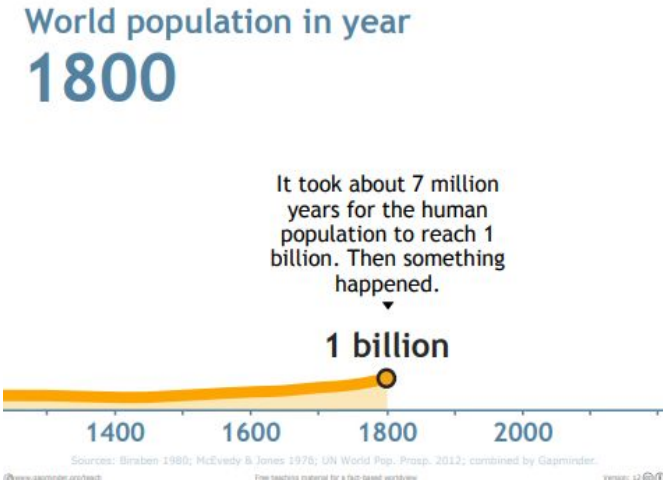
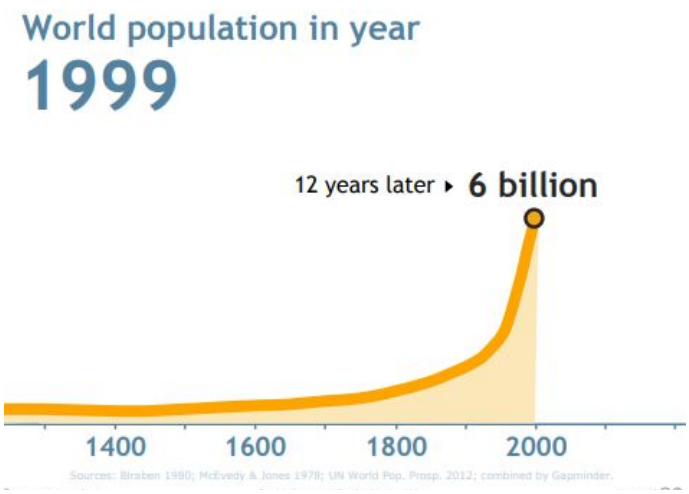
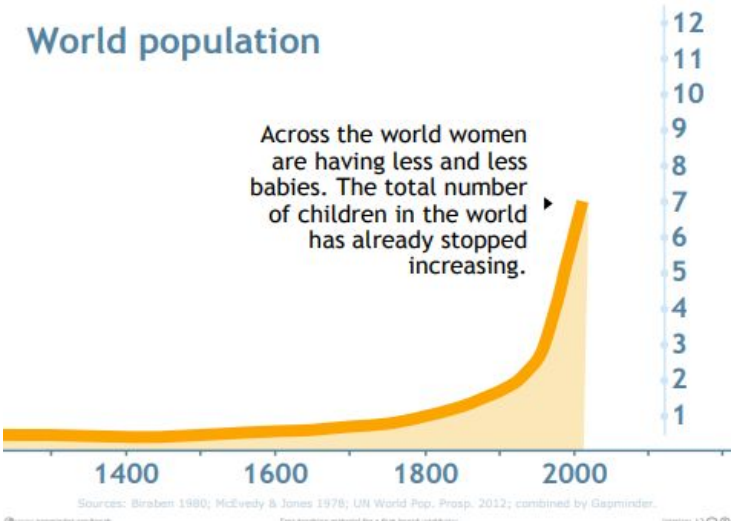
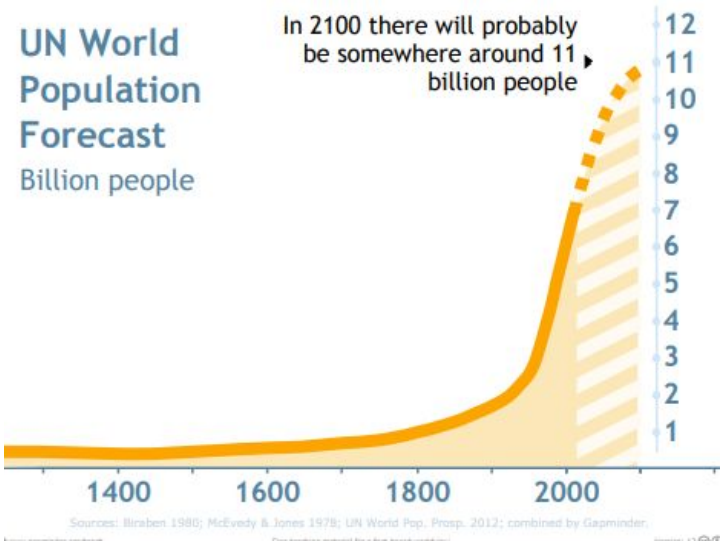
Data: World Population (Gapminder)









This data is from GapMinder. Before showing these graphs show the following video about how they can predict the change in population. There are two ways to show this data; it can either be shown in the form of the photos above or in the How did the world population change video (Gapminder (Ed.). (n.d.)).

