Mathematicians: Reflecting the Brilliance of Powerful Minds

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Mathematicians Reflection I

• Which mathematicians or names of mathematicians did you discuss during mathematics? Who are the first five that come to your mind?

• Who is the first mathematician that came to your mind?

• https://www.menti.com/isyzdjxwyq
Mathematicians Reflection II

- Consider a mathematician that you have learned about and discussed either during your K-12 career, teacher education preparation, or currently in your teaching practice that reflects the social identities of the learners in your classroom.
- Identify at least three and post it in chat.
“Representation matters because it can shape the reputation and self-image of women and Black, Indigenous, and People of Color within environments dominated by over-represented majorities” (Ijoma et al., 2022).
Algebraic Topology and Group Cohomology
Comparing Shapes

In Algebraic Topology, some shapes are considered the same, like a plate and a bowl or a coffee mug and a doughnut shape. Provide students pairs of pictures of shapes and ask them to discuss how they are similar and how they are different. Encourage students to think about attributes of shapes they have learned (i.e., faces, edges, vertices, number of sides, number of angles, etc.). Potential pairs of shapes students could compare are provided below.

Grades K-2

- Square and a rectangle
- Triangle and a diamond
- Small hexagon and a large hexagon
- Cube and a rectangular prism

Grades 3-5

- A right triangle and an equilateral triangle
- Cone and a pyramid
- Cylinder and a rectangular prism
- Parallelogram and a trapezoid

For Grades 6-8, the activity can be extended to compare volume and surface area of pairs of three-dimensional solids as well as compare figures after going through a series of transformations (dilation, translation, rotation, reflection, etc.). Potential ideas are provided below.

- Compare the volume of a cylinder and cone with the same radius and height/altitude.
- Compare the volume of a rectangular prism and pyramid with the same base dimensions and height.
- Compare the surface area of two different rectangular prisms.
- Compare a triangle and its image after being rotated and reflected.
- Compare a pentagon and its image after being translated and then dilated.
Shape Shifter

Provide each student clay or playdough. Have students create topologically equivalent shapes. Create a shape yourself using clay or playdough, show the class your shape, and then ask them to create a shape that is topologically equivalent. Continue the activity by repeating with other shapes, being sure to include figures with no holes, one hole, and two holes. Then, pair students together. Have partners take turns creating an original figure and then the other sculpting a figure that is topologically equivalent.
Alejandro Adem studies concepts of Algebraic Topology, one area of mathematics. One of the most commonly studied shapes in Algebraic Topology is the torus, the doughnut-like figure shown below. Ask students to work with a partner to determine how they could find the volume of a torus \([\text{Answer: } V = (\pi r^2)(2\pi r)]\). Provide pairs time to think and support their productive struggle as they discuss the problem. Questions to ask as you monitor students while they work are suggested below.

1. What do you already know about volume?
2. How can you use what you know about volume and apply it to this shape?
3. For Calculus students: Can you use the Shell Method to find the volume? Washer Method? Integrals? If so, how? If not, why not?
Thomas Fuller
1710–1790
Mental Math
Counting Collections

Students will begin to count efficiently like Thomas Fuller, the Virginian Calculator. Have students count collections of various objects to develop number sense. Counting collections of objects offers multiple entry points for students and provides opportunities for them to develop increasingly sophisticated strategies as they count, organize, and record the number of items in their collection. The article below provides details on how to implement counting collections in your classroom.


Number Line Number Sense

In this activity, students use a life size number line created by a long piece of brightly colored rope to explore the relationships between numbers. Students place numbers on the number line in relation to one another, aiding their development of number sense. This activity can include integers, fractions, and algebraic expressions with variables. Throughout the activity, students communicate and provide reasoning and justification for the placement of the numbers on the number line. A more detailed description with examples of it being used in a classroom is provided in the article.

Just Like Fuller


This is an original story written about Thomas Fuller in January 1789 by Dr. Benjamin Rush. It details Thomas' life as a slave and his mental calculation capacity. Before reading the story, have students calculate the number of seconds in 70 years, 17 days, and 12 hours. Discuss answers and strategies as a class. After reading, discuss that Thomas Fuller did all his calculations mentally and remembered the leap years!
Kathleen Ollerenshaw
1912–2014
Magic Squares

Magic Cube (Rubik's Cube)
The Magic, or Rubik’s, Cube is one of the world’s top-selling toys. Kathleen Ollerenshaw was the first person to identify the general solution to the colorful cube puzzle.

