<u>**WAMC Lab Template**</u>
Math Concept(s): Applied Math
Source / Text: Financial Algebra
Developed by: Jeff Albertsen   E-Mail: <u>jalbertsen@psd1.org</u>
Date: Summer Conference 2019

<u>**Attach the following documents:**</u>
- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

<u>**Short Description (Be sure to include where in your instruction this lab takes place):**</u>
You are planning a road trip with your best friend (lab partner) the summer following graduation. You have agreed you would like to travel along the West coast down highway 101, across the Southwest states on highway 10, crossing the US - Mexico Border in Texas, and travelling to your final destination in Mexico City. You will both be on a tight budget and, as such, will need to plan your travels carefully so you have enough money for food and lodging. This will require researching the gas mileage of 2 types of vehicles you are considering taking for your trip: your vehicle (large SUV) and your friend's vehicle (electric hybrid). You will also need to find the exchange rate for converting US Dollars (USD) into Mexican Pesos (MXP) so the cost of fuel can be calculated once you cross the border into Mexico. The average fuel cost in the US along both possible routes is $3.17 per gallon. The average cost for fuel in Mexico is 17.83 pesos per liter. The last step is to apply this process to a second possible driving route to compare fuel costs for both routes using multiple vehicles.

<u>**Lab Plan**</u>
Lab Title: Budgeting for Vacation Fuel Expenses

Prerequisite skills: Googling, Currency Conversions, Converting Kilometers to Miles, Calculating mpg, Google Maps

Lab objective: Students should be able to calculate the cost of fuel when planning a cross-country road trip.

<u>**Standards:**</u> *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*
Mathematics K–12 Learning Standards:
- Reason quantitatively and use units to solve problems.
  - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
  - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities
Standards for Mathematical Practice:
- Makes sense of problems and persevere in solving them.

- o Plan a solution pathway.
- Reason abstractly and quantitatively.
  - o Considering the units involved.
- Attend to precision.
  - o Careful about specifying units of measure.

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.
- Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.

K-12 Science Standards

- Analyze a problem situation and represent it mathematically.
- Make valid inferences and draw conclusions based on data.
- Synthesize information to draw conclusions and evaluate the arguments and conclusions of others.

Technology

- Students apply keyword choice search techniques (e.g., basic and advanced Boolean).
- Student recognize bias in online research and sources.

Engineering

- Attend to precision.
- Prioritize criteria, consider tradeoffs, and assess social and environmental impacts as a complex solution is tested and refined.

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)
⊠ Global Awareness   ⊠ Financial/Economic/Business/Entrepreneurial Literacy   ☐ Civic Literacy
☐ Health/Safety Literacy   ⊠ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION	INFORMATION, MEDIA & TECHNOLOGY SKILLS	LIFE & CAREER SKILLS	Productivity and Accountability
Creativity and Innovation	Information Literacy	Flexibility and Adaptability	☐ Manage Projects
⊠ Think Creatively	⊠ Access and Evaluate Information	☐ Adapt to Change	⊠ Produce Results
☐ Work Creatively with Others	⊠ Use and manage Information	⊠ Be Flexible	Leadership and Responsibility
☐ Implement Innovations	Media Literacy	Initiative and Self-Direction	☐ Guide and Lead Others
Critical Thinking and Problem Solving	⊠ Analyze Media	⊠ Manage Goals and Time	⊠ Be Responsible to Others
⊠ Reason Effectively	☐ Create Media Products	☐ Work Independently	
☐ Use Systems Thinking	Information, Communications and Technology (ICT Literacy)	☐ Be Self-Directed Learners	
⊠ Make Judgments and Decisions	⊠ Apply Technology Effectively	Social and Cross-Cultural	
⊠ Solve Problems		☐ Interact Effectively with Others	
Communication and Collaboration		☐ Work Effectively in Diverse Teams	
⊠ Communicate Clearly			
⊠ Collaborate with Others			

Teacher Preparation: (What materials and set-up are required for this lab?)
Materials

- Computer
- Web Browser

Set-Up Required:

- 10 minutes to discuss instructions and answer initial questions.

Lab Organization Strategies:
Leadership (Connect to 21st Century Skills selected):

- Students should understand the impact different vehicles have on the environment based on fuel efficiency claims.
- Students will use the internet to conduct fuel efficiency ratings of different vehicles.
- Both students will be accountable to one another to ensure the lab gets completed.
- Students will be required to finish this lab in one class hour.

Cooperative Learning:

- Students will be working together with a partner and discussing their results with other groups.

Expectations:

- Students should understand the importance of fuel economics, how to calculate miles per gallon, how to test manufacturer fuel economy claims, how to calculate fuel costs when planning a road trip, how to convert between standard and metric systems.

Timeline:

- This lab should take no longer than 1 class hour.

