Unit #2

Math and Your Car

Real World Math

Name _____

Period _____

Day 1 - Choosing your Cars

To start this unit, you are going to choose three different vehicles online and record your research on the next page. You will be using these cars for some of our lessons and activities throughout this unit.

1) Go to www.carprices.com.

2) Go to the third textbox: Research new cars

3) Choose a make from the first dropdown menu and a model from the second dropdown menu. Then click Find.

4) From the Summary Page, look at the first heading "Specifications" and write down the City MPG and Highway MPG

    a. The City MPG is listed first and the Highway MPG is listed second (after the /)

    b. If your MPG is given as a range of values, find the mean:

    Ex: If city MPG is 20-21, then to find the mean, add 20 and 21 and divide by 2

    $$\frac{20+21}{2} = 20.5$$

5) Then click on the "Price Quote" tab and record the total price (including any destination charge)

6) Repeat this process to find two different vehicles but they must have follow the following restrictions:

    a. You must have a car, a truck or SUV, AND a hybrid vehicle
    b. The vehicle must have the MPG for city and highway listed or you have to choose something else
    c. At least one must have a price under $30,000
    d. At least one must have a price over $50,000

	Vehicle #1	Vehicle #2	Vehicle #3
Make			
Model			
Type of Vehicle (car, truck, SUV, hybrid)			
City MPG			
Highway MPG			
Total Price			

Day 2 - Car Loans

Deciding what type of car to buy is a big decision. Unless you can pay cash for the car, the decision can be made for you by how much you can afford to pay each month. If you borrow the money, the amount you pay each month depends on how much you borrow, for how long, and the interest rate. When making your decision, you also want to consider the total cost of the car after you are done making the payments.

TABLE A

We will look at the prices of the 3 vehicles you chose for a 3-year loan at 6.25% interest

- Copy the 3 cars and prices from Day 1 into the table below.
- Go to the following website: https://www.bankofamerica.com/auto-loans/auto-loan-calculator/
  - Enter the initial price into the box for "Total Loan Amount"
  - Enter 36 for "Term in Months" since you will make 12 payments a year for 3 years
  - Enter 6.25 for "Interest Rate"
  - Hit "Calculate Payment"
- On the right side, you will see "Your Estimated Monthly Payment" in red. Please record that in the table for Monthly Payment
- Multiply the monthly payment by 36 to find the Total Price Including Interest
- To find the amount of Interest, take the total price and subtract the initial price
- To find the Percent Increase, take the interest, divide by the initial price and multiply by 100

	Car #1	Car #2	Car #3
Name of Vehicle			
Initial Price			
Monthly Payment			
Total Price with Interest			
Interest = Total Price – Initial Price			
Percent Increase $= \frac{interest}{initial\ price} \cdot 100$			

TABLE B

We will look at the prices of the 3 vehicles you chose for a longer loan of 5-years with the same 6.25% interest

- Copy the 3 cars and prices from Day 1 into the table below.
- Go to the following website: https://www.bankofamerica.com/auto-loans/auto-loan-calculator/
  - Enter the initial price into the box for "Total Loan Amount"
  - Enter 60 for "Term in Months" since you will make 12 payments a year for 5 years
  - Enter 6.25 for "Interest Rate"
  - Hit "Calculate Payment"
- On the right side, you will see "Your Estimated Monthly Payment" in red. Please record that in the table for Monthly Payment
- Multiply the monthly payment by 60 to find the Total Price Including Interest
- To find the amount of Interest, take the total price and subtract the initial price
- To find the Percent Increase, take the interest, divide by the initial price and multiply by 100

	Car #1	Car #2	Car #3
Name of Vehicle			
Initial Price			
Monthly Payment			
Total Price with Interest			
Interest = Total Price – Initial Price			
Percent Increase $= \frac{interest}{initial\ price} \cdot 100$			

TABLE C

We will look at the prices of the 3 vehicles you chose for a 5-year loan with a lower interest rate of 5%

