Theme 3: Traffic Management

Theme Objectives:

- Explore factors that impact the traffic flow
- Explore the statistical nature of traffic flow analysis
- Use a computer model to assess two potential solutions to a problem
- Write an algorithm composed of if-then statements
- Explain and interpret data tables and graphs and find the corresponding data description
- Create data based questions

Standards:

- MS-ETS-1 Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. https://www.nextgenscience.org/pe/ms-ets1-1-engineering-design
- MS-ETS-1 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. https://www.nextgenscience.org/pe/ms-ets1-4-engineering-design
- CCSS.Math.Content.7.SP.A.1 Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. http://www.corestandards.org/Math/Content/7/SP/A/1/
- CCSS.Math.Content.7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. http://www.corestandards.org/Math/Content/7/SP/A/2/
- CCSS.Math.Content.7.EE.B.3 Solve real-life and mathematical problems using numerical and algebraic expressions and equations. http://www.corestandards.org/Math/Content/7/EE/B/3/
- CCSS.Math.Content.8.SP.A.4 Investigate patterns of association in bivariate data. http://www.corestandards.org/Math/Content/8/SP/A/4/
- CCSS.Math.Content.6.SP.B.5 Summarize numerical data sets in relation to their context. http://www.corestandards.org/Math/Content/6/SP/B/5/

- CCSS.Math.Content.8.SP.A.4 Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. http://www.corestandards.org/Math/Content/8/SP/A/4/

Activity 1: Traffic Jam

Objectives:

- Explore factors that impact traffic flow
- Explore the statistical nature of traffic flow analysis
- Use a computer model to assess two potential solutions to a problem
- Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions.
- Understand that random sampling tends to produce representative samples and support valid inferences.

Background Information:

Computer models can be excellent tools for analyzing complex systems. In this activity, students will use a web-based computer model to explore the relationship between the volume of traffic and the time it takes for vehicles to get from point A to point B. Then they will use the model to assess two potential solutions to their particular example of traffic congestion. Students will be comparing small samples with larger samples to appreciate the benefits of using large, random samples.

Materials for a class of 24:

- 12 Computers or laptops with internet access. Students can work with a partner.
- Timing devices are helpful. Stopwatches, smart phones, or even a wall clock with a second hand will work. The teacher could also project one of the many websites with timers. The activity can even be completed without any of these if students are shown how to count seconds out-loud using the “one-Mississippi, two-Mississippi” method.
- Calculators will speed-up the data analysis, but the math can be done by hand if you prefer.

Advanced Preparation:

Verify that students can, using their hardware at school, access and run the simulation at: https://traffic-simulation.de/

Implementation:

Part 1:

Begin by asking students if they have ever been in a car or bus that was stuck in slow traffic. Let them share any stories they have.

Ask them what causes traffic jams. Accidents are an obvious answer, but see if they can think of other possibilities, too.

Help students find partners, pass out the student handouts, and get them up and running on the simulation.

In small groups, calculate average times for the low-traffic condition (1,000 vehicles per hour) have each group write its answer on the board. Need a quick review on averages? Check out https://www.youtube.com/watch?v=dPmQS4eSsBw

Lead a discussion in which students compare their answers. Have them discuss why there is so much variability between answers. Consider the possibility that groups were doing their work differently. Did anybody make adjustments using the other sliders that might make their simulation run differently?

Help the groups average their results together to obtain one class average. Discuss why this larger sample size (more vehicles were timed) might be more reliable than a smaller sample size.

Encourage students to work through 2,000 and then 5,000 vehicle traffic in groups and then as a class. Perhaps a volunteer student leader can coordinate the work instead of the teacher this time.

Part 2: Students may suggest another option to alleviate the traffic congestion in addition to the two options given. Help the class decide which groups will evaluate which options. When all the data have been analyzed, facilitate a group discussion and see if the class can reach a consensus on which solution is the best. Ask them to consider combining successful strategies for a better solution.

Video link to add to the discussion https://www.youtube.com/watch?v=2z7o3sRxA5g&t=1s

Debrief Questions:

- When actual engineers use simulations, they don't rely on 5 measurements or even 30. They use thousands. What are advantages of using a large number of measurements?
- What are the advantages of using a computer for this type of work?

