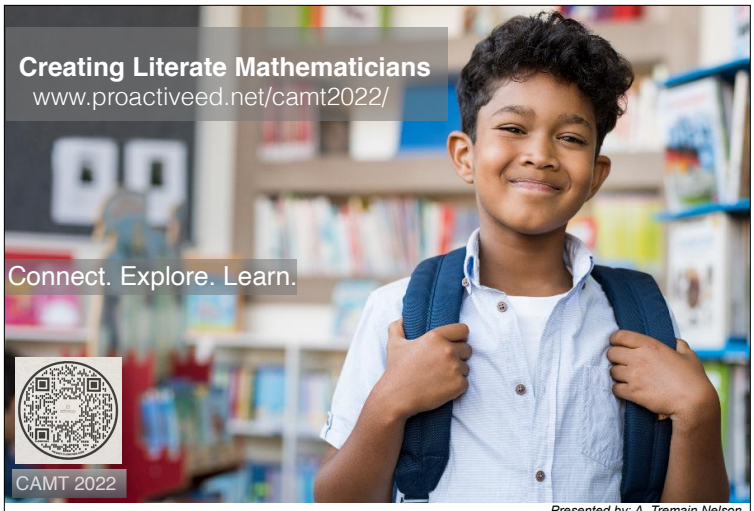

Presented by: A. Tremain Nelson

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OUR CONVERSATION

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A LITTLE ABOUT ME...

Husband - Father - NASA Engineer - Math Teacher - Administrator - S.T.E.A.M. Advocate

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LET'S STAY CONNECTED...

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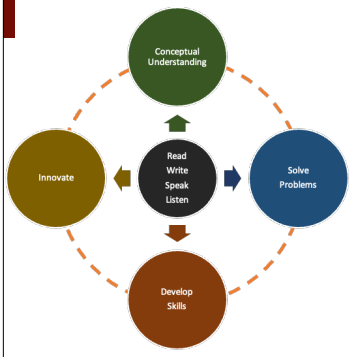
WHAT IS MATH LITERACY?



"Mathematically literate students can read, write, speak, and listen using the language of mathematics to acquire conceptual understanding, develop skills, solve problems, and innovate within mathematics."

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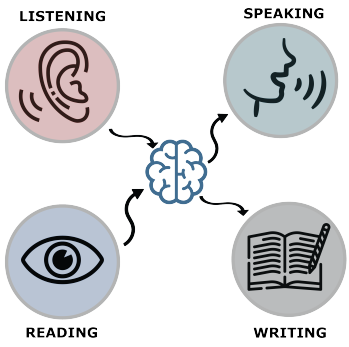
WHAT IS LANGUAGE ACQUISITION?

Language Acquisition is the process of understanding a language and using it to communicate with others.



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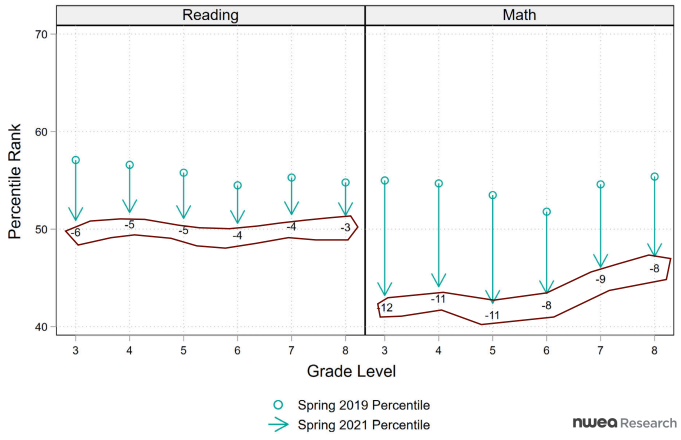
THE IMPACT ON LITERACY



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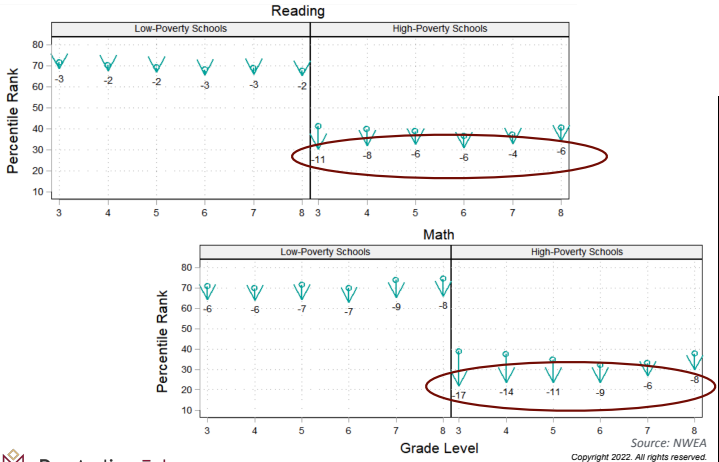