- Copy the 3 cars and prices from Day 1 into the table below.
- Go to the following website: https://www.bankofamerica.com/auto-loans/auto-loan-calculator/
  - Enter the initial price into the box for "Total Loan Amount"
  - Enter 60 for "Term in Months" since you will make 12 payments a year for 5 years
  - Enter 5 for "Interest Rate"
  - Hit "Calculate Payment"
- On the right side, you will see "Your Estimated Monthly Payment" in red. Please record that in the table for Monthly Payment
- Multiply the monthly payment by 60 to find the Total Price Including Interest
- To find the amount of Interest, take the total price and subtract the initial price
- To find the Percent Increase, take the interest, divide by the initial price and multiply by 100

	Car #1	Car #2	Car #3
Name of Vehicle			
Initial Price			
Monthly Payment			
Total Price with Interest			
Interest = Total Price – Initial Price			
Percent Increase $= \frac{interest}{initial\ price} \cdot 100$			

Making Car Loan Comparisons:

Compare each of your cars from table A:

1. How did the initial price of the car impact the monthly payment?

2. How did the initial price of the car impact the amount of interest?

3. How did the initial price of the car impact the percent increase in the cost?

Compare your first car in Table B with your first car in Table A:

1. How did the length of the loan impact the monthly payment?

2. How did the length of the loan impact the amount of interest you pay?

3. How did the length of the loan impact the percent increase in the cost?

Compare your first car in Table C with your first car in Table B.

1. How did the interest rate impact the monthly payment?

2. How did the interest rate impact the amount of interest you pay?

3. How did the interest rate impact the percent increase in the cost?

In general, describe the type of loan you would look for when buying a car?

Day 3 - Miles Per Gallon

"Gas mileage" is a very important factor to consider when buying a car. Miles per gallon **(mpg)** is the rate of how many miles the car can travel on one gallon of gas. You do not need to burn exactly 1 gallon of gas to calculate your car's mpg. Instead, fill your car's gas tank completely, reset the odometer, and drive around on your typical route for a couple of days. When you refill your car's tank with gas, use the odometer to figure out how many miles you have driven and the gas receipt to find out how many gallons of gas your car has used. **Divide the number of miles driven by the number of gallons your car has used.** This will be your gas mileage or miles per gallon (mpg).

Formula for Miles Per Gallon (mpg)

$$mpg = \frac{miles}{gallons}$$

Calculate the following different real life situations involving gas mileage.

1. Julian has had his car for a couple of years, and he knows it gets better than average gas mileage. On a recent trip to an amusement park, he used 14 gallons of gas and drove 471 miles. To the *nearest tenth*, what is his gas mileage?

2. Chris loves to watch NASCAR racing. He finds out that his favorite driver burns 106 gallons of gas in a 600 mile race. Calculate the miles per gallon for the stock car to the *nearest tenth*. Why do you think his gas mileage is so low?

3. Marilea has a new Sportage. On a recent trip to the Jersey Shore she drove 225 miles and used 8.2 gallons of gas. What was her gas mileage?

4. Jason has a 15 gallon gas tank in his car. If his car gets 22 miles to the gallon, how far can he drive on a tank of gas?

5. Roy bought a new car that is supposed to get on average 28 miles to the gallon. Roy fills up his gas tank, drives 325 miles, and fills up his tank again. To refill his tank he needed 13 gallons of gas. What is his gas mileage? Did his car perform as well as advertised?

6. Hank is taking 445 mile trip. His car's gas tank holds 20 gallons of gas and gets 23 miles to the gallon. Can Hank take the trip on without refilling his gas tank?

Day 4 - Fill Er Up

Task

In this activity, you will choose where you are going on a vacation and calculate the cost of gas to drive there and back. You will compare the difference between that cost twenty years ago and what you have to pay today.

Your vacation destination must be:
1. Outside of New York or any state that borders New York.
2. Accessible by car (i. e. not Hawaii).

Process

Your Cars

a) In columns A and B in the table on the next page, record the names of the three cars and their highway MPG. We are using highway MPG because you usually travel on major high speed roads for long trips.

Researching the Trip

a) Go to Mapquest (www.mapquest.com).
b) Type your home address in the Start section.
c) Type the destination for your vacation in the End section.
d) If you want to go to a place, but do not know the address for it, you can go to www.google.com and type the word "address" and where you want to go.
e) After entering the information into mapquest, press GET DIRECTIONS.
f) Record the total miles for the trip (one-way) _____.
g) Multiply this number by **two** to find the total traveling distance _____. Record this number in column C for each of the three cars.