Post Lab Follow-Up/Conclusions:
Discuss real world application of learning from lab

- The information and skills gained from this lab can be used when budgeting for a road trip, whether it is business-related or not.

Career Applications

- Long-Haul Truck Driver
- Shipping and Logistics Route Planner
- Accountant or Book Keeper for a Business

Optional or Extension Activities

- Find an alternative route from CHS to US Embassy in Mexico City.
- Research different hybrid vehicle options for your trip.
- Convert mph to kmh.
- Use a physical map to calculate trip mileage.
- Research gas prices along route.

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Materials:

Pencil or Pen

Scratch Paper for Conversions

Computer

Internet Access:

> Car comparison website
>
> Currency exchange rate website
>
> Google Maps or another mileage calculating website

Scenario:

You are planning a road trip with your best friend (lab partner) the summer following graduation. You have agreed you would like to travel to your final destination in Mexico City using the shortest route possible. You will both be on a tight budget and, as such, will need to plan your travels carefully so you have enough money for food and lodging. This will require researching the gas mileage of 2 types of vehicles you are considering taking for your trip: your vehicle (large SUV) and your friend's vehicle (gas/electric hybrid). You will also need to find the exchange rate for converting US Dollars (USD) into Mexican Pesos (MXP) so the cost of fuel can be calculated once you cross the border into Mexico. The average fuel cost in the US along the route you've chosen is $3.17 per gallon. The average cost for fuel in Mexico is 17.83 pesos per liter. Don't forget to convert between the standard and metric systems.

<u>Your first task is to perform the following research:</u>

Research:

Go to cars.com and research and record the fuel mileage specifications for the following vehicles:

2020 GMC Yukon XL – **mpg:**

2020 Chevrolet Bolt – **mpg:**

Research:

Go to Google Maps and find out how many miles it is from point A to point B:

Point A: Chiawana High School in Pasco, WA –

8125 W Argent Rd, Pasco, WA 99301

Point B: US Embassy in Mexico City –

Av. Paseo de la Reforma 305, Cuauhtémoc, 06500 Ciudad de México, CDMX, Mexico

Total Miles:

Research:

Go to any currency exchange rate website and find out the rate of pesos per $1 USD:

$1 USD = _____ MXP

1 Gallon = _____ Litres

Your second task is to calculate how much it will cost for your journey:

(Remember: the currency and measurement system change when you cross into Mexico)

Chiawana High School (point A) to the Embassy in Mexico City (point B).

SUV: $_____(USD)

Hybrid: $_____(USD)

Questions:

1. Which vehicle was more fuel-efficient?

2. Approximately many times would you have to fill up during your trip if the Yukon XL has a 20-gallon tank?

3. Based on the information you calculated, which vehicle would you take and why?

4. How much money would you save by driving the hybrid for your road trip?

Possible Lab Add-ons:

SUV on shorter route vs hybrid on longer route?

Calculate drive time using average speed of 58 mph?

Add in hotel stay research/comparison?

Research gas prices along route for better accuracy.

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KEY

Task 1:

Hybrid mpg = 52

Yukon mpg = 18

Task 2:

Total Miles: 2,619.4 (CHS to US Embassy, Mexico City)

Total Miles: 1,493.6 (CHS to El Paso)

Total Miles: 1,125.8 (El Paso to US Embassy, Mexico City)

19.15 MXP

3.78541 Liters

Task 4:

Hybrid: ~$167.30

SUV: ~$483.50

Questions:

1. Hybrid. It will cost less to drive it on the trip.
2. The fuel tank would have to be filled ~7 times.
3. I would take the hybrid because it would be less expensive.
4. The hybrid would cost $316.20 less than the SUV.

Math - Problem Solving : Trip-Planning Lab

Teacher Name: **Mr. Albertsen**

Student Name: _____

CATEGORY	4	3	2	1
Working with Others	Student was an engaged partner, listening to suggestions of others and working cooperatively throughout lesson.	Student was an engaged partner but had trouble listening to others and/or working cooperatively.	Student cooperated with others, but needed prompting to stay on-task.	Student did not work effectively with others.
Mathematical Errors	90-100% of the steps and solutions have no mathematical errors.	Almost all (85-89%) of the steps and solutions have no mathematical errors.	Most (75-84%) of the steps and solutions have no mathematical errors.	More than 75% of the steps and solutions have mathematical errors.
Mathematical Terminology and Notation	Correct terminology and notation are always used, making it easy to understand what was done.	Correct terminology and notation are usually used, making it fairly easy to understand what was done.	Correct terminology and notation are used, but it is sometimes not easy to understand what was done.	There is little use, or a lot of inappropriate use, of terminology and notation.
Completion	All problems are completed.	All but one of the problems are completed.	All but two of the problems are completed.	Several of the problems are not completed.