Extensions:

The traffic simulation website has many options and features that students might want to explore. Allow them to study one of the other traffic situations and compare two solutions to a problem involving traffic flow. Encourage students to create new options that will help to regulate the flow of traffic. Here are a couple of options:

- If trucks are taken off the roads, how are materials transported? Trains? https://www.youtube.com/watch?v=9poImReDFeY
- What happens to the traffic flow and the time it takes for cars to move in traffic if the amount of truck traffic is set to 0%, 10%, or even 50%?
- What happens when cars are removed from the roadways? Take a look at a superblock. https://www.youtube.com/watch?v=ZORzsubQA_M

Career Connections:

- Mathematicians and Statisticians
- Survey Researchers
- Operations Research Analysts

Name _____ Period_____

Traffic Jam – Student Handout

Have you been stuck in traffic while trying to get somewhere recently? It is a common problem and one that is getting worse. Americans spend an average of one hour a week stuck in traffic trying to get to work. Imagine being trapped in a 62-mile long traffic jam that lasted for an incredible 12 days. That just what happened to the poor folks on the Beijing-Tibet expressways in 2010. For some, the trip took three days. This traffic jam was caused by too many vehicles on the road. As a population grows, highway planners will need to anticipate the increase in traffic. Computer models can analyze how a highway might perform as traffic increases over time. You will use a computer model to compare two different approaches to reducing traffic congestion on a small section of highway.

Procedure: Part 1: Open the simulation at https://traffic-simulation.de/ Spend a minute watching the traffic. Look at the display in the center of the screen. What does the color of each vehicle tell you about its speed?

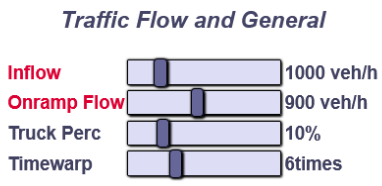
Engineers have installed 3 automated sensors on the highway to detect the passage of vehicles. The sensors resemble double lines running across the road. The first sensor the vehicles encounter will be our **Start Line** at the top of the track. The final sensor that the vehicles cross before they exit out of our field of view will be our **Finish Line**. It is on the bottom of the track. You will not need the one in the middle.

Timing the vehicles

Click on the pause button at the top of your screen to stop the cars from moving. Use your cursor to select an individual vehicle. Make sure to select a car before it reaches the Start Line. You will know that you have an individual vehicle selected when it has a heavy, dark outline. This makes it easier to see and to track this vehicle. Select the green GO! button, to get the cars to start moving again. Time how long it takes your car to reach the Finish Line. You may use a stopwatch or a clock or you may just count the seconds out loud.

Time it took for your car to go from the Start Line to the Finish Line = _____ seconds

Depending on the traffic, it may take some cars longer to reach the finish line than others. To find an average time, you will need to make several measurements. You can adjust the number of vehicles entering the simulation using the “Inflow” slider. Find and adjust the slider to 1,000 vehicles per hour. Use the arrow keys to adjust the



number of vehicles once you have clicked on the slider bar and gotten the number close to 1000. With this amount of traffic, you will determine how long it takes cars to get from the start line to the finish line. Record times for five individual cars. Then calculate the average. Show all your measurements and calculations in the box below.

Car	Travel time in seconds
1	
2	
3	
4	
5	

To find the average, add all 5 numbers together and divide by 5 to get your average time. Average time for 1000 cars _____

Now combine your data with the rest of the class to find the class average. Do the same procedure for 2000 and 5000 vehicles per hour. Record the travel time for each group in the class data table below.

Group Number	Average time for 1000 vehicles per hour	Average time for 2000 vehicles per hour	Average time for 5000 vehicles per hour
1			
2			
3			
4			
5			
6			
Class Average			

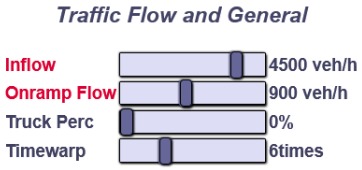
How do the class averages compare to your average?

Which one do you think is more accurate? Why?