Finding the Cost

Now that you have found the length and type of driving required for the trip, you need to calculate the cost of the gas for the trip now and ten years ago.

a) The price of gas twenty years ago was $1.83 per gallon (adjusted for inflation). Write this value in the first cell in column E.
b) The price of gas today is $2.42 per gallon. Write this value in the first cell in column F.
c) Complete the Chart for each of your three car choices. Use the **Method row** to help you if you are not sure how perform the calculations.
d) Answer the reflection questions at the end of the activity.

(Round to the *nearest hundredth*.)

A.	B.	C.	D.	E.	F.	G.	H.
Car	MPG HWY	Miles	Total Gallons of Gas	Cost of Trip Ten Years Ago: ____	Cost of Trip Today: _____	Difference Between E and F	Percent increase
Method	-----	-----	$\frac{miles}{mpg}$	rate · gallons	rate · gallons	Cost Today - Cost 20 years ago	$\frac{\text{change in cost}}{\text{original cost 20 years ago}} \cdot 100$
Car #1							
Car #2							
Car #3							

Reflection Questions

1. Was the total cost of the trip today more or less than you expected? By how much?

2. Compare your two cars with the biggest average difference between their mpg for highway driving. What is the difference between their "today" costs for the trip?

3. Is this more or less than you would expect?

4. How many miles do you think you would drive in a year? (The average is 15,000, so choose a number between 10,000 and 20,000.)

5. Using the number of miles you drive in a year, how much more would the car with the worst gas mileage cost than the one with the best mileage? Use today's cost of $2.42 per gallon.

   Formula: $\frac{\text{miles}}{\text{mpg}} \cdot \text{price per gallon}$

6. What do you notice about the percent increase (column H) for the cost of the trip for the three car choices. Why did this happen?

Day 5 - Car Insurance Vocabulary

Liability Coverage: **Car insurance that covers bodily injury as well property damage to others when you are in an accident that is your fault. This type of coverage is mandatory.**

Collision Coverage: **Car insurance that covers repairs to your car when you are in an accident that is your fault. This type of coverage is optional.**

Comprehensive Coverage: **Car insurance that covers damage from fire, vandalism, natural disasters, etc. This type of coverage is optional.**

Deductible: **The amount of the cost you (the driver) have to pay to repair your car when you are in an accident. The insurance company covers any amount above that.**

Examples: $500 deductible

Accident Costs $300 – you pay it all

Accident Costs $600 – you pay $500, insurance company pays $100

Accident Costs $5000 – you pay $500, insurance company pays $4500

Premium: **The amount you pay to have car insurance. The premium can be a monthly, quarterly, biannual, or annual rate.**

Car Insurance Tips:

- Increasing your deductible usually lowers your premium. If you are willing to pay more out of pocket when you get in an accident, you will pay less each year for having the insurance.
- Eliminate optional coverages (e.g., towing and labor, rental insurance) from your auto insurance.
- Consider dropping collision and/or comprehensive coverages on older cars. If your car is worth less than 10 times the premium, purchasing the coverage may not be worth it.
- Ask about available discounts for your auto insurance (airbags, drivers education, defensive driving, low-mileage discounts, discounts for safety or antitheft devices).
- Avoid buying a vehicle that is more likely to be vandalized.
- Choose a car with a low cost to replace parts.
- Keep your car in a garage.
- Drive safely to establish a good driving record. If you have had tickets or accidents that were your fault in the past three years your premium will be higher.

Finding Costs of Car Insurance:

1) You have car insurance with a **$600 premium every six months** and a **$500 deductible**. How much would you pay in a six month period if you had an accident that that was your fault and cost **$150 to repair**?

2) You have car insurance with a **$450 premium every year** and a **$800 deductible**. How much would you pay in the six month period if you **did not have an accident**?

3) You have car insurance with a **$800 premium every six months** and a **$300 deductible**. How much would you pay in the six month period if you had an accident that was your fault and **cost $1000 to repair?**

4) You have car insurance with a **$120 premium every month** and a **$500 deductible**. How much would you pay in the six month period if you had an accident that cost **$3000 to repair**?

5) You have car insurance with a **$300 premium every six months** and a **$1500 deductible**. How much would you pay in the six month period if you had an accident that that was your fault cost **$2000 to repair**?

