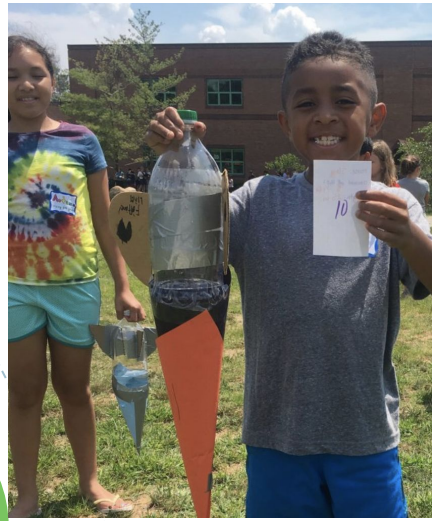
STEM Integration for Wolf Trap Teaching Artist



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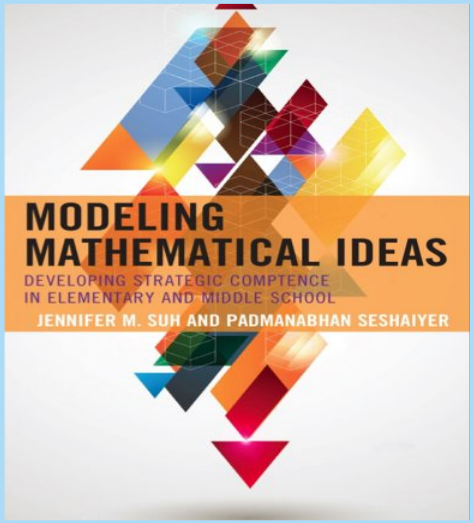
Research Interests:

- Design Research with Teachers using Lesson Study
- Model important mathematical ideas using real world **STEM connections and Mathematical Modeling**
- Spark their sense of wonder through real world phenomenons and personally meaningful **contexts**
- **Empower teachers and students** as math doers and thinkers