How does the data serve as an engaging context for the math concept?

The data above is a real-world example of exponential growth that can start the beginning of an exponential unit for Algebra 1 students. Exponential functions are more real-world applicable due to the nature of the function than some of the other functions studied in Algebra 1. The data will allow students to see how the population has changed over time and how it

continues to increase as more people are being born, and the populations all over the world are rapidly evolving. They can look at outside factors and have discussions about the changes in population over time and how it might be due to life expectancy and the number of births each year. Using these data Algebra students will be using prior knowledge of patterns and abstract reasoning to find the trend and equation that demonstrates exponential growth. To do this, students will have to take data given to them in the photos and begin to see how it changes over time. As they go through this process, and through guiding questions, they will get to an equation to model the trend. From this equation, they will be able to calculate the approximate population when they were born, when they will graduate from high school and of a year of their choosing.

What is the measurable objective of the activity?
Students will be able to:

- Use data to create a table to find trends in given data
- Create an exponential function from a graph
- Classify exponential growth and decay
- Determine values using a created exponential function

CCSS-M Practice Standards:
CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them.

CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively.

CCSS.MATH.PRACTICE.MP4 Model with mathematics.

CCSS.MATH.PRACTICE.MP7 Look for and make use of structure.

CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning.

Source: Standards for Mathematical Practice. (n.d.)

CCSS-M principles addressed- Write out each objective completely.
CCSS.MATH.CONTENT.HS.A-SSE.A. Seeing Structure in Expressions: Interpret the structure of expressions.

Interpret expressions that represent a quantity in terms of its context.★ (CCSS: HS.A-SSE.A.1)

a. Interpret parts of an expression, such as terms, factors, and coefficients. (CCSS: HS.A-SSE.A.1.a)
b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $p(1+r)^n$ *as the product of* P *and a factor not depending on* P. (CCSS: HS.A-SSE.A.1.b)

CCSS.MATH.CONTENT.HS.A-CED.A. Creating Equations: Create equations that describe numbers or relationships.

a. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*(CCSS: HS.A-CED.A.1)
c. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* (CCSS: HS.A-CED.A.3)

CCSS.MATH.CONTENT.HS.F-IF.C.8.B Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.* (CCSS: HS.F-IF.C.8.b)

CCSS.MATH.CONTENT.HS.F-BF.A.1.b Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* (CCSS: HS.F-BF.A.1.b)
Source: Colorado Department of Education. (2019).

Collect evidence regarding the use of data in the classroom.

For this Data project through exponential functions, I was unable to try it with students as we are out for the summer. I do plan to use this during the year next year so that I can see the difference in understanding from this year's students to future years. I have not done many activities like this data project, but I do believe based on the research that we have been given in this class already this way of thinking is much more valuable than just notes and practice problems.

One of the things that I think is going to help students grasp the concept better is the idea that this connects to their lives outside of the classroom. Population growth affects everyone and can be helpful to understand. I think that connecting topics like this to mathematical patterns and properties allows for students to see a bigger picture behind why we are doing the math.

A lesson that I have done in the past that incorporates data into the classroom is my scatterplot project. The project lends to a lot of freedom of choice for the students around the questions they want to analyze. They have to have at least two numerical questions to ask students, for example, how many movies have you seen this year, and then collect the data from their peers. From there, we talk about what the data tells us. Last year, I talked them through making a two-way table, and we did it all together. With the open-ended questions in mind, I

think in future classes, I will ask them what they think they should do with the data? How can you use the data to your benefit? Then I will let them struggle a little to come to their conclusions before teaching them about two-way tables and scatter plots.

Since I was unable to do this lesson, I have created a few assessments that I would give my students during this activity as well as at the end of the unit. I will also include a survey that provides the teacher with student feedback.

Formative Assessment (Exit Ticket after population activity):

Exit Ticket: Population Growth

Name:_____Period:_____

Complete the following summary:

3 things I noticed:

1.
2.
3.

2 things I wonder:

1.
2.

1 question I still have:

1.

Answer the following question

If the population started at 108,000 people in 1800 and it grew at the same rate as the data, we look at today how many fewer people would there be on the year you were born?

Survey (after population activity or at the end of the unit):

Project Survey

Name:_____Period:_____

On a scale of 1-5 with 5 being the highest answer the following questions.

This project was engaging

1 2 3 4 5

This project was helpful to my learning.

1 2 3 4 5

This project made me think.

1 2 3 4 5

This project helped me get a deeper understanding of the material.