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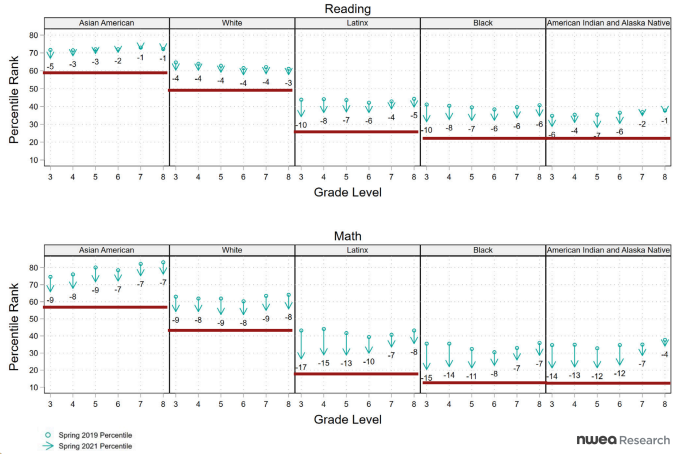

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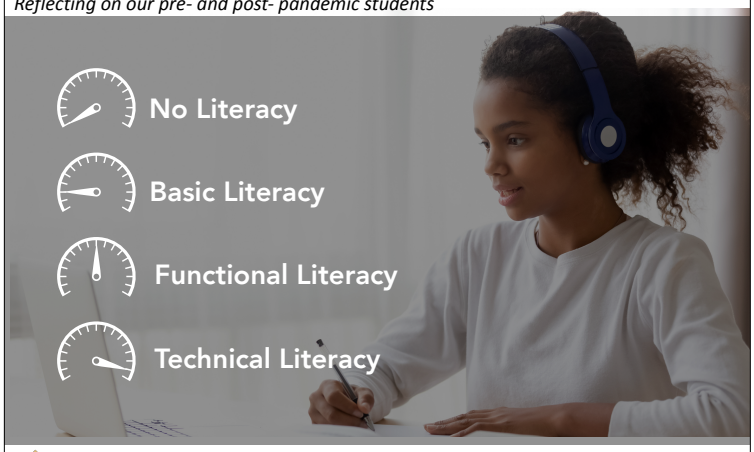
CREATING LITERATE MATHEMATICIANS

Reflecting on our pre- and post- pandemic students



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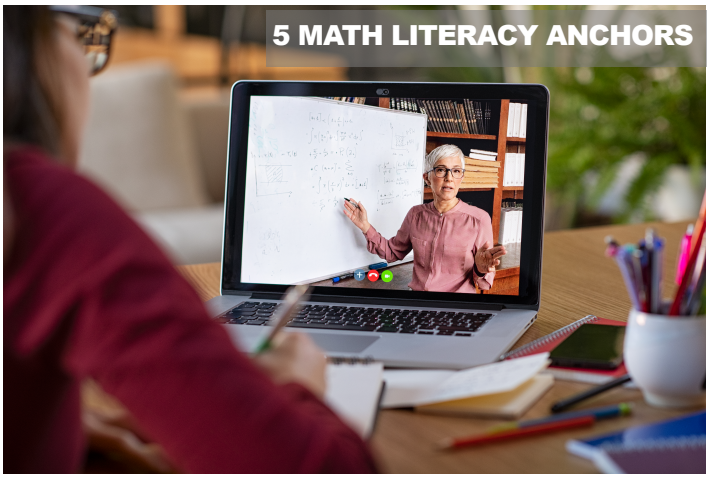

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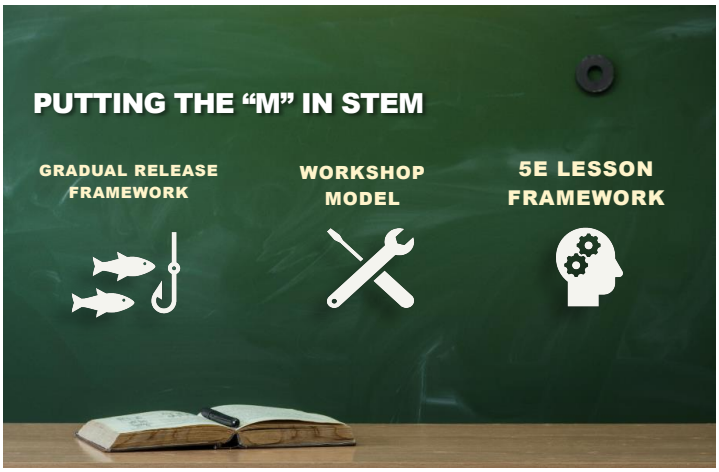