Spark

STEM

Scientific and mathematical modeling

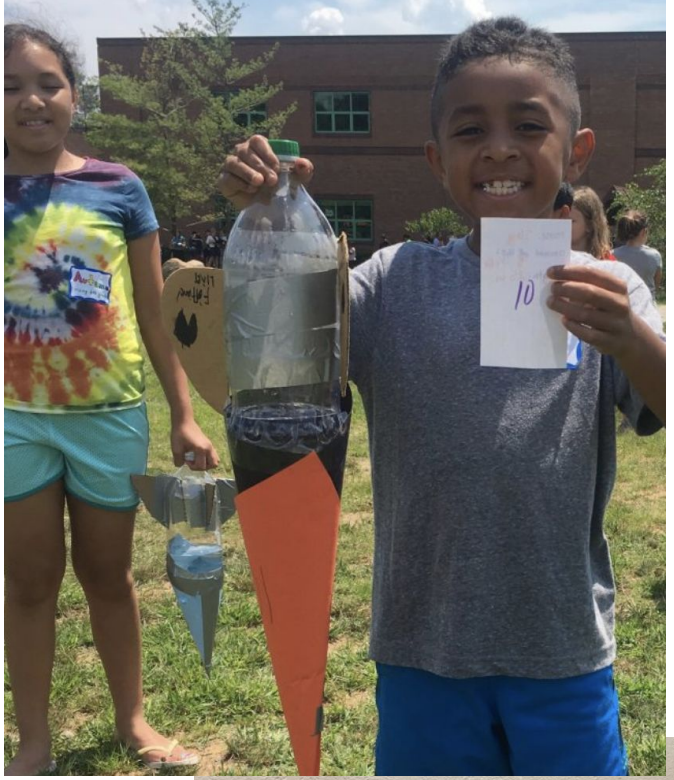
Problem-based Learning

Access through Equitable Teaching Practices

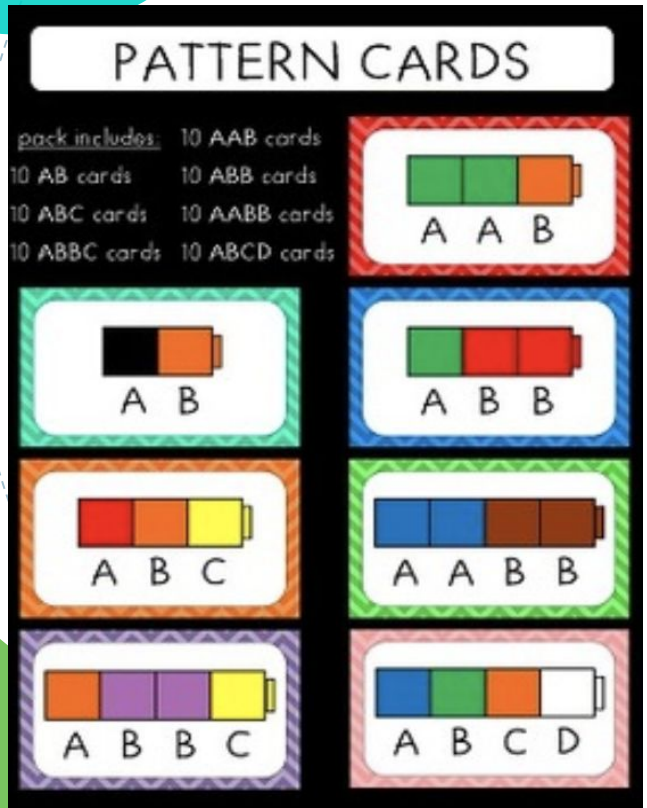
Rigorous Content Knowledge

Knowledge and Confidence as STEM learners

http://sparkstem.onmason.com/framework/



Children are Natural Pattern Seekers



Using Movement, Rhythm, Art, or other creative medium, create a pattern that repeats the **core** at least **3 times.**

Children are Pattern Seekers

1st Grade

The first-grade standards place emphasis on **counting, comparing, and ordering** sets of up to 110 objects; recognizing and describing simple repeating and growing **patterns**; and tracing, describing, and sorting **plane figures**. Students' understanding of number is expanded through recognizing and describing part-whole relationships for numbers up to 10, solving **story and picture problems** using addition and subtraction within 20; using nonstandard units to **measure**; and organizing and interpreting **data**. Fractional concepts will be expanded through **sharing scenarios** involving halves and fourths. The use of appropriate technology and the interpretation of the results from applying technology tools must be an integral part of teaching, learning, and assessment.

Children are Pattern Seekers

1st Grade

1st Grade

The first-grade standards continue to stress basic science skills in understanding familiar objects and events. Students are expected to begin conducting **simple experiments** and be responsible for some of the planning. Students are introduced to the concept of **classifying** plants and animals based on simple characteristics. Emphasis is placed on the **relationships** among objects and their **interactions** with one another. Students are expected to know the basic relationships between the **sun and Earth**, and between **seasonal changes** and plant and animal activities. Students will also begin to develop an understanding of moving objects, simple solutions, and important natural resources

Learning Progression in Mathematics

K

The kindergarten standards place emphasis on developing the concept of number by counting; combining, sorting, and comparing sets of objects; recognizing, describing, and creating simple repeating patterns; and recognizing shapes and sizes of figures and objects. Students will investigate measurement through direct comparisons, collect data, and create graphs. The concept of fractions is introduced through sharing experiences.

1

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2

The second-grade standards extend the study of number and spatial sense to include three-digit whole numbers and solid geometric figures. Students will continue to learn, use, and gain proficiency in addition and subtraction within 20. Students will begin to use U.S. Customary units to measure length and weight; predict and use simple probability; and create and interpret pictographs and bar graphs. Students will work with a variety of patterns and will develop an understanding of equality.

K

Kindergarten

The kindergarten standards stress the use of basic science skills to explore common materials, objects, and living things and will begin the development of an understanding that scientific knowledge is based on evidence. Emphasis is placed on using the senses to gather information. Students are expected to develop skills in posing simple questions, measuring, sorting, classifying, and communicating information about the natural world. The science skills are an important focus as students learn about life processes and properties of familiar materials, such as magnets and water. Through phenomena including shadows, patterns of weather, and plant growth, students are introduced to the concept of change. The significance of natural resources and conservation is introduced in the kindergarten standards.

1

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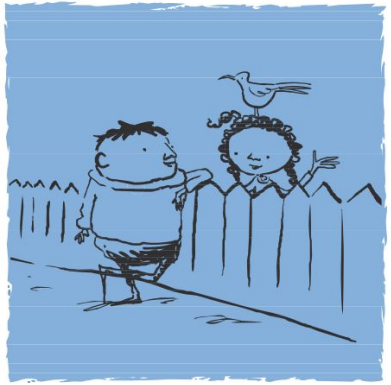
2

2nd Grade

The second-grade standards continue to focus on using a broad range of science skills in understanding the natural world. Making detailed observations, drawing conclusions, and recognizing unusual or unexpected data are stressed as skills needed for using and validating information. Measurement in both English and metric units is stressed. The idea of living systems is introduced through habitats and the interdependence of living and nonliving things. The concept of change is explored in phases of matter, life cycles, weather patterns, and seasonal effects on plants and animals.