1 2 3 4 5

The best part of the project for me was (explain) :

The most challenging part of the project for me was (explain):

If I were to do this project again, one thing I would like to see changed:

Summative Assessment (This is the exponential test I gave this year with a few modifications to add the data element- changes will be in blue).

Chapter 6 Test: Exponential Functions

Calculator Active:

Determine whether the table represents an *exponential growth/decay function*, a linear function or *neither*. If exponential or linear, write the equation that models the data.

x	1	2	3	4
y	72	36	18	9

1.

Linear or Exponential growth or Exponential decay or neither (Circle one)

Equation:_____

x	2	4	6	8
y	5	8	11	14

2.

Linear or Exponential growth or Exponential decay or neither (Circle one)

Equation:_____

7. You deposit $500 in a savings account that earns 7% interest compounded ***monthly***.

a. Write a function that represents the balance after *t* years.

b. What is the balance after 2 years? Show all of your thinking.

8. Solve for x: $(4)^{x+2} = 6$

Round to the nearest 100^{th}. Sketch your graph, and label the solution.

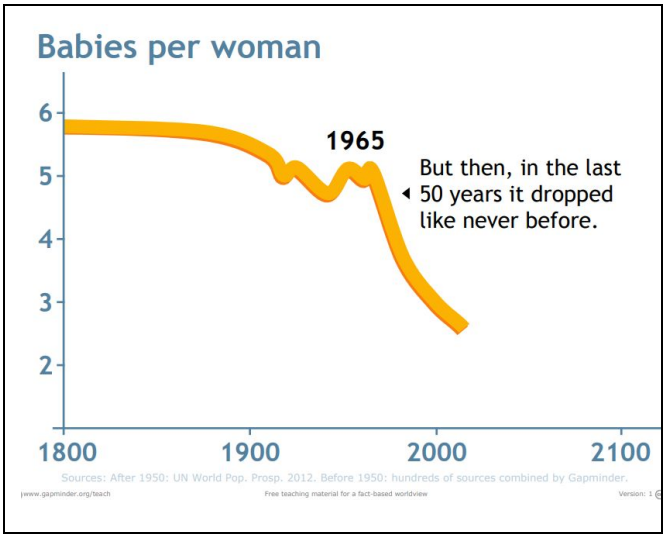
9. You buy a used car for $6599. Its value decreases by 12% every year.

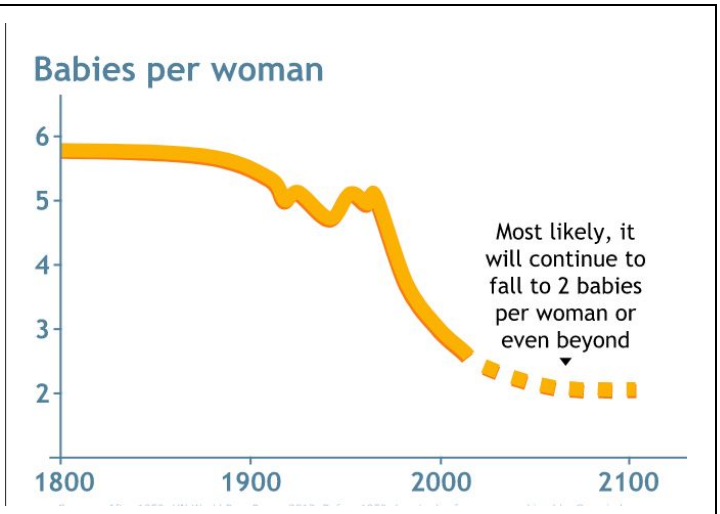
a. Write a function that represents the value y (in dollars) of the car after t years.

b. What is the value of the car after 2.5 years? Show all of your thinking.

c. When will the value of the car be $1000? Show all of your thinking. Round to the nearest 100th.

Use the following data to answer the questions below.





What do you notice from 1965 to 2100?

Approximately when will the babies per woman hit precisely 2? Explain how you found your answer.

Jamie believes that based on the trends in the data in the year 2220, there were only be 0.5 babies per women. James disagrees with her and says there will still be two babies per woman in 2220. Whom do you agree with and why?

Resources:

Colorado Department of Education. (2019). 2020 Colorado Academic Standards Online. Retrieved May 29, 2019, from https://www.cde.state.co.us/apps/standards/

Gapminder (Ed.). (n.d.). How Did The World Population Change? Retrieved from https://www.gapminder.org/answers/how-did-the-world-population-change/

Free Videos from Gapminder.org

Gapminder (Ed.). (n.d.). How Did Babies per Woman Change in the World? Retrieved from https://www.gapminder.org/answers/how-did-babies-per-woman-change-in-the-world/

Standards for Mathematical Practice. (n.d.). Retrieved May 29, 2019, from http://www.corestandards.org/Math/Practice/