Part 2: People living in this area might be very unhappy about the traffic congestion and predictions are for more problems as the population grows. It will take longer to get to work or school. Everyone will expect the local government to solve this problem. Imagine that local leaders hold a meeting to discuss possible solutions. Some ideas emerge:

Option 1. *The highway is not wide enough! We should widen the highway by adding a fourth lane. (You can add a lane to the highway with the blue + button on the top of the screen.)*

Option 2. *Large trucks are the problem! We should require shipping companies to use railroads for transporting freight. Ban large trucks from the highway. (You can change the percentage of truck traffic with the Truck Perc slider bar.)*



Option 3: *What other option might be effective for relieving traffic congestion?*

Your class will divide into groups to evaluate the options.

Prediction: Which option do you believe will be a better for reducing the traffic times?

Which option will your group examine? _____

How will you do it?

Now use the computer simulation to collect and analyze data. Record your data in the space below.

Data chart for YOUR group's observations.

Trial	_____Vehicles per Hour	_____ Vehicles per Hour	Observations
1			
2			
3			
4			
5			
Average			

Share your data with the class and discuss the results.

Based on the data from this trial, which option do you think is a better solution? Defend your answer using your data and calculations, as well as any other factors you think are relevant. **Provide three reasons why your option is the best choice. How could your choice be improved?**

Activity 2: Anger Management

Objectives:

- Explore factors that may cause changes in driving habits.
- Explore potential driver positive responses to changes in road conditions.
- Examine alternative strategies in road engineering that can reduce road rage**.**
- Communicate to peers and the community through an infographic (graphic design).

Background Information:

Road rage is anger caused by inconveniences, incidents, or irresponsibility while driving. It can result in yelling, honking, tailgating, weaving, and blocking traffic. Road rage fatalities are increasing but there are strategies to help lessen road rage. These include overhead signs warning of upcoming traffic, weather, and car or truck incidents. Traffic and travel apps, which offer various route suggestions, travel times, and road hazards, may help as well. This activity will examine personal behaviors that drivers should exhibit to reduce road rage and then asks students to consider strategies to reduce this growing issue.

Materials for a class of 24:

- 12 Game Boards
- 12 Sets of Game Cards
- Printed Game rules
- Printed Chart 2
- Sets of Defensive Driving cards (for Part 2)
- Markers (objects like old game pieces or buttons)
- 12 Dice (one die per group)
- Computer or phone (if possible)
- Paper and color pencils (if technology is not available)

Advanced Preparation:

- Print the game boards, one game board for 2-5 students.
- Print and cut the game cards and the Defensive Driving cards (once set per group)
- Print copies of the Game Rules (one for each student)
- Print copies of Chart 2 (one per group)

Implementation:

Part I. Ask the students for their thoughts about behaviors that they have seen when riding with someone else.

- Have you seen incidents where drivers were polite to other drivers or pedestrians?

- Have you seen incidents where drivers were driving aggressively?
- What were the results of the aggressive driving?
- What road conditions might anger a driver?

Share with students that they will now play a game that explores some of the incidents that may affect driving. Provide a copy of the Game Rules to each student. This includes a chart that each student will fill out during the game. **Do not distribute Chart 2 until after all the students have completed their journey.** When the students have completed their chart, have them use Chart 2 to determine the point values from their die rolls during the journey and find out who won based on total points.

Part 2. Road rage is a factor in more than 50% of all car crashes that end in fatality, according to the AAA. Remind students of their ideas from the opening discussion. Pass out the deck of Defensive Driving cards. Have them work with a partner, look through the deck of cards, and find one or 2 cards with interesting information that they can use to create an infographic. An infographic is a visual that uses engaging images to communicate information quickly and clearly. See the accompanying PPT for examples.

Video Resources:

- What is an infographic? (2:00)
  https://www.youtube.com/watch?v=zvmDi82xEMc
- History of Infographics (4:00)
  https://www.youtube.com/watch?v=uSMLIzPuinE
- Why Do Infographics Matter? (2:00)
  https://www.youtube.com/watch?v=pLDxBbQcwNY
- What Makes an Effective Infographic? (2:15)
  https://www.youtube.com/watch?v=rl9ZcfKt8sY
- 7 Common Types of Infographics (2:45)
  https://www.youtube.com/watch?v=A6_7zC0mB9w

Ask student to brainstorm ways that highways already reduce the poor behavior of drivers. (Things like speed limits, speed cameras, warning signs, and painted lines on the road.) Use some of the information on this site to design an infographic with a useful message for drivers to reduce serious collisions and keep the public safe. Ask students to share their products.