21st Century Skills

Today's students are moving beyond the basics
and embracing the 4C's — "super skills" for the 21st century!



Communication

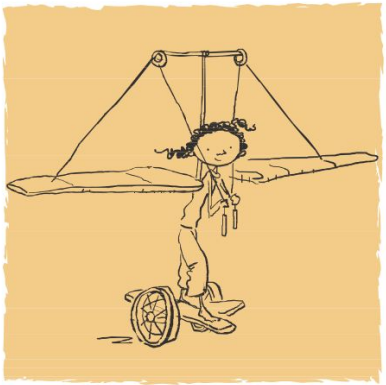
Sharing thoughts, questions, ideas, and solutions

Collaboration

Working together to reach a goal — putting talent, expertise, and smarts to work

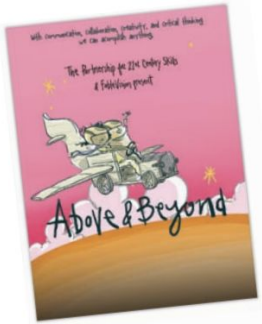
Critical Thinking

Looking at problems in a new way, linking learning across subjects & disciplines



Creativity

Trying new approaches to get things done equals innovation & invention



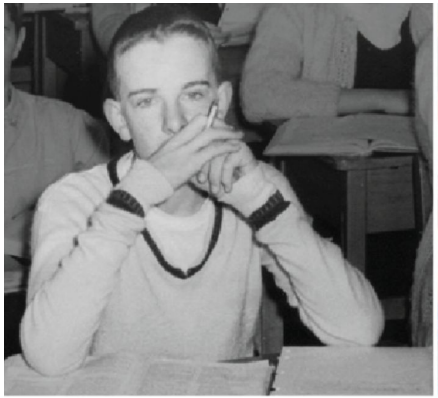
For more 4C resources from
the Partnership for 21st Century Skills,
including the animated film ABOVE & BEYOND
by Peter H. Reynolds & FableVision, journey to
www.p21.org/4Cs

Partnership for 21st Century Skills

FableVision

Portrait of a Graduate
21st century Skills
4Cs

- ★ Creativity
- ★ Communication
- ★ Critical thinking
- ★ Collaboration



STUDENT A

Math
Science
English
Social Studies

STUDENT B

Content Mastery
Communication
Collaboration
Other 21st Century Skills

Spark a Wonder Conversation!
Aluminum boats

http://sparkstem.onmason.com/

Useful STEM words:

Displacement	capacity
Water	measure
surface area	metric
surface tension	precision
density	units
volume	mass
buoyancy	balance
Float	sink

How much can you hold in your aluminum boat?

I wonder...prompts!

Does the size of the boat affect how much weight it can hold?
Does aluminum foil float?
Do the weights float by themselves?
How long does it take the boat to sink?
Does the thickness of the bottom of the boat affect the weight it can hold?
How do the heights of the sides affect the surface area available to hold weights?
What happens when the sides of the boat are made higher?
Does it matter if you put the boat into the water empty or filled with weights?
Does the placement of the weights in the boat matter?
Does the shape of the boat matter?
How much water can the boat take on before it sinks?

Tapping into Family's Funds of Knowledge

Bath Time Fun: Why don't you fill the tub with water completely?

Splish Splash: What happens when you do a belly flop or a cannonball into a swimming pool? How are they different?

Dr. Jennifer Suh • jsuh4@gmu.edu ;Dr. Andrew Gilbert • agilbe14@gmu.edu; Dr. Padhu Seshaiyer pseshaiy@gmu.edu

Children are Curious

They Notice and Wonder about the World Around Them!

Foil boats StEM lesson

DESIGN CHALLENGE

- Using a 10x10 cm square of Aluminum foil...design a boat that can hold the most cargo possible
- Within your groups make at least two separate designs
- Use the plastic pieces to measure the mass the boat can hold and keep track of your data
- Save each boat and plot your best result on the class bar graph

What do you wonder?

