How Much Will I Spend on Gas?

Student/Class Goal
Students will determine their gasoline cost for a month's time. They will use this information to calculate yearly gas cost.

Outcome (*lesson objective*)
The students will use the current and future price of gasoline to construct T-charts, write algebraic equations, and plot the equations on a graph.

Time Frame
Two 1 ½ hour classes
One 3 hour class

Standard *Use Math to Solve Problems and Communicate*

NRS EFL 3-6

Number Sense	Benchmarks	Geometry & Measurement	Benchmarks	Processes	Benchmarks
Words to numbers connection		Geometric figures		Word problems	3.21, 4.25, 5.25, 6.26
Calculation	3.2, 4.2, 5.1, 6.1	Coordinate system	3.7, 4.8, 5.7	Problem solving strategies	4.26, 5.26, 6.27
Order of operations		Perimeter/area/volume formulas		Solutions analysis	4.27, 5.27, 6.28
Compare/order numbers	3.3, 4.4, 5.3, 6.3	Graphing two-dimensional figures		Calculator	3.22, 4.28, 5.28, 6.29
Estimation		Measurement relationships		Mathematical terminology/symbols	3.23, 4.29
Exponents/radical expressions		Pythagorean theorem		Logical progression	
Algebra & Patterns	**Benchmarks**	Measurement applications		Contextual situations	4.31, 5.31, 6.32
Patterns/sequences	3.14, 4.15	Measurement conversions		Mathematical material	
Equations/expressions	3.15, 4.16	Rounding		Logical terms	
Linear/nonlinear representations	4.17, 5.17, 6.17	**Data Analysis & Probability**	**Benchmarks**	Accuracy/precision	3.26, 4.33, 5.34, 6.35
Graphing	4.18, 5.18, 6.18	Data interpretation		Real-life applications	3.27, 4.34, 5.35, 6.36
Linear equations	4.19, 5.19, 6.19	Data displays construction		Independence/range/fluency	3.28,4.35, 5.36, 6.37
Quadratic equations		Central tendency			
		Probabilities			
		Contextual probability			

Materials
Graph paper – 40x30 paper is included at the end of the lesson (Worksheet 4)
Colored pencils (if available)
Calculators
How Do I Find My Gas Mileage? Handout
T-Chart Illustration
How to Graph a Linear Equation in 5 Quick Steps Student Resource

Learner Prior Knowledge
Basic understanding of gas prices and what is meant by miles per gallon (mpg), found at lesson, *Pumped Up Gas Prices*.

Instructional Activities
Step 1 - Discuss with students the current gasoline price and what they expect to happen to gas prices in the future. Ask students about how much they are spending on gas each month and how many miles the car they are driving gets per gallon? Students may need to research this information by actually calculating their mileage on the handout *How Do I Find My Gas Mileage?* or by visiting Cars and mpg 1984-2012 . This web site lists the in-city and highway mileage for 1985 or newer vehicles. If using this site, students will need to decide what type of driving they do during a month (city or highway) and estimate their car's mileage.

Step 2 - Using $4 per gallon as the price of gas, construct, with the class, a T-chart showing the relationship between the number of gallons purchased(x) and the total cost of the gas(y). See *T-Chart Illustration* for an example. As a class, look at the T-chart that was constructed. Give the students time to discover the relationship between the number of gallons purchased(x) and the total price of the gas(y). Express this relationship verbally (The number of gallons purchased times $4 will equal the total cost.). Discuss how this relationship can be written as an equation as a function of x? (4x=y)

Step 3 – Next, with the students, graph the relationship/equation the class discovered during Step 2. The *How to Graph a Linear*

Equation in 5 Quick Steps, a student resource from their math journals, provides basic guidelines for graphing equations. Help the students determine appropriate intervals and labels for the x and y axes and a title for the graph. Plot several points together and then let the students plot the remainder of the points. Draw a line passing through the points and label the line with the equation written in Step 2.

Step 4 - Discuss with the students how many miles they drive each month. Share with the class that many people drive about 1,000 miles in a month. Why might their personal mileage be more or less? Discuss how they could calculate how many gallons of gas they will use to go 1000 miles or their personal mileage for a month. (Dividing the miles driven in a month by the miles their car gets per gallon of gas will give the student the number of gallons of gas they will need to purchase to drive their car for a month. Help the students calculate this amount. Use the graph the class and each student made to calculate their monthly fuel cost. How could they calculate the cost of driving their car for a year? (Monthly cost times 12 = yearly cost) Ask the students to share their results with the class. What might they do to spend less on gas? (If the activity is to be done in two classes, this is a good stopping point. Be sure to collect the class work for the next class.)