This website has information about road rage in 2021.
https://www.bankrate.com/insurance/car/road-rage-statistics/

Debrief Questions:

- What do you notice about the information presented in the student infographics?
- How long did it take you to understand the “message” of each infographic?

- How could infographics help discourage angry driving?

Extension:

Students may choose to display their infographics outside of the classroom for others to see. Although middle school students do not drive yet, they can take the information and share it with their family members. Anger management is a topic that everyone can appreciate. Prepare an area for students to exhibit this information. A bulletin board or whiteboard will work fine.

Career Connections

- Psychologists
- Graphic Designers

Name _____ **Period**_____

Anger Management Game Rules- Student Handout

- Place traffic game cards face down to the side of the board.
- Roll one die to determine who will go first. The highest number goes first.
- Place a marker for each player in the Start space.
- When it is your turn, roll the die and move that number of squares.
- If you land on a "STOP" square, you lose a turn but you should also draw a card from the top of the card deck. Record the traffic information on the card in the chart below and write what you would do if you were a driver in that situation. (There are some ideas in the box on the right.) Roll a die and record the number. You will use this later to get a score for your trip. Return the card to the bottom of the deck.
- If you land on a "Caution" square, you will need to draw a card from the top of the card deck. Record the traffic information from the card and then write what you would do if you were the driver in that situation. Roll a die and record the number. Return the card to the bottom of the deck.
- If you land on an arrow, move to the space as directed by the arrow.
- Once everyone reaches the finish, it is time to calculate the scores. Your teacher will give you Student Chart 2 that has the point values of your die rolls when you landed on STOP or Caution during the trip. Complete the data chart below to find out how many points to add or subtract and calculate your final score.

What would you do? Examples of driver behavior in traffic incidents
Slow down.
Speed up
Drive on the shoulder to go around
Yell and honk your horn
Find a new route
Stay home or go at a different time
Wait until the path is clear

Traffic Incident from the STOP or Caution card	**What would You do in this situation if you were the driver? (There are many possible answers.)**	**# on the Die Roll**	**Point Value of the die#**

Your Final Score _____

Activity 3: Traffic Management

Objectives:

- Write an algorithm composed of if-then statements.
- Solve real-life and mathematical problems using numerical and algebraic expressions and equations.
- Create and use models to analyze existing systems.

Background Information:

Traffic management in busy urban areas is an extremely complex problem. Issues such as traffic congestion from home to work, suburban growth, preservation of scenic landscapes and historic neighborhoods, and the ability to walk, bike, and access public transit make traffic management a challenge. Traffic Management can include lane closures, detours, pedestrian access, and speed limits. It also includes intersections engineered for safe passage of vehicles in a stream of traffic that must cross each other's paths. Complicating factors for intersections include bikes, pedestrians, and emergency vehicles.

It is the driver's responsibility to be aware of the posted speed limit. In Illinois, the maximum speed limit is 70 miles per hour on interstate highways outside urban areas, 65 miles per hour on rural interstates, 55 miles per hour on interstate highways near or in major cities and on other highways, and 30 miles per hour in an urban area unless some other speed restriction is established. School zones and residential areas post slower speeds.

One of the most common ways to control the right-of-way at intersections is the traffic signal. It does restrict traffic flow causing some vehicles to stop and wait. Automated systems provide help in maximizing the efficiency of such an intersection. Traffic engineering is a high-tech occupation. Essential elements include:

- the traffic signals (lights that drivers can see easily)
- sensors that can detect the presence of vehicles
- a timer
- a simple computer
- computer program to control the lights based on time and sensor input

Other solutions to road intersections include the roundabout, a circular intersection where drivers travel counterclockwise around a center island. There are no traffic signals or stop signs. Drivers yield at entry to traffic in the roundabout, then enter the intersection and exit at their desired street.