Think See and Wonder

(generate questions from students)

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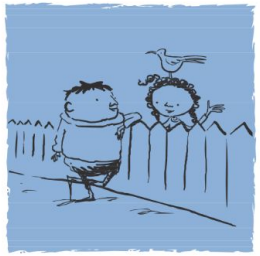
Centralize the STEM with 21st Century Skills

http://www.doe.virginia.gov/testing/sol/scope_sequence/mathematics_2009/index.php



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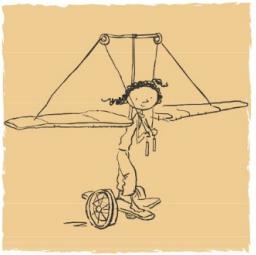
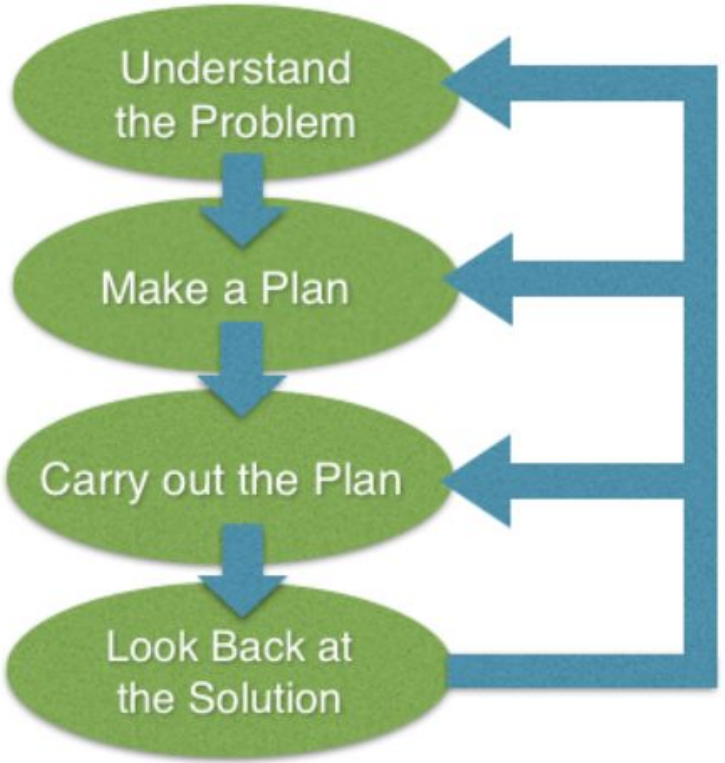


Creativity
Trying new approaches to get things done equals innovation & invention

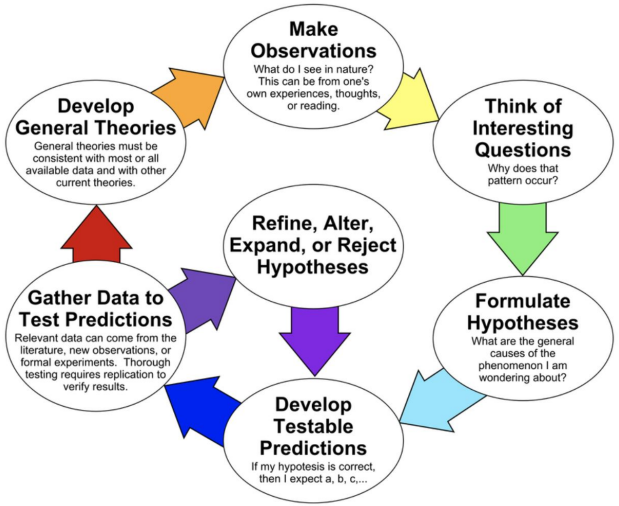
Aluminum Boats

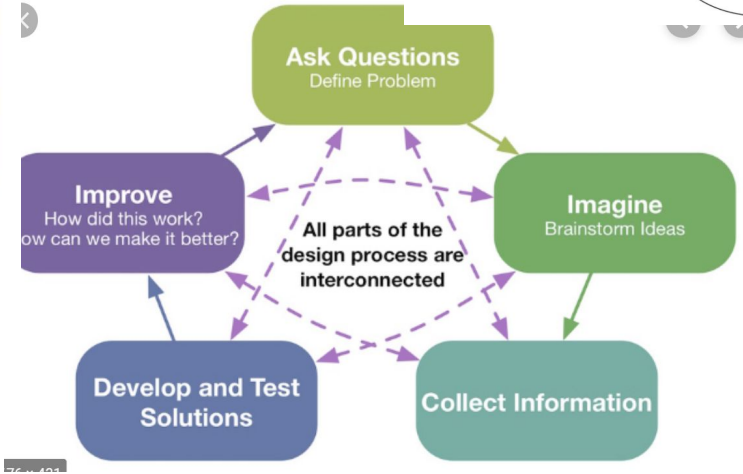
	STEM (How do we target science, technology, engineering and mathematics?)
Inquiry/Questioning Practices	
Data Practices	
Modeling Practices	
Interpreting Practices	
Connecting to Big ideas/Real World	