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CREATING LITERATE MATHEMATICIANS

5E LESSON FRAMEWORK

- **Engage –** Capture students' interest
- **Explore –** Develop conceptual understanding
- **Explain –** Facilitate H.O.T. questions and answers
- **Extend/Elaborate –** Increase students' Depth Of Knowledge (DOK)
- **Evaluate –** Embed Performance Tasks

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ANCHOR 1 - ENGAGE & EXPLORE: ACADEMIC DISCOURSE

Teaching Tip:
Use academic discourse to build academic vocabulary.

Scavenge for Systems

Math describes the world around us, and systems of equations are no different. A system is a set of things working together using shared parts. In the railroad system, trains share the same tracks. In the solar system, planets and the sun share gravity. In the digestive system, the stomach and intestines share nutrients from food. Just like these systems, in a system of equations, two or more equations share variables.

Systems have shared parts that depend on each other. That is, if we change something in one part of the system, it may have an impact on the whole system. For example, if we remove railroad tracks then the entire railroad system would stop working. If we changed the position of the sun, that could be disastrous for the entire solar system.

Stop here and write down as many other systems as you can think of:

Now, look around the room you're in and try to find even more systems!
They are all around us!

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ANCHOR 1 - ENGAGE & EXPLORE: ACADEMIC DISCOURSE

Scavenge for Systems

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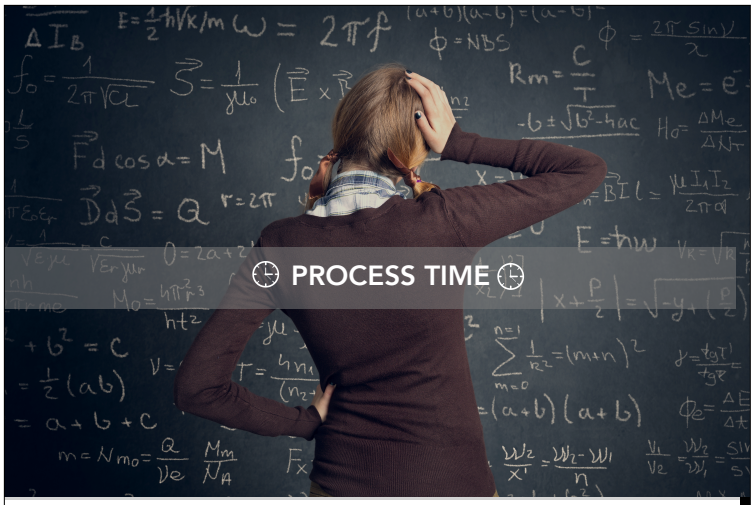

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ANCHOR 1 - ENGAGE & EXPLORE: ACADEMIC DISCOURSE

Common Topics	Scavenger Hunt
Addition and Subtraction with Regrouping	Composition and Decomposition
Multiplication and Division	Equal Groups
Fractions and Decimals	Part-Whole Relationships
Systems of Equations	Shared Parts
Rational Expressions	Boundaries
Imaginary Numbers	Circular Motion
Integrals and Derivatives	Composition and Decomposition

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ANCHOR 2 - ENGAGE & EXPLORE: CONCEPTUAL UNDERSTANDING

Teaching Tip: Use the scientific method to develop conceptual understanding.

Hypothesis: Equations must be balanced in order to be true.

Materials: 1 hanger, pencil, tape, 2 cups, 4 strings, 5 opaque bags of marbles, spare marbles

Procedure:
Step 1: Gather your materials.
Step 2: Use your hanger, pencil, cups, and strings to create your balance.
Step 3: Place 1 of your bags on the left side of your balance.
Step 4: Use your spare marbles to determine the number of unknown marbles in the bag. Observe what happens when the number of marbles are and are not the same.
Step 5: Write an equation that describes the number of unknown marbles in the bag. How does this equation prove equations must be balanced in order to be true?

Conclusion: This experiment shows that we can determine an unknown quantity by keeping the scale balanced. When the scale wasn't balanced we did not know the correct number of marbles. Therefore, equations must be balanced in order to be true.

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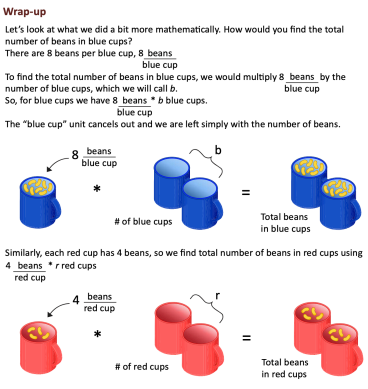
ANCHOR 2 - ENGAGE & EXPLORE: CONCEPTUAL UNDERSTANDING

Teaching Tip: Use conceptual understanding to accelerate problem solving and procedural fluency.