6) You have car insurance with a **$700 premium every year** and a **$1500 deductible**. How much would you pay in the six month period if you had an accident that that was your fault cost **$200 to repair?**

Day 6 - Yearly Cost of Owning a Car

The information for the following activity was taken from www.aaaexchange.com.

Every Year ***AAA*** does an extensive study on the cost of car ownership. They categorize the costs into operating costs (fuel, maintenance, and tires) which are dependent on the number of miles you drive and ownership costs (insurance, license/registration/taxes, depreciation based on 15,000 miles, and finance charge) that are calculated per year. We will study their findings for small sedans and SUV's in 2011. They also conduct their studies for medium sedans, large sedans, and minivans.

Complete the two tables below.

1. Find the total cost per mile.
2. Use the number of miles you think you drive in a year to calculate the total operating cost.
3. Find the total ownership cost per year.
4. Add the operating costs to the total ownership cost to find the total yearly costs.

Small Sedan

Operating Costs	**Per Mile**		**Ownership Costs**	**Per Year**
Fuel	10.05 cents		Full Insurance Coverage	$951
Maintenance	4.11 cents		License, Registration, Taxes	$438
Tires	.67 cents		Depreciation (averaged over 5 years, based on 15,000 miles)	$2,560
Total Cost Per Mile			Finance Charge (interest from a loan or lease)	$584
Total Operating cost for _____ miles			Total Ownership Cost Per Year	

Total Yearly Cost for the small sedan: _____

SUV

Operating Costs	**Per Mile**		**Ownership Costs**	**Per Year**
Fuel	17.04 cents		Full Insurance Coverage	$912
Maintenance	4.80 cents		License, Registration, Taxes	$757
Tires	1.14 cents		Depreciation (averaged over 5 years, based on 15,000 miles)	$5,052
Total Cost Per Mile			Finance Charge (interest from a loan or lease)	$1,071
Total cost for _____ miles			Total Ownership Cost Per Year	

Total Yearly Cost for the SUV: _____

Minimizing your Costs of Owning a Car:

1. **Fuel**: Based on the late 2001 rate of $1.83 per gallon.
    a. Is the gas price higher or lower now?

    b. Why is the SUV price for gas so much higher than the small sedan?

    c. List two ways you can decrease the yearly price of gas.

2. **Maintenance**: Includes the cost for parts and labor for routine maintenance as well as an average amount of wear and tear. Sales taxes are included. It is difficult to control the maintenance cost for your car. You can make sure that your car gets regular maintenance such as oil changes so that you will not have costly repairs later.

3. **Tires**: Based on the price of tires at the recommended number of miles that are identical to the tires that came with the car. It is difficult lower the tire cost because cheaper tires might not last as long.

4. **Insurance**: Based on a married 47-year-old male with a good driving record, living in a small city. The policy gives average coverage with a $500 deductible for collision and a $100 deductible for comprehensive coverage.
    a. Do you think **your** car insurance would cost more or less than the amount listed here?

5. **License/Registration/Taxes**: Includes all government taxes and fees when purchasing the car and fees due each year to license and register the car. You do not have much control over these costs. If you buy a cheaper car, however, the initial taxes will not be as high.

6. **Depreciation**: Based on the difference between a new-vehicle purchase price and the estimated trade-in value at the end of five years.
    a. How could you decrease the amount of depreciation on your car? Think about the type of car you buy.

7. **Finance Charge**: The finance charge is based on a five-year loan at 6% interest with a 10% down payment. Taxes and first year license fees are included.
    a. How you could decrease or even eliminate the finance charge?