Polya's Problem Solving Model

The Scientific Method as an Ongoing Process

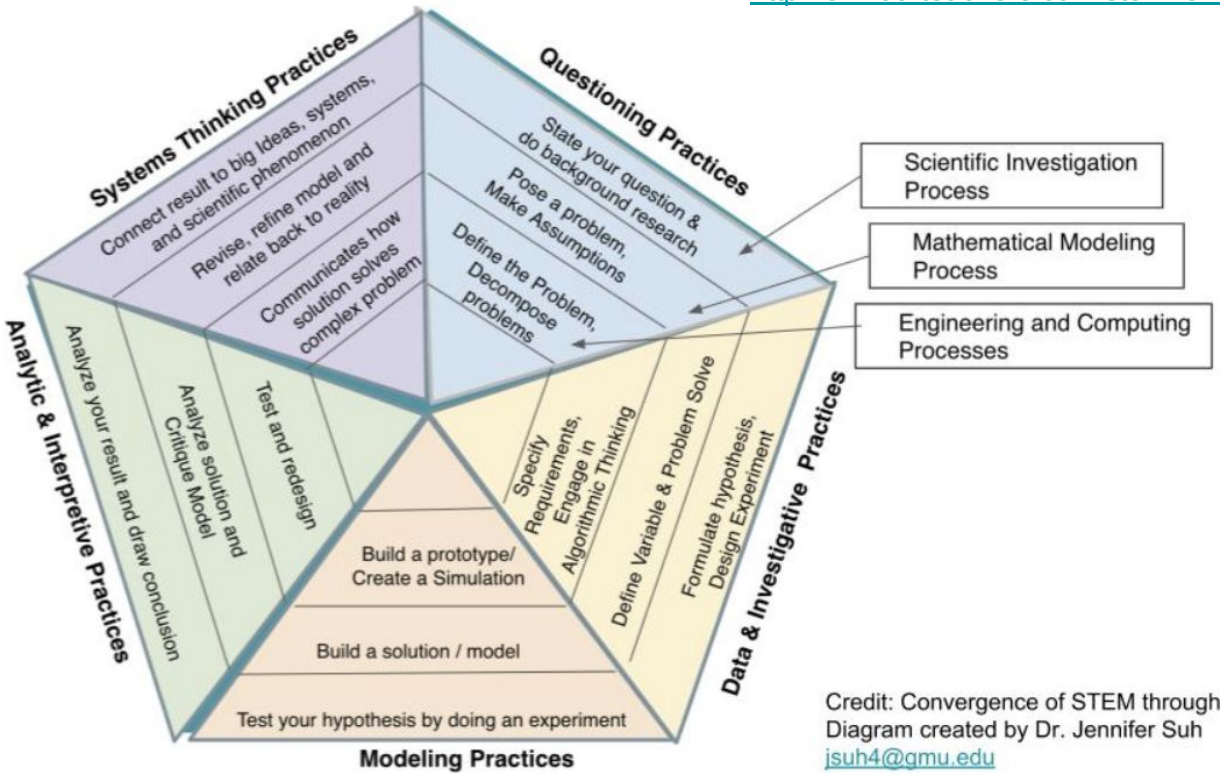




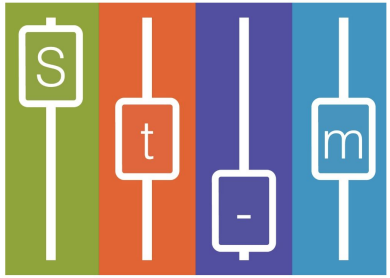
Convergence of STEM practices	Scientific Investigation	Mathematics Problem Solving	Engineering Design Process
Inquiry Practices/ Questioning	State your question	Pose a math problem	Define the problem
Investigation & Data Practices Quantitative & Logical Reasoning	Do background research Formulate hypothesis, identify variables	Find relevant quantities/data Define Variable	Do background research Specify requirements
	Design experiment, establish procedure	Do the Math & Solve	Create solutions, choose the best one
Modeling Practices	Test your hypothesis by doing an experiment	Build a model Use math to make decisions	Build a prototype
Analysis and Interpretative Practice	Analyze your results and draw conclusions	Analyze solution and Critique model	Test and redesign as necessary
Systems Thinking Connecting back to Big Ideas and Real world	Communicate result based on how it relates to the big ideas and within the context, system and scientific phenomenon	Revise, refine and report on how this solution or model works/fits in with reality	Communicate how the design improves the problem from a holistic view in solving a big and complex problem