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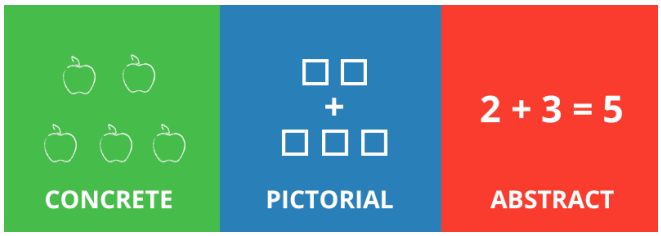
ANCHOR 2 - ENGAGE & EXPLORE: CONCEPTUAL UNDERSTANDING



Teaching Tip: Concrete representations can accelerate conceptual understanding.

National Institute of Education Nanyang Technological University Singapore

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ANCHOR 2 - ENGAGE & EXPLORE: CONCEPTUAL UNDERSTANDING

Real World Problems

You are going on vacation and you are driving down the freeway headed east at 60 miles per hour. How far would you be after 7 hours if you drive at a constant speed?

Concrete Representations

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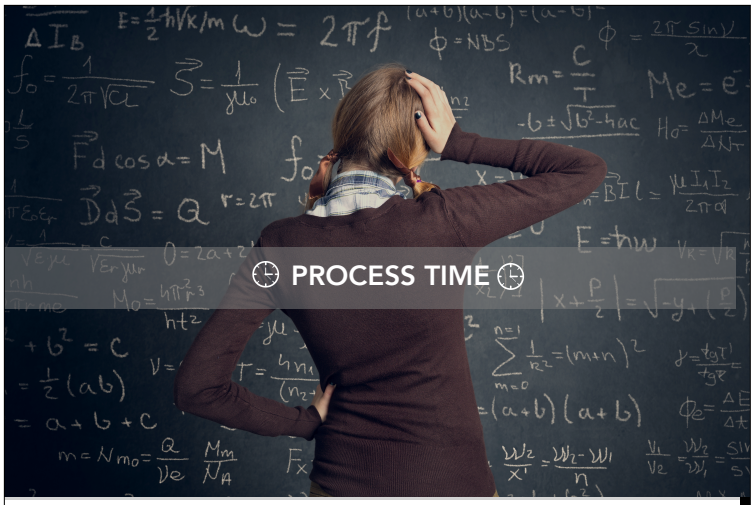

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ANCHOR 2 - ENGAGE & EXPLORE: CONCEPTUAL UNDERSTANDING

Common Topics	Concrete Representations
Addition and Subtraction with Regrouping	Sticks and Place Value Mats
Multiplication and Division	Building Blocks
Fractions and Decimals	Color Wheels
Systems of Equations	Cups and Beans
Rational Expressions	Clay and Topographical Maps
Imaginary Numbers	Pencil and Flashlight
Integrals and Derivatives	Building Blocks

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ANCHOR 3 - ELABORATE AND EXPLAIN: INFORMATIONAL TEXT

Teaching Tip: Use informational text to allow for language acquisition to occur at the pace of the reader.

Reading & Writing Instructions

Identify the Craft and Structure

- Find and highlight definitions for systems of equations and solutions.
- Write your own definitions in the margins.
- Share your definitions with a partner.
- Read the passage and stop at every word you don't know. Place a dot above the words and keep reading.
- Compare your dotted words with a partner and try to figure out what they mean.
- Write your meanings in the margin
- Reread the passage using your definitions.

Find the Key Ideas and Details

- What is the text about?
- What are the different ways to solve a system of equations?

Integrate Your Knowledge and Ideas

- Provide an example of a system of equations.
- How do you use graphing to find the solution to a system of equations?
- How do you use substitution to find the solution to a system of equations?
- How do you use elimination to find the solution to a system of equations?

Write: Letter to Your Parent or Guardian

Write a summary explaining what systems of equations are and how to solve them.

- Describe what you learned about systems of equations.
- Explain at least two strategies for solving a system of equations.
- Provide your own examples of each strategy you describe.
- Provide examples of systems of equations in the real world.
- Use complete sentences, diagrams, and pictures as needed.
- Include at least 2 vocabulary words in your writing.

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ANCHOR 3 - ELABORATE AND EXPLAIN: INFORMATIONAL TEXT

Teaching Tip: Use informational text to allow for language acquisition to occur at the pace of the reader.

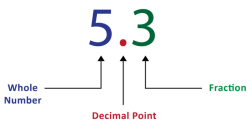
Diving into

What are Decimals?