Materials for a class of 24:

- Student handouts
- Computer or phone (if possible)
- Paper and color pencils or markers
- 4 toy cars or markers for each group of students

Advanced Preparation:

- Make sure all digital files are downloaded and ready to go before class
- Share any digital documents with the students according to the activity

Implementation: Part I. Speed Limits

Start with a discussion about their experiences on the road:

- Have them list different speed limits they might have encountered while riding in the car.
- Ask students where they see lower speed limits (residential neighborhoods, etc.) versus where they have seen higher speed limits (highways).
- Discuss the reasons for the variations in speed limits and ask them what might happen if there was just one speed limit, regardless of location.

Have the students work through Part 1 of their handout, calculating average speeds.
Speed is the distance covered per unit of time. Speed also requires a unit of measurement. If the distance is in miles and the time is in hours, then the unit of measurement of speed is miles per hour or mi/hr. For example 55 miles per hour. In each hour of travel at that speed, the car would go 55 miles.

Speed = Distance Travelled / Time Taken

Problem 1: A car travels 90 miles in 2 hours; find the average speed of the car.
__45____ miles per hour

Problem 2: A car is stuck in traffic and travels a distance of 4 miles in 30 minutes.
*Remind students to change the 30 minutes into .5 hours.

What was the average speed of the car?
___2___ miles per hour

Problem 3: A bus route covers a distance of 60 miles in 5 hours. Find its average speed.
___12___miles per hour

Problem 4: The speed limit in the downtown area is 25 m/hr. An officer notices that it took .02 hour (1.2 minutes) for a driver to travel between Main Street and Town Road, a distance of half a mile. He issues a speeding ticket, even though he didn't have a radar gun. Should the driver challenge the ticket citation? What evidence could the driver show to prove their innocence?

Yes. The driver was traveling at the speed limit of 25 m/hr. Distance of .5 miles divided by .02 hours = 25 m/hr. Maps of the city to verify the distance between Main Street and Town Road.

Part 2: Intersections

Show a video about traffic signals to guide a class discussion. Ask students to share any personal or background knowledge about traffic signals. Remember that they are not driving yet and may not have paid much attention as passengers.

https://youtu.be/Hj87mH_a4jk

https://www.youtube.com/watch?v=TW0Eq2Q-9Ac

https://www.youtube.com/watch?v=i7pgW6AS4zE&t=224s

https://www.youtube.com/watch?v=PaaY7XAau14

Prompt the students to think about a way to write step-by-step instructions for a series of stop lights. Traffic signals must work together for a traffic flow to be constant and efficient.

Review the idea of If-then statements. These are conditionals, an action that occurs if something specific happens. If-then statements are used in programming to trigger a set of instructions. For example, **if** tomorrow is less than 80 degrees, **then** I will play soccer with my friends. **If** it is more than 80 degrees, **then** I will stay inside the house. Provide students with examples to complete:

- If it is cold outside then I will wear ___
- If it is rainy then I will wear ___
- If a cell phone battery charge is 0 then ___
- If the microwave reaches the time set for cooking then ___

Go over the specifications for students to consider while writing their program. Open the Powerpoint slide “Intersections” for the students to work from. There are 3 intersection options. Choose the one most appropriate for the skill level of your students.

If the students are using #1 or #2, have them make a model of their intersection using paper and markers. Use small toy cars or markers to simulate the action of the intersection. If the students are using intersection #3, ask them to work through https://traffic-simulation.de/roundabout.html. Lights can be added at places on the streets that feed into the roundabout with click and drag movements.

Students will develop a set of instructions that use if - then statements. For example,

If light #1 if red, Then light #3 is also red

If light #1 and #3 are red, Then lights #2 and #4 are green.

Here is an example of a short sequence that might be used for the lights at Intersection #1.

If	Then
Lights 1 and 3 are red	Lights 2 and 4 are green
Lights 2 and 3 are green	Lights 1 and 4 are red
If a pedestrian wants to cross Main street	Lights 2 and 4 are red

Students will write their if-then statements in a way that will mimic a pre-coding set of instructions in order to transfer it into a computer program. There is no “one correct solution”.

When assessing students’ work, focus on their *intent*. You are not expecting them to write a functional program. That would require more than if-then statements. The emphasis of this activity is to think abstractly, work with numerous variables, analyze data, and apply it to a complex, real-life situation.

Programmers often write out the algorithm (series of logical steps) in a “short-hand” version similar to what students are doing here, before converting it into the actual code.

