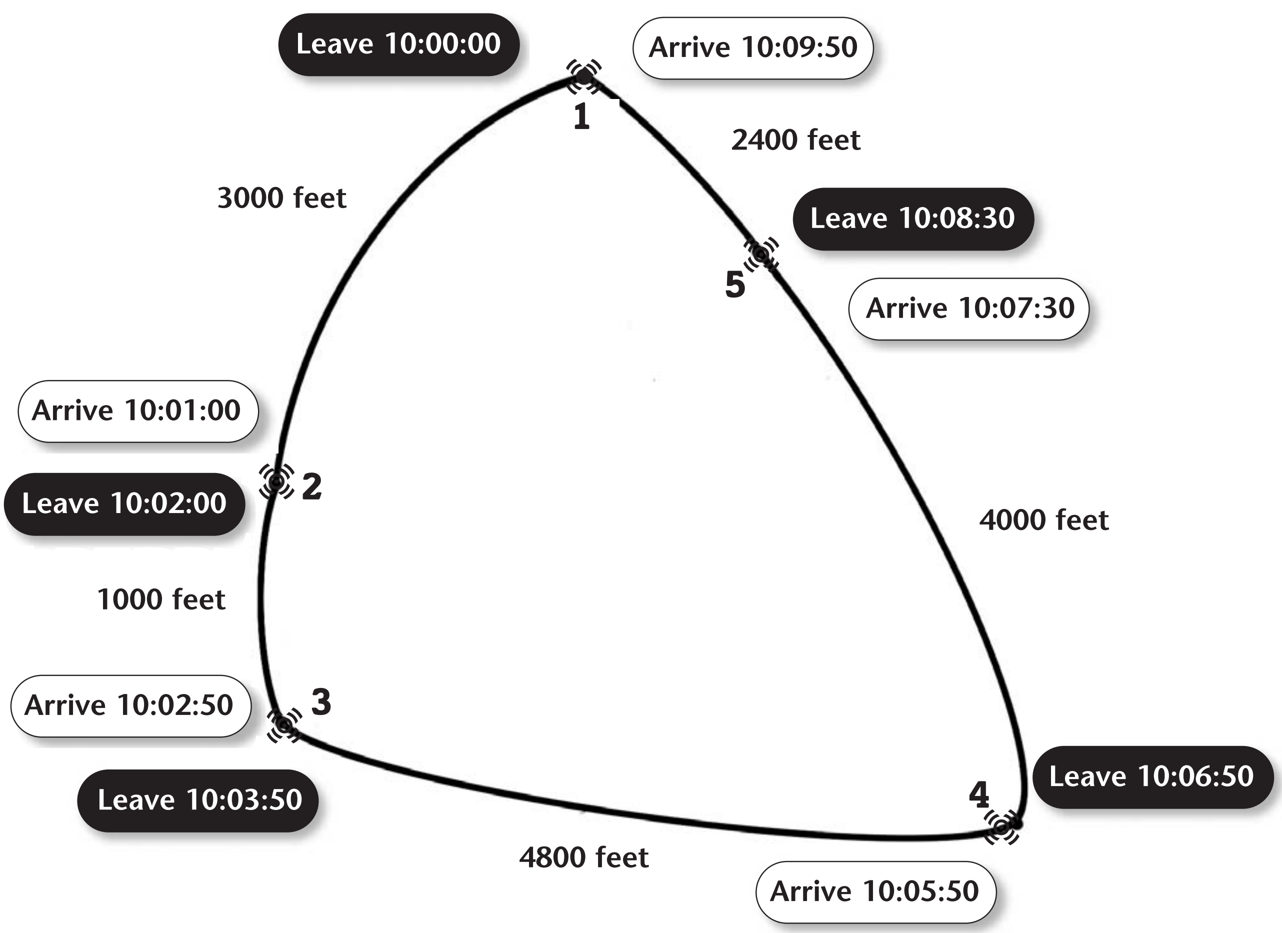
Plot these points on a graph, with *time* as the independent variable and *number of riders* as the dependent variable. Draw a straight line which represents the trend, and use it to estimate the number of riders that might be expected in the year 2005.

Year	Riders
1995	7,763,341
1996	7,885,769
1997	8,252,329
1998	8,666,178
1999	9,085,249
2000	9,326,591
2001	9,507,150
2002	9,387,364

Subway Speed

This is a picture of a subway route. Between what two points does the subway train travel the fastest?





Teaching Guidelines: Subway Speed
Math Topics: Measurement (time, speed)

Students can work on this activity individually or in teams of two. If you feel that your students will need help to work out an approach to solving this problem, you may wish to get them started as follows:

Start by asking students to tell you what it is that they are being asked to determine *(where the train goes the fastest).* Then ask them what information they would need to have to answer that question *(the speed of the train for each part of its route.)*

Next ask what information they would need to know to determine the speed (*distance* and *time*). (If they have not already learned the speed formula, then you should review that formula with them now.)

Write the formula on the board:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

Ask how they could find the distance from point 1 to point 2 (it is labeled on the map, 3000 feet).

Ask how they could determine the time taken. Discuss until all students understand that they can find the time by subtracting the time when the train leaves point 1 from the time when the train arrives at point 2. Tell students that they should all use "seconds" as the time unit in this activity, and so the time from point 1 to point 2 is 60 seconds.

Then have the students use the formula to determine the speed:

$$\text{speed} = \frac{3000 \text{ feet}}{60 \text{ seconds}}$$

$$3000 \text{ feet} \div 60 = 50$$
$$\text{speed} = 50 \text{ feet per second}$$

Ask students to work in teams to determine the speed for the other parts of the train's route. While they are doing so, circulate and help the teams work through any difficulties.

Point 1 to point 2: Distance = 3000 feet, time = 60 seconds, speed = 50 feet per second.
Point 2 to point 3: Distance = 1000 feet, time = 50 seconds, speed = 20 feet per second.
Point 3 to point 4: Distance = 4800 feet, time = 120 seconds, speed = 40 feet per second.
Point 4 to point 5: Distance = 4000 feet, time = 40 seconds, speed = 100 feet per second.
Point 5 to point 1: Distance = 2400 feet, time = 80 seconds, speed = 30 feet per second.

If you enjoyed this Futures Channel Movie, you will probably also like these:

Maglev Trains, #1004	Gliding on a wave of electromagnetic force, a maglev (magnetic levitation) train could travel at 300 miles per hour or faster.
Roller Coasters, #1008	Designing safe roller coasters requires an understanding of forces.
Solar Powered Cars, #1001	Using the energy it takes to run a hair dryer, this solar-powered car travels 200 miles at speeds of 50 to 65 mph.