STEM PRACTICES Converge

http://okmathteachers.com/stemframework/



Credit: Convergence of STEM through Modeling
Diagram created by Dr. Jennifer Suh
jsuh4@gmu.edu



http://okmathteachers.com/stemork/

S	T	E	A	M
Science content and practices are equally represented and on grade level.	Technology is both created and operated purposefully.	Engineering knowledge and design are present, and science and mathematics concepts are utilized.	Art/Storytelling is present, concepts are utilized.	Mathematics content and practices are equally present and on grade level.
s	t	e	a	m
Science content or practices are absent or science content and practices are not on grade level.	Technology is operated purposefully but not created.	Engineering knowledge or design are present but lacks utilization of science and mathematics concepts.	Art / Story Telling is present but lacks utilization of concepts.	Mathematics content or practices are absent or mathematics content and practices are not on grade level.
—	—	—	—	—
Science content and practices are absent.	Purposeful operation and creation of technology are absent.	Engineering knowledge and design are absent.	Art is not present	Mathematics content and practices are absent.

Planning for STEM lessons

https://drive.google.com/file/d/1IztMVTqlQs9Sc7eEvY2AfC2E2GaHrqoy/view?usp=sharing

[Selected Lesson Plan Title Using the 5 E planning]

Engage:

[Describe how you will Engage students and activate prior knowledge]

Explore:

[Describe the activities will give students the opportunity to build their knowledge or skills related to the lesson content]

Explain:

[Describe how students verbalize or demonstrate their new knowledge]

Elaboration:

[Describe how students extend, apply, and practice their knowledge to build deeper understanding]

Evaluation:

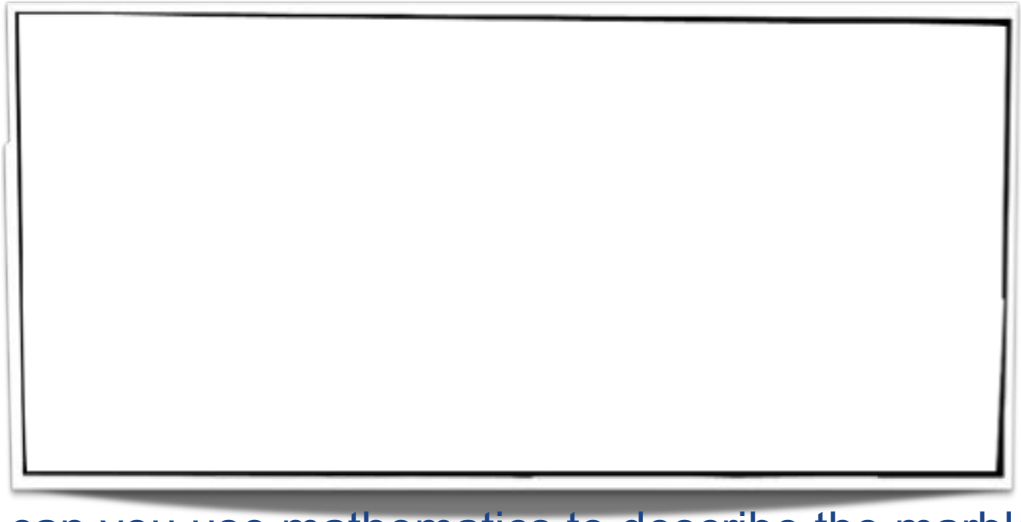
[Describe how students will assess their knowledge and how teachers will evaluate student learning]

Marble Run STEAM lesson

DESIGN CHALLENGE

STEM + MODELING

Draw your marble run below and describe it below.



How can you use mathematics to describe the marble run?

Use pictures, words and numbers to describe your marble run.

DATA COLLECTION

Run three trials of your coaster and have three timers.

	Timer 1	Timer 2	Timer 3	
Run #1				
Run #2				
Run #3				

DATA

What is the **best** way to summarize your data?