In the Explore section, you did a lot of work with part to whole relationships. You used wheels, grids, and rulers to show how a whole can be divided into equal parts to represent a number less than one.

Decimals are a way to express these part to whole relationships. The prefix "deci" means 10. Decimals are a base 10 system, which means that the whole gets divided into powers of 10 (such as 10, 100, 1000, etc).

Decimals contain a **decimal point** which looks like a period and is used to separate the whole number on the left from the fraction on the right.



Place Value

Since decimals are a base 10 system, each place value is a power of 10. You already know the place values of whole numbers: ones, tens, hundreds, thousands, etc. Remember, the fraction portion of the number is to the right of the decimal point. A fraction is a number that is less than one. When a whole number is divided into pieces using a base 10 system, the fewest number of pieces that it can be divided into is ten. Therefore, the first place to the right of the decimal point is tenths. The next power of 10 is 100, so the next place value is hundredths. The next power of 10 is 1000, so the next place value is thousandths.

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ANCHOR 3 - ELABORATE AND EXPLAIN: INFORMATIONAL TEXT

Teaching Tip: Use informational text to allow for language acquisition to occur at the pace of the reader.

Dear Dad and Mom,

Today, I will be teaching you about decimals. Decimals are just another way to represent fractions and they are also part of a whole of a fraction. Decimals have place values. The different values in decimals are tenths, hundredths, and Thousandths. Did you know that also, Decimals can be related to fractions!? For example, 0.5 is equal to 5/10, and the reason why is that the 5 in the decimal is in the tenths place which makes the statement true that 0.5 is related to 5/10.

Another way of showing decimals is to compare. To compare 2 decimals, is to figure out which decimal is bigger or to just add a zero so that way students can see the difference in between the two decimals. Lastly, What happens to the decimal point when a number is being multiplied or divided? For example say like 0.23x1000=230, and the reason why the answer turned out to be 230 is because with the times

1000, I moved three place values over to the right which gave me an answer of 230. And if it was being divided by 1000 it would move three decimal places over to the left which gives students an answer of 0.0023. Let's try multiplying and dividing by 100. So say like, 0.672 x 100= 067.2 because I moved 2 decimal places over to the right.

And if students divided 100 by 0.672 it would give the student a total of 00.672 because when dividing, we're moving to the place values on the left and if we're multiplying, we're moving over to the decimal place values on the right.

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ANCHOR 3 - ELABORATE AND EXPLAIN: INFORMATIONAL TEXT

Teaching Tip: Use informational text to allow for language acquisition to occur at the pace of the reader.

Today I learned more about decimal fractions. Decimal fractions have a whole number, a decimal point, and a fractional part. A decimal fraction can be turned into a common fraction or an equivalent fraction. You can even break up a decimal fraction into an equation. For example, "6 x 10 + 7 x 1 + 5 (1/10) + 3 x (1/100) + 9 x (1/1000)" and the product is 67.539. But to get into what you are reading this letter for is because Mrs. Schmitt made me too..... JUST KIDDING, you came here to know what a decimal fraction is, A decimal fraction is a fraction where the denominator is a power of ten, such as 100 and 1,000.

A decimal point is what is used to represent a decimal fraction. You say the decimal point has and. A decimal point is also what separates a whole by the fractional part. The fractional part goes below the ones. For example, it's like coins! Coins go below the ones. So if you see a place value system, it kind of goes like this, Trillions, Billions, Millions, Thousands, ones, DECIMAL POINT, Tenths, Thousandths, and Millionths.

To understand a little more about the decimal system, you do not start from one because if tenths look like 1.3 then you couldn't do ones. In the decimal system you had "ths" To the end of the word. Tenths look like 3.4, you say this as three and 4 tenths. So if you

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ANCHOR 3 - ELABORATE AND EXPLAIN: INFORMATIONAL TEXT

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ANCHOR 3 - ELABORATE AND EXPLAIN: INFORMATIONAL TEXT

Teaching Tip: Use informational text to allow for language acquisition to occur at the pace of the reader.