Yearly Cost for YOUR car

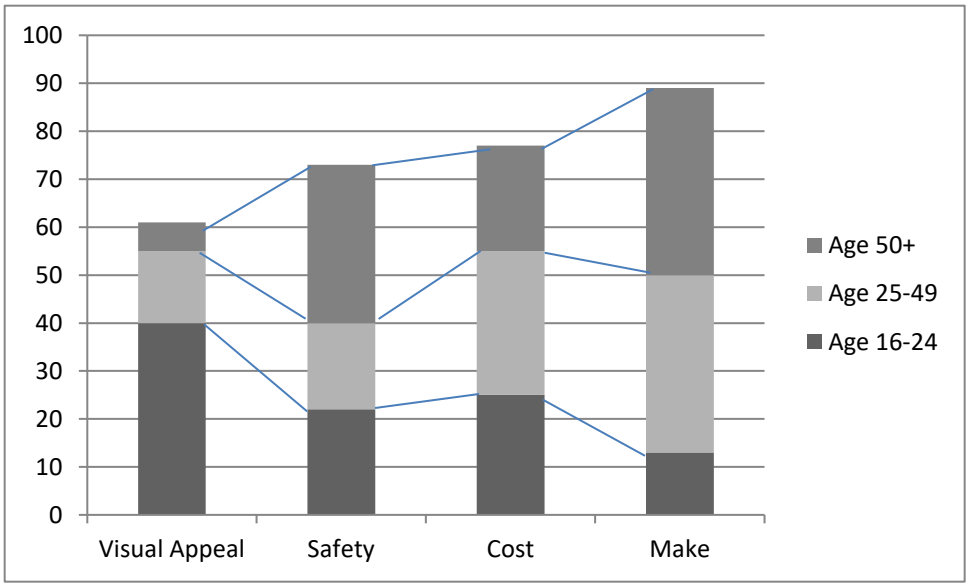
Using the values in the two tables at the beginning of the activity as well as your answers to the "minimizing the cost" questions, calculate how much it would cost for you to maintain a car you might have now or in the future. Make this as realistic as possible. For example, if you know you would need a car loan, do not cut out the finance charge.

Operating Costs	**Per Mile**		**Ownership Costs**	**Per Year**
Fuel			Full Insurance Coverage	
Maintenance			License, Registration, Taxes	
Tires			Depreciation (averaged over 5 years, based on 15,000 miles)	
Total Cost Per Mile			Finance Charge (interest from a loan or lease)	
Total Operating cost for _____ miles			Total Ownership Cost Per Year	

Total Yearly Cost for YOUR car: _____

Day 7 - Rating Car Traits

When purchasing a car, what features matter the most? A recent survey of different age groups was conducted to answer that question. The choices for the survey were appearance, cost, safety rating, and make of the car. The results are shown below in an augmented bar graph. The numbers on the y-axis are percents.



1. Which feature was most common among all respondents?

2. Which feature was the most common in the 16-25 age group? What percent of the people in that age group chose that feature?

3. Which feature was the most common in the 50+ age group? What percent of the people in that age group chose that feature?

4. As the age of the respondents increased, which feature became less important? Why do you think this happened?

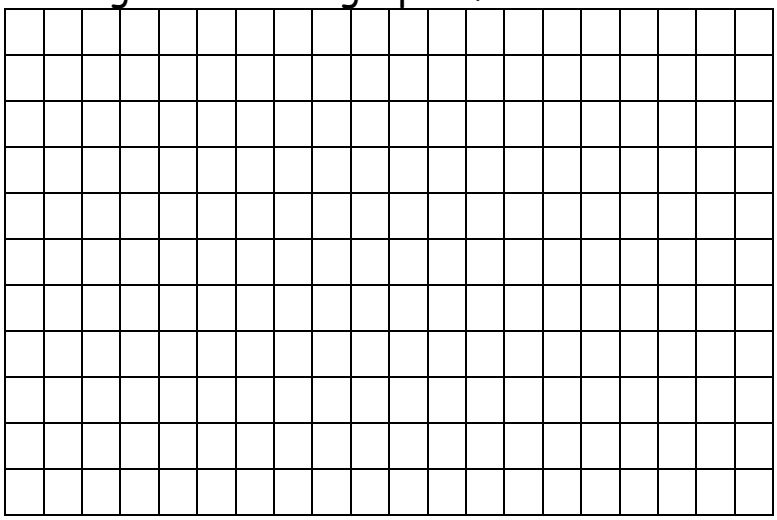
5. One feature of an augmented bar graph is the diagonal lines drawn between the columns. How do these lines enhance the graph?

Conduct Your Own Car Traits Survey

As a class we collected data for what you thought was the most important quality when choosing a car. Instead of using age groups we collected the information for boys and girls. Organize the result in this table. Round to the nearest *whole number*.

Gender	Total in Class	Visual Appeal	Safety	Cost	Make
Boys: numbers					
Boys: % of total					
Girls: numbers					
Girls: % of total					

Create an augmented bar graph of the data we collected.