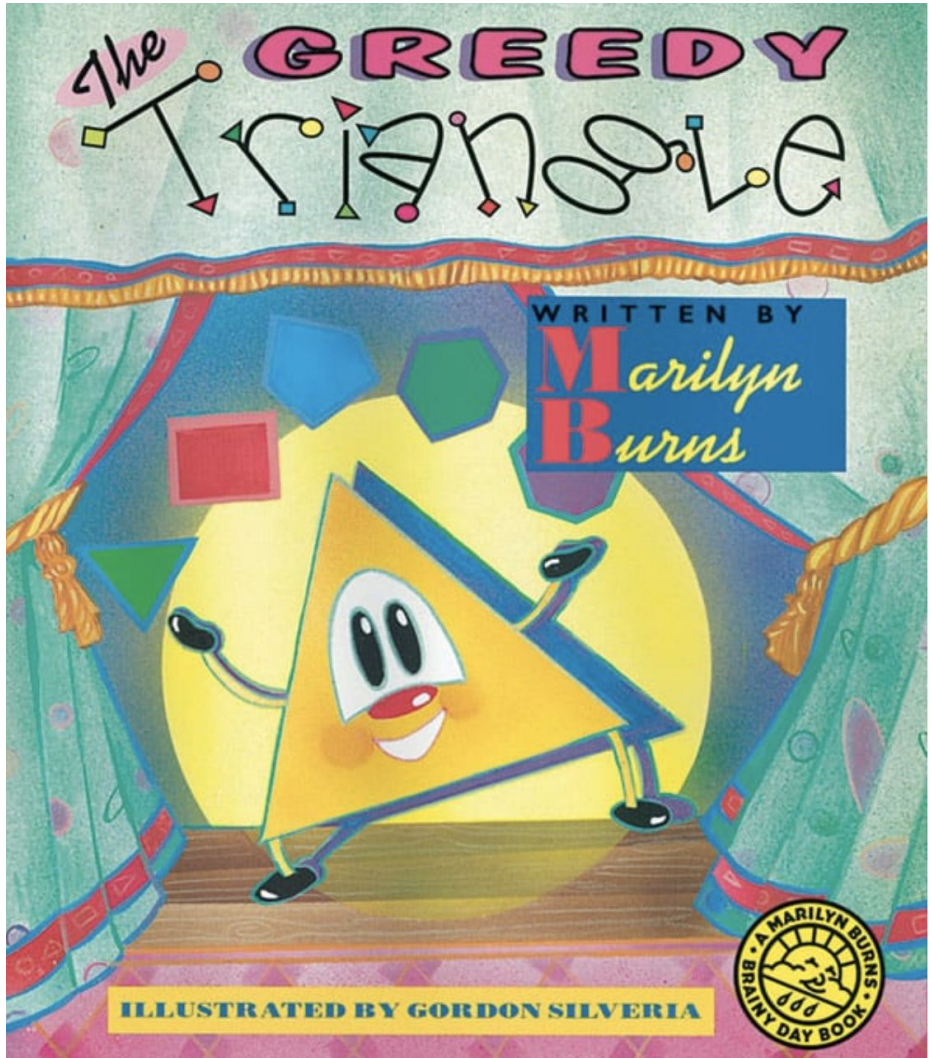
What measures can you use to compare your marble run with a friends?

Greedy Triangle stEAM lesson
Engineering, Storytelling with Math

Summarize the story using math manipulatives.

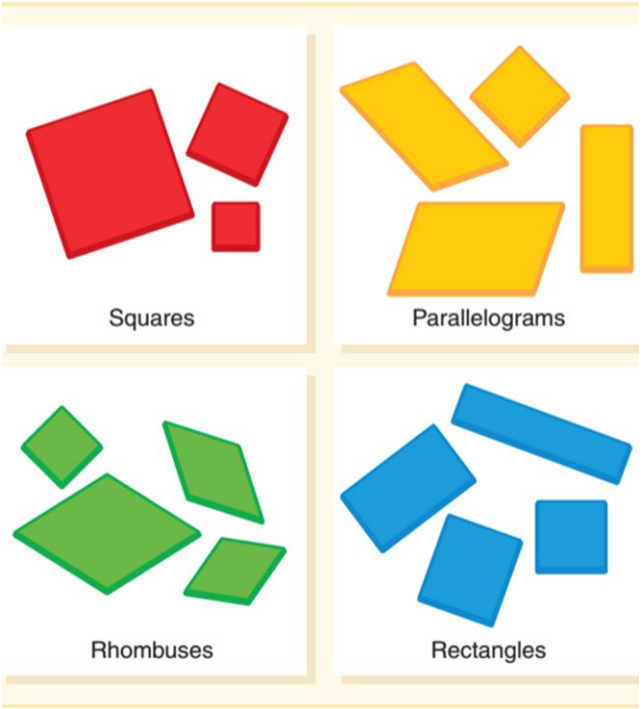
Why is the triangle so used to build bridges?