I will teach you how decimal work and what is decimal

- First I'm gonna tell you what decimals are . Decimals are an equal part of wholes . Like for example 2.78 it would be two and seventy eight hundredth it very nothing complicated
- In addition now I'm going to explain the place value to the right side of decimal point one is in the middle between the decimal numbers and the regular 10 100 100 that is called the whole number and add the decimal point and now the decimal number they are call tenth hundredth and thousandth
- Furthermore Have you wonder what the same between fractions and decimal they both have different parts of a whole
- Then I going to compare fraction and decimal is they both are parts of fractions
- Finally now have you wonder what happen when the decimal point is divided or multiplied so if it times the dot go on the right and if it division go on the and the leftover over holes you put zero s

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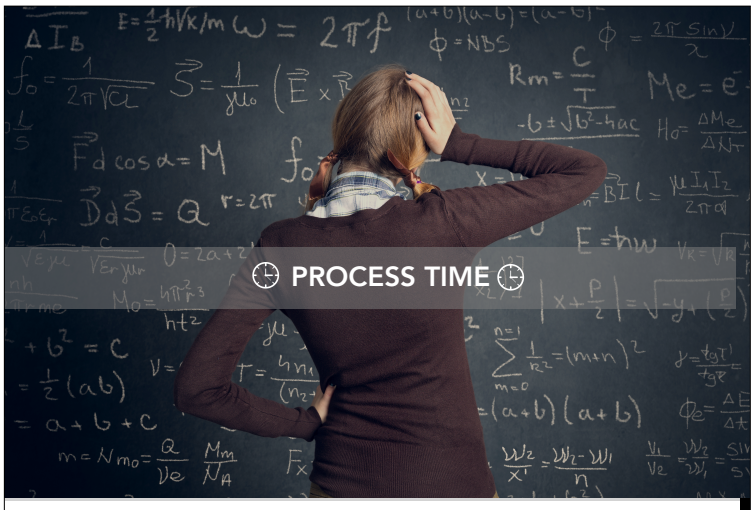

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ANCHOR 3 - ELABORATE AND EXPLAIN: INFORMATIONAL TEXT

Common Topics	Reading Passages
Addition and Subtraction with Regrouping	Mission of Addition Action of Subtraction
Multiplication and Division	The Power of Equal Groups
Fractions and Decimals	Diving Into Decimals
Systems of Equations	What's the Point?
Rational Expressions	The World's Boundaries and Borders
Imaginary Numbers	Simplifying the Complex
Integrals and Derivates	Build it Up. Tear it Down.

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ANCHOR 4 - EXTEND AND EVALUATE: S.T.E.M. PROJECTS

PARALLEL LINES

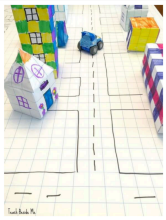
Teacher Tip:
Make authentic connections between conceptual understanding and STEM projects.

The Geometric City

In this S.T.E.A.M. Challenge, you will need to create a model city with certain specifications for the location of buildings and roads. The buildings in your model city need to be three-dimensional and stand without support.

You are going to need to build at least eight buildings, and every building must be built off an intersection of roads.

You may have as many roads as you like, but they all need to be straight lines.



Your city design will also need to fulfill the following requirements:

1. There must be two roads that are parallel to each other
2. There must be two roads that are perpendicular to each other
3. There must be at least two roads that are transversal
4. There must be a house and a restaurant at alternate exterior angles
5. There must be a library and a grocery store at alternate interior angles
6. There must be a gas station and a gym at corresponding angles
7. There must be a school and a park at same side interior angles

You will be given cardstock, [illegible] make your city.

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Racing Robots

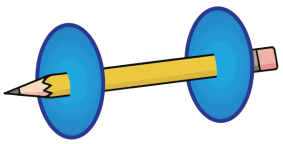
A servo motor is a motor commonly used in robots. This type of motor allows each part of the robot to move at its own precise and accurate measurement.

Your task is to develop a robot that will be able to maneuver through a course. Your robot will be built using a pencil as the body and a fraction wheel on each end. You will use your fraction circles as wheels to get your robot through the maze. Each wheel is allowed to make its own movements. Follow the criteria below to design a maze and program your robot to get through the maze. When you write your program, make sure to include each step in detail describing the movement of the wheels.

CRITERIA

Your fraction/decimal wheels must make the following movements (in no particular order) at least once throughout the course.

- 5.9 left wheel rotation
- 1.25 right wheel rotation
- 3.7 left wheel rotation
- 2.45 right wheel rotation



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ANCHOR 4 - EXTEND AND EVALUATE: S.T.E.M. PROJECTS

ORDER OF OPERATIONS

Teacher Tip:
Make authentic connections between conceptual understanding and STEM projects.

Turn up the Volume

Maracas are musical instruments made out of hollow objects filled with beans to create different sounds when shaken. They are believed to first invented by the Taino, the indigenous people of Puerto Rico.

You have been asked to design a set of four maracas for your music class at school! Your music teacher wants the four maracas to each have a different amount of beans so each maraca makes a different sound; however, the four maracas should all be related to each other by the same growing pattern.