Answer the following questions. Make sure that you would get the same answers from your table as your graph. This is a good way to make sure your graph is constructed correctly.

1) Which of the four responses was the most/least common among all respondents?
   Most: _____ Least:_____
2) Which of the four responses was the most/least common among the boys?
   Most: _____ Least:_____
3) Which of the four responses was the most/least common among the girls?
   Most: _____ Least:_____
4) How do the opinions of your class compare to the opinions of the 16-24 year old age group from the previous page? Were the boys or the girls in your class more similar to them?

_____

_____

_____

_____

Day 8 – How Long Does it Take to Get There?

1) Write "half an hour" as a decimal. What does half an hour mean?

2) Write three and one quarter hours in hours and minutes and as a decimal.

3) Write five and thirty-seven sixtieths of an hour in hours and minutes and as a decimal to the *nearest hundredth*.

4) Convert 4 hours 27 minutes to a decimal.

5) You are driving 230 miles at a speed of 45 miles per hour. How long does it take you to make the trip? Round to the *nearest minute*. (Do this problem in the textbox to the right.)

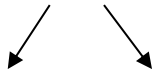
$distance = rate \cdot time$

D=RT

____ = ____ · _____

Once you find the time, you can convert the decimal to minutes by multiplying it by 60.

_____hours



___ hours ___minutes

6) You are driving 230 miles at a speed of 60 miles per hour. How long does it take you to make the trip? Round to the *nearest minute*.

7) How much time would you save if you went 60 mph on this trip instead of 45 miles per hour?

How much time are you saving?

Sometimes it is tempting to go faster than the speed limit to save time when driving long distances. Today we are going to find out how much time you are really saving.
Let's assume that the speed limit is 65 mph. We will compare this with traveling at 75 mph.
(In each problem, round to the ***nearest minute***.)

1) Traveling from Saugerties to Albany, NY.
   Distance: 45 miles.
   a. Time when traveling at 65 mph:

   b. Time when traveling at 75 mph:

   c. Time Saved:

2) Traveling from Saugerties to Seaside Heights, NJ.
   Distance: 187 miles.
   a. Time when traveling at 65 mph:

   b. Time when traveling at 75 mph:

   c. Time Saved:

3) Traveling from Saugerties to Washington D.C.
   Distance: 328 miles.
   a. Time when traveling at 65 mph:

   b. Time when traveling at 75 mph:

   c. Time Saved:

How will this lesson impact the speed at which you drive?

Day 9 - D=RT Multistep Problems

It is an important life skill to be able to calculate the amount of time it will take you to get somewhere. In order to do so, you just need to know the distance to your location and the average speed at which you will travel. You can also use the formula, distance=rate(time) to determine your total distance travelled when you know your speed and the amount of time you have been travelling. Lastly, you can calculate the speed at which you travel when given the travel time and the total distance. Answer the questions below.

1. Jessica needs to travel 240 miles. To start out, she drove for 2 hours and 45 miles per hour. After stopping for a lunch break, she finished the trip travelling at 50 miles per hour. How long did she drive in the second portion of her trip?

2. You drove for 3 hours at 45 miles per hour. After stopping to buy some souvenirs in a famous town along the way, you drove for 2 more hours at 65 miles per hour. After eating a quick dinner at a rest stop, you finished your driving with 2 more hours at 65 miles per hour. What was the total distance you travelled?

3. Jerome needs to travel 305 miles to get to Myrtle Beach. In the first three hours he was able to travel at 65 miles per hour. For the last two hours there was more traffic. On average, how fast did he travel for these last two hours?

4. Louis in going on a 265-mile trip. To start out, he drove for 2 hours and 65 miles per hour. After stopping to get gas, he finished the trip travelling at an average of 45 miles per hour due to traffic. How long did the second portion of the trip take?

5. Justin drove for 3 hours at 45 miles per hour. For the next two hours, Justin travelled on a major highway at 60 miles per hour. After eating a leisurely dinner with some friends who lived along the way, he finished your driving with 2 more hours at 55 miles per hour. What was his total distance you travelled?

6. I need to travel 345 miles to get to a wedding. For the first three hours, I travelled at 60 miles per hour. If I need to arrive at my destination in another three hours, how long fast should I drive for the remainder of my trip?