- What ways can you turn the sections of the cube?
  - What is the difference between clockwise and counterclockwise?
  - How can we describe the different turns?
    - What is a 90 degree turn? What is a 180 degree turn?
    - What would happen if you rotated a section of the cube 360 degrees?
  - How many squares are on each face of the cube?
    - What is a quick way to determine the number of squares?
    - How many squares are on the faces of the entire cube?
    - What are the characteristics of a cube? What other objects do you encounter that are cubes?
  - How many small cubes make up the entire Rubik’s cube?
    - What strategies did you use to figure that out?
Look at the following figure and make observations about what you notice. What patterns are occurring and how do the arrows represent how the numbers are moved around the magic square (aka Rubik’s cube)?
Gladys West
1930–
GPS satellites broadcast radio signals providing their locations, status, and precise time ($t_s$) from on-board atomic clocks.

The GPS radio signals travel through space at the speed of light ($c$), more than 299,792 km/second.

A GPS device receives the radio signals, noting their exact time of arrival ($t_r$), and uses these to calculate its distance from each satellite in view.

To calculate its distance from a satellite, a GPS device applies this formula to the satellite’s signal:

$$\text{distance} = \frac{\text{rate} \times \text{time}}{c}$$

where rate is ($c$) and time is how long the signal traveled through space.

The signal’s travel time is the difference between the time broadcast by the satellite ($t_b$) and the time the signal is received ($t_r$).

The GPS Master Control Station tracks the satellites via a global monitoring network and manages their health on a daily basis.

Ground antennas around the world send data updates and operational commands to the satellites.

Once a GPS device knows its distance from at least four satellites, it can use geometry to determine its location on Earth in three dimensions.
Exploring Earth

The Seasat satellite, a project Gladys West managed, could remotely sense oceans using radar to measure the distance between the satellite and the ocean. This helped Gladys gather the data needed to develop a more accurate model of the shape of the Earth – a geoid. Show students the image of the geoid. Ask students what they notice and wonder.
Estimating Earth’s Circumference

This article provides a lesson idea in which students use proportional reasoning, apps, and GPS technology to estimate the circumference of the Earth.


The Mathematics of GPS

This journal article provides a series of scaffolded activities in which students explore the mathematics underlying GPS technology and apply their mathematical knowledge and skills to solve real world problems involving GPS.

Powerful Mathematicians Book Series

**Powerful Mathematicians who Changed the World from A to Z**

- Kelley Buchheister
- Kari Jurgenson
- Vashalice Kaaba
- Jessica Stagg
- Cynthia Taylor

**PreK-2 Grade Band**
- Kelley Buchheister
- Amy Napoli

**3-5 Grade Band**
- Naomi Jessup
- Eva Thanheiser

**6-8 Grade Band**
- Debra Goldstein
- Kari Jurgenson
- Jessica Stagg
- Cynthia Taylor

**9-12 Grade Band**
- Zandra de Araujo
- Maria del Rosario Zavala
- Toya Frank
Liliana is a fourth-grade girl whose strategy is misunderstood when solving a multi-step word problem using multi-digit numbers. Liliana’s method was shared with her by family in Peru. The teacher invites mathematician Marcia Ascher to connect mathematics and culture by counting quipus which originated in Peru. This book provides a glimpse into a mathematics learning space that honors multiple strategies and children's cultural ways of reasoning about mathematics.

*Knotting Numbers: Marcia Ascher*
Five friends go on adventures to learn more about secret, coded messages they find in a tunnel in the woods. As they learn more about cryptography and Agnes Meyer Driscoll, a remarkable cryptologist, they crack the codes and discover something disturbing is happening in their town. Readers will have opportunities to code and decode messages and learn more about an underrepresented mathematician and her field of cryptology.

*The Mystery Underground: Agnes Meyer Driscoll*
Moises wakes up across the country, briefly remembering he’s no longer home in Oakland, CA but has made a life-changing move with his family to St. Louis, MO. Pretty soon he makes new friends Astrud and Marissa. When the trio investigates inequities in the local magnet school’s admission process, they join forces with mathematician Federico Ardila to find a solution. Bonding over math and a desire for making things a little better, these three amigos set out on an ambitious path. Teachers can bring this story into their classroom to help students see how math can help you to combat injustice and investigate how equal is not always equitable.

What We Do When Fairness Fails Us: Featuring Federico Ardila
Thank You!!!