Your design task is:

1. Choose a starting number of beans for maraca #1. Write your chosen number of beans on the base of the maraca #1.
2. Cut out maraca #1, put the beans inside, and tape the edges closed.
3. Create a pattern (equation) of how you want each maraca to grow in their number of beans, starting from maraca #1. You must choose two different operations (ex: multiply by 3, subtract 1).
4. Use your pattern (equation) to figure out how many beans should go in maraca #2. Write the equation on the edge of the maraca and the total number of beans on the base of the maraca #2.
5. Cut out maraca #2, put the beans inside, and tape the edges closed.
6. Create maracas #3 and #4 using the same procedure from steps 4 and 5.
   a. Once you have completed your four maracas, each maraca should have its equation on the edge and the total number of beans on the base.
7. Sound Check: Shake each maraca. What do you notice about the noise each maraca makes? Why do you think the sounds are different? What you hear from maraca to maraca is what your equation sounds like in bean form!

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ANCHOR 4 - EXTEND AND EVALUATE: S.T.E.M. PROJECTS

EFFECTIVE S.T.E.M. SCENARIOS

- Standards Based
- Collaborative Structures
- Flexible Strategies
- Authentic Scenarios
- Number Sense
- Multiple Solutions
- Justifications
- Technical Language
- Multiple Representations
- Presentation Protocols
- Creativity & Innovation
- Conceptual Understanding

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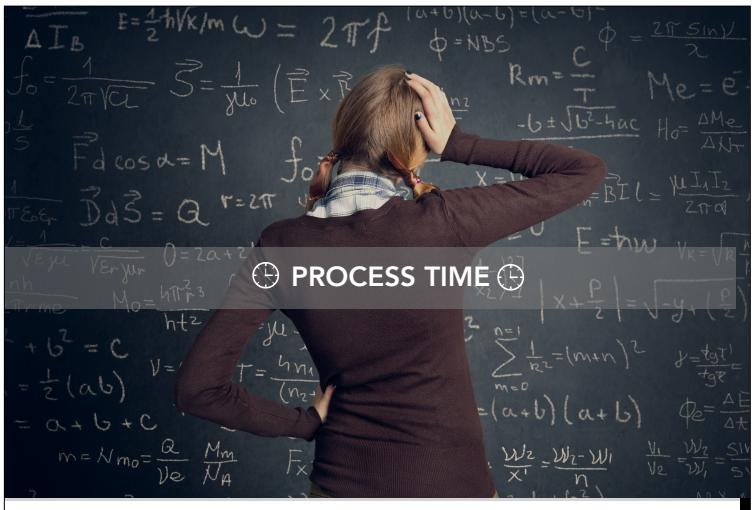

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ANCHOR 4 - EXTEND AND EVALUATE: S.T.E.M. PROJECTS

Common Topics	S.T.E.A.M. Connections
Addition and Subtraction with Regrouping	Build a Bridge
Multiplication and Division	Create Art Mosaic
Fractions and Decimals	Program Servo Motors
Systems of Equations	Improve Production Efficiency
Polynomials	Model Cell Mitosis
Complex Numbers	Design an AC Circuit

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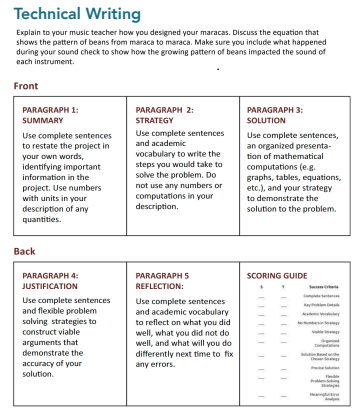
ANCHOR 5 - EXTEND AND EVALUATE: TECHNICAL WRITING

Teacher Tip:
Provide students opportunities to practice their technical writing skills.



Technical Writing

Explain to your music teacher how you designed your maracas. Discuss the equation that shows the pattern of beans from maraca to maraca. Make sure you include what happened during your sound check to show how the growing pattern of beans impacted the sound of each instrument.

Front

PARAGRAPH 1: SUMMARY	PARAGRAPH 2: STRATEGY	PARAGRAPH 3: SOLUTION
Use complete sentences to restate the project in your own words, identifying important information in the project. Use numbers with units in your description of any quantities.	Use complete sentences and academic vocabulary to write the steps you would take to solve the problem. Do not use any numbers or computations in your description.	Use complete sentences, an organized presentation of mathematical computations (e.g. graphs, tables, equations, etc.), and your strategy to demonstrate the solution to the problem.

Back

PARAGRAPH 4: JUSTIFICATION	PARAGRAPH 5 REFLECTION:	SCORING GUIDE
Use complete sentences and flexible problem solving strategies to construct viable arguments that demonstrate the accuracy of your solution.	Use complete sentences and academic vocabulary to reflect on what you did well, what you did not do well, and what will you do differently next time to fix any errors.	