Allow as much time as possible for the students to organize and interpret their findings. At the end of the activity, students will share their program and intersection diagram with the rest of the class by displaying it in a gallery walk. One student from each group will travel to see other programs and one student will stay with their program and explain it to other students. They can then switch roles to repeat the process.

Debrief Questions:

- What was the most difficult part of this activity?
- How would you adjust your program to accommodate the right of way for emergency vehicles?
- How would you adjust your program traffic for heavier traffic on one of the roads?

Extension

Ask students to consider the changes needed when pedestrians are added to the intersection. Here is an example of a busy street in Vietnam with no traffic lights and no pedestrian signals.

https://www.youtube.com/watch?v=BGM8APNHkQs

Career Connections:

- Technical Writers
- Programmers
- Software Developers, Quality Assurance Analysts, and Testers

Name _____ Period_____

Traffic Management - Student Handout

Part I: Speed Limits

It is the driver's responsibility to be aware of the posted speed limit. In Illinois, the maximum speed limit is 70 miles per hour on interstate highways outside urban areas, 65 miles per hour on rural interstates, 55 miles per hour on interstate highways near or in major cities and on other highways, and 30 miles per hour in an urban area unless some other speed restriction is established. School zones and residential areas post slower speeds.

The Illinois State Police have several methods to determine whether a driver is obeying speed limits. They hand-held radar, moving radar, pacing, laser speed measurement devices, photo speed enforcement and air speed measurement to determine the speed of vehicles. Radar uses radio waves that bounce off moving vehicles. The laser devices use laser light beams that bounce off a moving vehicle. The state police operate a fleet of aircraft for speed enforcement using the stopwatch method of measuring vehicle speeds. This calculates the time it takes a vehicle to travel between two points and converts that to vehicle speed.

Speed is the distance covered per unit of time. Speed also requires a unit of measurement. If the distance is in miles and the time is in hours, then the unit of measurement of speed is miles per hour or mi/hr. For example 55 miles per hour. In each hour of travel at that speed, the car would go 55 miles.

Speed = Distance Travelled / Time Taken

Problem 1: A car travels 90 miles in 2 hours; find the average speed of the car.
_____ miles per hour

Problem 2: Broken down truck in the roadway! You are stuck in traffic and travel 4 miles in 30 minutes. What was the average speed of your car?
_____ miles per hour

Problem 3: A bus route covers a distance of 60 miles in 5 hours. Find its average speed.
_____miles per hour

Problem 4: The speed limit in the downtown area is 25 m/hr. An officer noticed that it took .02 hour (1.2 minutes) for a driver to travel between Main Street and Town Road, a distance of half a mile. He issues a speeding ticket, even though he didn't have a radar gun. Should the driver challenge the ticket citation? What evidence could the driver use to prove their innocence?

Part 2: Intersections

You are a traffic engineer and you need to design a set of logical instructions to control the traffic signals at a new intersection of a busy road. You will create a flowchart or program and a poster to share with the rest of the class. There are 3 intersection diagrams.

If you are using intersection #1 or #2, then create a paper model of your intersection. You will use toy cars to model the flow of traffic. If you are using intersection #3, you will do your modeling on the computer. Create a drawing of your intersection.

Lights on the intersections are labeled #1 through #4. You will develop a set of instructions that use **if - then statements. For example,**

If light #1 if red, Then light #3 is also red

If light #1 and #3 are red, Then lights #2 and #4 are green.

Here is an example of a short sequence for intersection #1.

If	Then
Lights 1 and 3 are red	Lights 2 and 4 are green
Lights 2 and 3 are green	Lights 1 and 4 are red
If a pedestrian wants to cross Main street	Lights 2 and 4 are red

Use the following charts to organize a **step-by-step** process for controlling the lights.

If	Then

After organizing and analyzing your data, create a poster either digital or physical using paper and color pencils displaying your program and your intersection diagram and share it with the rest of the class.

How would you adjust your program to accommodate the right-of-way for emergency vehicles?

How would you adjust your program in order to consider heavier traffic on one road compared to the other one?

Activity 4: Information Board

Objectives

- Explain and interpret data tables and graphs and find the corresponding data description
- Create data based questions
- Investigate patterns of association in bivariate data.
- Summarize numerical data sets in relation to their context.