7. A group of friends are taking a 315-mile road trip. To start out, they drove for 3 hours and 60 miles per hour when they got a flat tire. After replacing the flat with a donut, they finished the trip at 45 miles per hour for obvious reasons. How long did the second portion of the trip take?

8. Lucinda drove for 3 hours at 60 miles per hour. For the next three hours, she travelled in stop and go traffic, averaging 45 miles per hour. After stopping to take pictures of some historical landmarks on the way, she finished her trip with 3 more hours at 60 miles per hour. What was his total distance she travelled?

9. Make up your own question that is similar to one of the questions in this lesson. Make it applicable to a trip you would actually take in your life.

   Q:

   A:

Day 10 - Drunk Driving

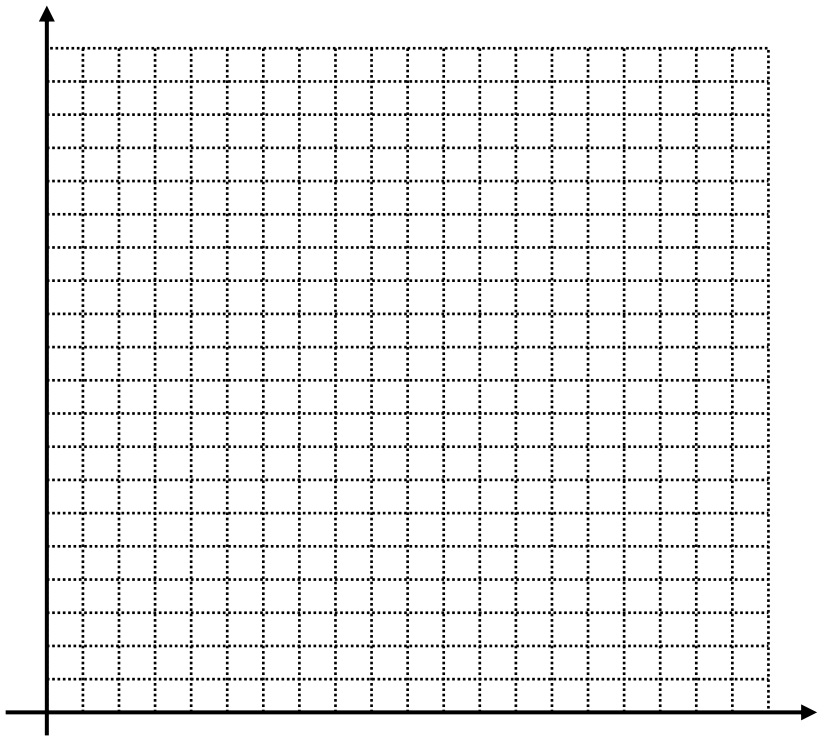
There are always risks when driving a car, but there are certain times of day when these risks are higher due to drunk driving. Complete the table below and answer the related questions to learn more about when it is most dangerous to be on the road.

For each time interval, calculate the percent of the fatal crashes that were alcohol related. Round to the *nearest percent*. If necessary, use scrap paper to perform your calculations.

Time of Day in 3 hour intervals	Total Number of Fatal Crashes	Number of Alcohol related fatal crashes	Percent of Fatal Crashes that were Alcohol Related
Midnight -3:00 AM	4725	3716	
3:00AM – 6:00 AM	2767	1751	
6:00 AM to 9:00 PM	3545	510	
9:00 AM -12:00 PM (noon)	3620	404	
12:00 PM - 3:00 PM	4749	752	
3:00 PM -6:00 PM	6301	1639	
6:00 PM - 9:00 PM	5873	2790	
9:00 PM - Midnight	5447	3474	

Note: This data was taken from the Highway Safety Administration in 1996. They no longer publish this data in 3 hour intervals. Currently there are less total traffic fatalities due to improved safety features, but the percentage of alcohol related fatal crashes for each time of day remains consistent.

1. Draw a histogram showing the relationship between the time of day and the percent of fatal crashes that involve alcohol.



2. During what time of day is a fatal accident most likely to involve alcohol? Why do you think this is true?

3. There is a law for young drivers that relates to this activity. What is this law?

4. The highest number of fatal accidents occur between 3:00 PM and 6:00 PM. Why do you think this is true?

5. Even though there are so many fatal accidents at this time, if you are driving, why is your probability of getting in a fatal accident still greater at night?