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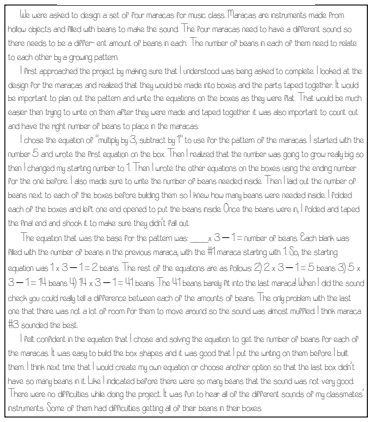
ANCHOR 5 - EXTEND AND EVALUATE: TECHNICAL WRITING

Teacher Tip:
Provide students opportunities to practice their technical writing skills.



Grade 5: Designing Maracas

We were asked to design a set of four maracas for music class. Maracas are instruments made from hollow objects and filled with beans to make the sound. The four maracas need to have a different sound so there needs to be a differ- ent amount of beans in each. The number of beans in each of them need to relate to each other by a growing pattern.

I first approached the project by making sure that I understood was being asked to complete. I looked at the design for the maracas and realized that they would be made into boxes and the parts taped together. It would be important to plan out the pattern and write the equations on the boxes as they were. Put. That would be much easier than trying to write on them after they were made and taped together. It was also important to count out and have the right number of beans to place in the maracas.

I chose the equation of "multiply by 3, subtract by 1" to use for the pattern of the maracas. I started with the number 5 and wrote the first equation on the box. Then I realized that the number was going to grow really big so then I changed my starting number to 1. Then I wrote the other equations on the boxes using the ending number for the one before. I also made sure to write the number of beans needed inside. Then I laid out the number of beans next to each of the boxes before building them so I knew how many beans were needed inside. I folded each of the boxes and left one end opened to put the beans inside. Once the beans were in, I folded and taped the final end and shook it to make sure they didn't fall out.

The equation that was the base for the pattern was: ____ x 3 – 1 = number of beans. Each blank was filled with the number of beans in the previous maraca, with the #1 maraca starting with 1. So, the starting equation was 1 x 3 – 1 = 2 beans. The rest of the equations are as follows: 2) 2 x 3 – 1 = 5 beans 3) 5 x 3 – 1 = 14 beans 4) 14 x 3 – 1 = 41 beans. The 41 beans barely fit into the last maraca! When I did the sound check you could really tell a difference between each of the amounts of beans. The only problem with the last one that there was not a lot of room for them to move around so the sound was almost muffled. I think maraca #3 sounded the best.

I felt confident in the equation that I chose and solving the equation to get the number of beans for each of the maracas. It was easy to build the box shapes and it was good that I put the writing on them before I built them. I think next time that I would create my own equation or choose another option so that the last box didn't have so many beans in it. Like I indicated before there were so many beans that the sound was not very good. There were no difficulties while doing the project. It was fun to hear all of the different sounds of my classmates instruments. Some of them had difficulties getting all of their beans in their boxes.

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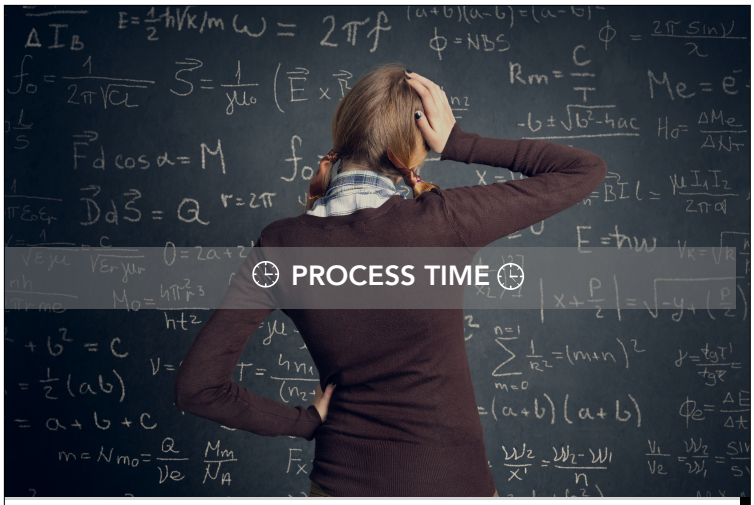

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CREATING LITERATE MATHEMATICIANS

Teaching Tips:

1. Use academic discourse to build academic vocabulary.

2. Use the scientific method to develop conceptual understanding.

3. Use informational text to allow for language acquisition to occur at the pace of the reader.

4. Make authentic connections between conceptual understanding and STEM projects.

5. Provide structured opportunities for students to practice their technical writing skills.

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