WAMC Lesson Plan

Name(s): Jeff Albertsen
Email Address: jalbertsen@psd1.org
Lesson Title: Calculating Fuel Economy
Date: 06/25/19
Text: Financial Algebra   STEM Correlation: Science, Technology, Engineering, Math
Lesson Length: 3 days

Big Idea (Cluster): How to calculate fuel efficiency.

Mathematics K–12 Learning Standards:
Makes sense of problems and persevere in solving them.
1. Plan a solution pathway.

Reason abstractly and quantitatively.
1. Considering the units involved.

Attend to precision
1. Careful about specifying units of measure.

Mathematical Practice(s): Calculations of fuel economy and distance/rate/time.

Content Objectives: Calculate the fuel efficiency of different types of vehicles and understand variables effecting fuel efficiency.	Language Objectives (ELL): Ability to understand key terms related to fuel efficiency and mileage/speed tracking devices in vehicles.
Vocabulary: Odometer, Trip Odometer, Speedometer, Miles Per Gallon (mpg), Liters Per Gallon (lpg), Miles Per Hour (mph), Kilometers Per Hour (kph), English Standard System, Metric System	Connections to Prior Learning Conducting Internet Research Vehicle-related Vocabulary Simple Mathematical Computations
Questions to Develop Mathematical Thinking: • What factors effect fuel efficiency? • How will fuel efficiency have an impact on my financial situation(s)? • How does fuel efficiency effect the environment? • How does engine design effect fuel efficiency? • How do driving habits effect fuel efficiency? • How does fuel octane level effect fuel efficiency? • How does tire and wheel size effect fuel efficiency? • What are the legalities associated with odometer readings when buying or selling a vehicle?	Common Misconceptions: • All vehicles get similar gas mileage. • All fuels are similar in quality. • All large vehicles are not fuel efficient. • All small vehicles are fuel efficient. • Calculating fuel economy is difficult. • Manufacturer reported fuel economy ratings are truthful.

Assessment (Formative and Summative):

• Vocabulary Worksheet • Vocabulary Quiz • Fuel Economy Problem Worksheet • Fuel Economy Quiz

Materials:

- Textbook
- Computer with Internet Access
- Various Types of Odometers (analog/digital)
- Projector
- Computer with Power Point or Prezi Access
- Document Viewer
- Industry Professional Presentation – Master Mechanic from Kaizen Speed

Instruction Plan:

Introduction:
Discussion Prompts:
1. How many of you drive a vehicle? What type? How large?
2. How many of you pay for your own fuel?
3. Do you think it is expensive to drive a vehicle?
4. How many of you know what fuel efficiency/economy ratings mean?

Explore:
1. Show video about fuel economy: https://youtu.be/Ac5zFuRiN80
2. Discuss vocabulary terms.
3. Show physical examples of analog and digital odometers.
4. Discuss differences between types of odometers.
5. Discuss legal issues are associated with odometers.
6. Discuss professions that use odometers to calculate mileage costs.

When I observe students: Check for understanding. Are they able to appropriately answer chapter-related questions?
Questions to Develop Mathematical Thinking as you observe: Does fuel efficiency have an environmental impact.
Answers: Yes. Vehicles with low fuel efficiency ratings, such as 12 mpg, produce more carbon dioxide.

Summarize: Day 1: Introduction to fuel economy vocabulary. Hands-on with analog/digital odometers.
        Day 2: Industry Professional Presentation – Variables effecting fuel efficiency.
        Day 3: Trip- Planning Lab Activity – Calculate fuel costs while planning a road trip.

Career Application(s):

- Mechanic
- Transportation Professional (Drivers)
- Logistics
- Car Sales
- Pilot
- Agriculture
- Travel Planner

Leadership/21st Century Skills:

WAMC Lesson Plan

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☐ Health/Safety Literacy ⊠ Environmental Literacy

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☐ Collaborate with Others			

1. An _____ is located in a vehicle's dashboard and tracks how many miles the vehicle has travelled since leaving the factory?

2.

3. Where can you go to find the exchange rates for the world's currencies?

4. You've been travelling for 5.25 hours at an average speed of 63 mph. Approximately how many miles have you travelled?

5. You are driving a vehicle with a fuel tank that holds 16 gallons of fuel and a mile per gallon rating of 27 mpg. How many miles can you travel on a full tank of fuel?

1. An _____ is located in a vehicle's dashboard and tracks how many miles the vehicle has travelled since leaving the factory?

   odometer

2. Where can you go to find the exchange rates for the world's currencies?

   Various answers accepted similar to below:

   https://www.xe.com/currencyconverter/

3. You've been travelling for 5.25 hours at an average speed of 63 mph. Approximately how many miles have you travelled?

   ~330 miles

4. You are driving a vehicle with a fuel tank that holds 16 gallons of fuel and a mile per gallon rating of 27 mpg. Approximately how many miles can you travel on a full tank of fuel?

   ~430 miles