Step 5 - Provide the opportunity for the students to practice this skill (other liquids, such as mile, could also be calculated). Ask small groups of students to construct additional T-charts showing the relationship between the gallons of gas purchased and total cost. Gas costs might be $4.50, $5 or $6 per gallon. Let your students decide what price per gallon they would like to use. Have the students write the equation for the data on their T-chart. Have the students graph the points on their additional T-charts ($4.50, $5.00 and $6.00 per gallon). Plot at least one of the data sets on the same graph as the first equation (4x=y). Be sure each line is labeled. Assist the students as needed.

Step 6 - After the students have 2 equations plotted on each graph, ask the students to make a list of what information they can learn from the graph. Possible answers might include: How much will be spent on gasoline in a month. The difference in monthly cost between $4 and $5. etc.

Step 7 - To assess student understanding of constructing a T-chart, writing an equation, and creating a graph, use the price of gas in some European cities. Although gas is not sold in gallons in Europe, the cost (converted to gallons) is $8.00 per gallon.

Assessment/Evidence (*based on outcome)*
Students will demonstrate an ability to develop and understand a T-chart, graph and equation by constructing each model and explaining their meaning.

Teacher Reflection/Lesson Evaluation
Not yet completed.

Next Steps
Relate this activity to the cost formula found on the GED Test formula sheet [Total cost = (number of units) x (price per unit)]. Discuss how the formulas they discovered relate to the total cost formula. Continue looking at fuel costs and buying a car at *Which Car Should I Buy?*

Technology Integration
Cars and mpg 1984-2012 www.fueleconomy.gov/Feg/findacar.htm
Calculate mpg www.fueleconomy.gov/mpg/MPG.do?action=calcMPG
Graph paper with T-chart http://www.jamesrahn.com/graph%20paper/graph%20and%20chart.pdf

Purposeful/Transparent
The activity addresses the student goal of finding their monthly and yearly costs of gasoline.

Contextual
The activity looks at the fuel costs of automobiles, a very important issue today.

Building Expertise
The lesson gives the students practice basic graphing and equation development to prepare of more advanced problems.

How Do I Find My Gas Mileage?

Finding the number of miles you get on one gallon of gas can be done by following these 6 steps and using the equations at the bottom of the page.

Step 1 - Next time you go to fill up your car with gas, write down the reading on the odometer (gauge that tells how many miles you have driven) in your car.
Odometer reading #1 _____

Step 2 - Fill up your car with gas.
You must fill up the tank until the pump clicks off or this method will not work

Step 3 - Drive your car as you normally would until you need to fill up the gas tank.

Step 4 - When you arrive to buy gas, record the reading on the odometer. In addition, record the amount of gas you purchased for your car. This amount is on the gas pump.
Odometer reading #2 _____
Gallons of gas put in the tank _____

Step 5 - Subtract the first odometer reading from the second reading (smaller number from the larger number). This is the number of miles you drove on the tank of gas. (**See equations at the bottom of the page)**

Step 6 - Take the number of miles you drove on the tank of gas and divide this number by the number of gallons of gas you put in your tank. You will want to use a calculator to do this. Your answer will be the number of miles your car will go on a gallon of gas or the mpg for your car.