1. Go to www.brainingcamp.com
2. Click Redeem
3. Enter code **SUH2019**



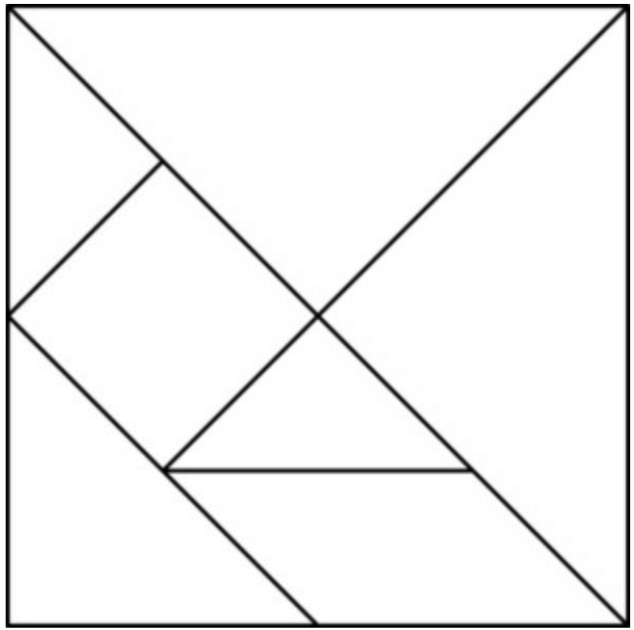
Van Hiele Level 1 Analysis

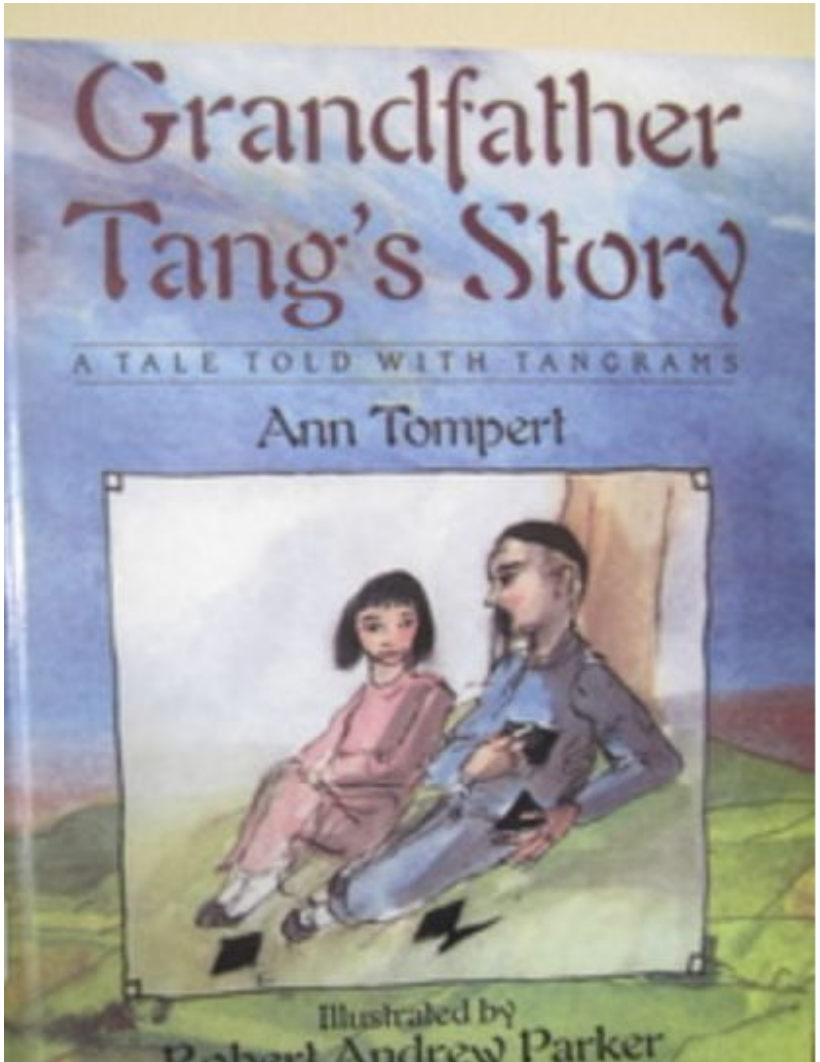
1. Consider all shapes within a class.
2. Able to talk about the properties of **all** rectangles.
3. Focus on what makes a rectangle a rectangle.
4. If a shape belongs to a particular class it has the corresponding properties of that class.



Create!

https://tasks.illustrativemathematics.org/content-standards/tasks/1311





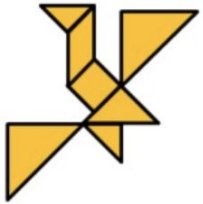
CREATE!

What other animals or objects can you make?

Fox fairy (1)

Fox fairy (2)

Hawk



Squirrel

Dog

Thanks!

Any questions?

You can find me at jsuh4@gmu.edu twitter @completemath