Background Information:

In 1969, the National Household Travel Survey (NHTS) began collecting data about Americans' travel habits. During the survey period, each household was sent a travel diary and asked to report all travel by household members on a randomly assigned "travel day". Data were weighted to correctly reflect the day of week and month of travel to allow comparisons of weekdays or seasons. The type of transportation used, length and distance of trips and the purpose of travel are some examples of data gathered through the surveys. Organizations such as insurance companies, transportation agencies, and the government analyze and use the data to make decisions. In this activity, students will look at 8 tables or graphs from the survey and then find a corresponding description. Data cards are from the NHTS survey https://nhts.ornl.gov/2009/pub/stt.pdf

Materials for a class of 24:

- 12 Sets of graph/table set cards
- 12 Data description cards
- 24 blank note cards
- Copies of Student Handout
- Computer or phone (if possible)

Advanced Preparation:

- Print and cut 12 sets of graph/table cards and 12 sets of description cards. One set of each for every 2-3 students.
- If a larger display of the graphs is helpful, a Powerpoint set of slides with graphs in color is available.
- Graphing and data table review might be helpful for some students. Here are a few resources to consider.
    - https://www.scholastic.com/teachers/sponsored-content/unexpected-math/17-18/bars-lines-and-pies/
    - https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/section/1.31/primary/lesson/scientific-graphing-ms-ps/
    - https://www.buffaloschools.org/Page/40356

Implementation: Part 1:

Engage students in a discussion about data using questions such as:

- How do you think decisions are made about new road construction, changes to intersections, or speed limits?
- What data might be needed to help make decisions about a highway problem?
- Can you think of a local problem with highways or roads that needs to be solved?
- Would data collection be useful to help solve the problem? Explain.

Share with students that they will be looking at data from a survey taken about transportation patterns from a large sample of people. Explain that each group will receive two sets of cards. One set contains data in the form of a graph or data table. The other set contains descriptions of the data. Their groups need to match a data card with a corresponding description card. The Powerpoint slides have the answers as well in the notes of each slide.

Answer key

A = 4	B = 7	C = 2	D = 3
E = 1	F = 8	G = 6	H = 5

Part 2:

1. After all the groups have had a chance to match their cards, host a class discussion for students to share their ideas. Ask the students to share any matching set they believe is correct. Ask the class to explain why they agree or disagree.
2. Next, each group should select a matching set of cards, and use the information to create 2 questions that can be answered using the card set. Write each question on a separate blank note card. Caution students not to give hints about which graph or description the question is tied to. Groups place their questions in a common location, such as a wall or table. Questions are placed face down on the board or table.
3. One person per group will select a question from the wall and bring it to their group. When a group finishes answering the question, a member stands up and says, “Information Board.” This person then reads the question and their answer to the class. If the answer is correct, the authors say, “Correct,” and if it is incorrect, the authors say, “Revise.” Repeat this process for the remaining questions.

Debrief Questions:

- There are many ways to represent data sets. Make a list of some of the common representations that you have seen with this activity.
- Are some graphs or data tables easier to interpret? Why or why not?
- How do graphs or data tables help a person analyze data?

Career Connections:

- Mathematicians and Statisticians

Name _____ Period_____

Information Board - Student Handout

1. Shuffle your two decks of cards together and place the cards face up on your desk.
2. Work with your group to match a data table/graph card to a description card. Record the matches in the table below.
3. As a class, come to consensus as to the matches.

A =	B =	C =	D =
E =	F =	G =	H =

4. In your group, select **one** set of matching cards. Use the information on the cards to develop 2 questions about travel habits that can be answered using the information on the cards. Write each question on a separate blank note card. Do not give hints about which graph or description the question is tied to. Place the questions in a common location, such as a wall or table. Questions are placed face down.

5. When it is your turn, have a person from your group go up to the question area and select one of the questions. You may not select your own.

4. Work on answering the question in your group. When your group has the answer, have a person stand up and say, “Information Board.” Read the question and then tell which data table/graph or description that it matches.

5. The authors of the question will say, “Correct,” if your answer is correct. If it is incorrect, then they will say, “Revise.”

6. If it is, “Revise,” then continue working on that question.

7. Once you have correctly answered the question, your group selects another question.

8. Continue to play the game using the same rules so that all groups have had a question discussed.