Reading #2 – Reading #1 = Miles traveled

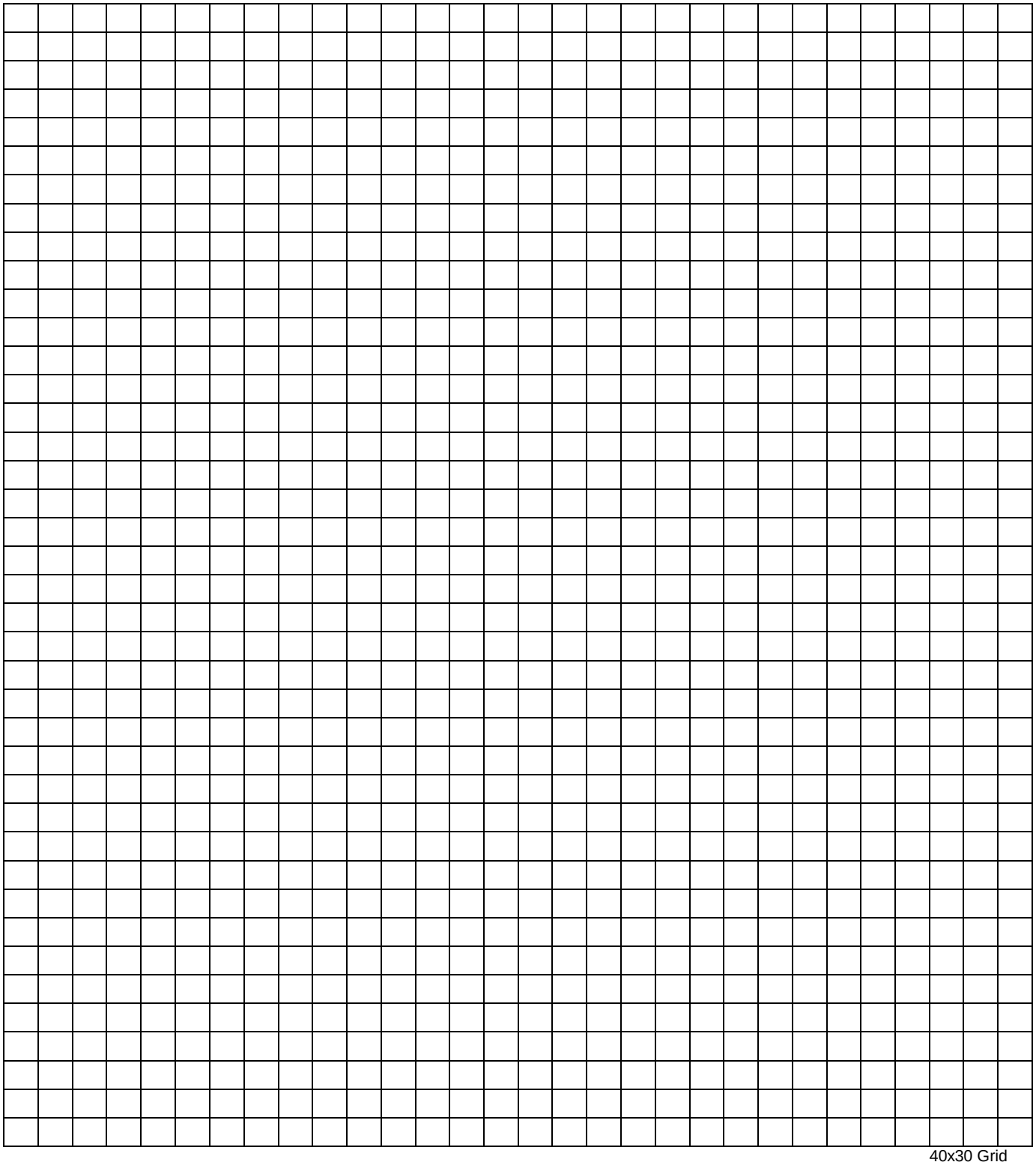
_____ **-** _____ **=** _____

Miles traveled ÷ Gallons of Gas = miles per gallon (mpg)

_____ **÷** _____ **=** _____

T-CHART ILLUSTRATION

Gallons purchased (x)	Total gas cost (y)
1	$4.00
2	
5	
10	$40.00
25	
50	
75	



40x30 Grid

How to Graph a Linear Equation in 5 Quick Steps

Step 1 – Construct a T-chart of Values
Using your equation, construct a T-chart of values if one has not been done already. Substitute some simple numbers into the equation for x or y. If x=1, what is y? If x=10, what is y? If y=0, what is x? Each pair of values in your T-chart will become a point on the graph. (See illustration 1 for an example of a T-chart)

Step 2 – Decide on the interval for each axis
Before starting the graph, look at the T-chart to determine the highest value for y found on the chart. Look at the values needed for x. Using graph paper, count the number of lines on the x and y axes. Use these numbers to determine the intervals on each axis. (If you use the graph paper at the end of this lesson there are 30 spaces on the x axis and 40 spaces on the y axis.) If the largest total cost/y value that needs to be graphed is $80 and there are 40 lines on the y axis, let each line on the y axis represent $2. The number of gallons of gas/x value that goes with $80 is 20. There are 30 lines, so to make it simple one line will equal one gallon. Be sure the students realize they do not need to put a number next to every line. For example, the x might be labeled on every 5^{th} line (five gallons) and the y axis might also be labeled on every 5^{th} line (or $10). This is a good step to do in pencil. That way if the interval you selected did not work out, the numbers can be erased any you can start over.

Step 3 – Label each Axis
Decide what labels need to be added to the x and y axis. What do the numbers on the x-axis represent? What do the numbers on the y-axis represent? Usually the labels will match the descriptions/labels of x and y on the T-chart. (Note: When graphing equations involving elapsed time, time is traditionally represented by x)

Step 4 – Plot the points
Using each pair of points from the T-chart, plot the points on the graph. Every point does not need to be plotted. Just be sure you have at least 3. Using a ruler, draw a line through the points you have plotted. Write your equation next to the line.

Step 5 – Give the graph a title
Decide on a title for the graph. Make sure it accurately represents what is being shown on the graph. Does it explain the relationship between x and y?