Connecting Mathematics to Your World

Mathematics as Metaphor

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Grade Level	9th – 10th Grade	**Time Frame**	1-2 class period(s)
Subject	Mathematics	**Duration**	90 minutes
Course	Algebra 1, Geometry		

Essential Question

How do mathematical concepts connect to or represent parts of your life?

Summary

Metaphors are often associated with flowery, figurative language and do not routinely find their way into mathematics courses. In this lesson, we create space for students to form arguments and better understand mathematically abstract concepts when they are provided opportunities to connect them to their personal experiences. This lesson can be implemented in nearly every subject and within multiple grade levels since it involves broadly connecting mathematics concepts to personal experiences and ideas.

Snapshot

Engage

Students will use Window Notes to organize their thinking about a mathematical concept.

Explore

Students will explore how they can use a mathematical concept to metaphorically represent an aspect of their life.

Explain

Students will share their metaphors with other students.

Extend

Students will be asked to create visual representations of their metaphors as a way of integrating art into mathematics

Evaluate

Students will reflect on the process using the What? So What? Now What? strategy.

Standards

Oklahoma Academic Standards for Mathematics (Process Standards)

M.1: Develop a Deep and Flexible Conceptual Understanding: Demonstrate a deep and flexible conceptual understanding of mathematical concepts, operations, and relations while making mathematical and real-world connections. Students will develop an understanding of how and when to apply and use the mathematics they know to solve problems.
M.6: Develop the Ability to Make Conjectures, Model, and Generalize: Make predictions and conjectures and draw conclusions throughout the problem solving process based on patterns and the repeated structures in mathematics. Students will create, identify, and extend patterns as a strategy for solving and making sense of problems.
K.PS2: Develop the Ability to Communicate Mathematically: Students will discuss, write, read, interpret and translate ideas and concepts mathematically. As they progress, students' ability to communicate mathematically will include their increased use of mathematical language and terms and analysis of mathematical definitions.

Materials

- Paper
- Colored pencils/markers
- Scissors (optional)
- Word processor

Engage

Using the Window Notes strategy, ask students to take out a blank sheet of paper, divide it into four quadrants, and label the quadrants **Facts, My Procedure, Diagrams, and Feelings.**

Depending on the content you are covering in your class, these categories might need to be changed. The goal, though, is for students to think about the facts involved in describing the mathematical concept, the procedures that could be involved in using the mathematical concept, what diagrams, graphs, or equations illustrate the concept, and how they are feeling about the concept.

Which Content To Use?

Students are free to use any concept or construct that they are currently learning or have previously learned in their course. The purpose of this lesson is not necessarily to learn a new concept, but to use metaphors to help solidify learning of a concept to which they have already been introduced.

Give students approximately 10 minutes to think through each of the four areas.

For Example?

Say the concept being covered concerns sinusoidal graphs. Students might state facts about the concept like, "the graphs are periodic" or "graphs have amplitude, minima, maxima, and phase displacement." In terms of procedures, students might think though a systematic way of graphing a sinusoidal function. For connections, students might see the nature of the sinusoidal graph relating to other mathematical graphs, ocean tides, jumping on a trampoline, or their mood over the course of math class. In terms of feelings, students might be feeling confident in the material or potentially shaky. The purpose in all of this is to have students organize their thoughts in order to begin writing creatively.

Explore

Ask students to think of how the mathematical concept they described above using Window Notes relates to an aspect of their life or to their life as a whole. For example, the concept could provide a way of explaining how they feel when the are going through a difficult time, or the concept could illustrate an aspect of their identity. Give them ample time to think and to brainstorm.

Instruct students that they will have 30 minutes to begin crafting a metaphor for their life or an aspect of it. Students are free to write using pen and paper or a word processor. The time can be adjusted as you see fit. This can even be given as a homework assignment to allow longer processing time.

Writing In Math Could Be Weird!

For many students, this might be the first time they have been asked to think metacognitively in mathematics. You might need to provide examples of metaphors for students, but don't be too quick to do so—you don't want students simply copying the example you provide. This is meant to be a creative, reflective exercise that allows students to make personal meaning out of mathematical concepts.

Below are some sentence stems to help students begin writing:

- This concept reminds me of...
- An important event in my life was...
- This concept makes me feel...
- I am...
- People describe me as...
- This relates to (the mathematical concept) because....
- The shape of the graph is similar to...
- The equation represents...

Student Example

If a single function and its derivative could represent my entire being, that function would have to be f(x)=x. It is noticeable that this derivative is not very complex, in fact it is simple. I am not complex in the sense that I am honest. I say what I am thinking, I mean what I say, and I do not often lie. I have found many people to be indecisive, they will say one thing but think something completely different. Like f(x)=x, I do not make anything over-complex. The function graphed looks like a diagonal line across the Cartesian plane, increasing in height. The graph of this parent function increases, as does my constant thirst for knowledge. As long as I'm alive I want to learn new things, create, and explore with that knowledge. The function never ends in the x- or y-direction. As so long as time is increasing (x-axis), knowledge thirst is increasing as well (y-axis). The derivative of f(x)=x is equal to 1: f'(x)= 1. Beneath my outer shelling I am actually one of a kind. I am an individual, semi-independent, with my own thoughts and my own motivations. The graphed version of this derivative is a constant, horizontal line that rests above the origin. This is symbolic of the positive and negative things that affect my life; I'm always resting in the positive side of the graph. f(x)=x is not over-complicated, nor flashy, and the graphed function symbolizes my infatuation with learning. The derivative of this wonderful function, f'(x)=1, represents my unique individuality, and when it is graphed it reflects my positive attitude. Both of these functions represent a metaphor of myself. (This is an example of metaphorical writing from one of my former calculus students.)

Will My Students Write This Much?

This depends on how comfortable they are with writing and how much you want to ask of them. As a teacher, use your discretion to outline requirements for students. You can require a page, a paragraph, or just a sentence or two.

Explain

After students have written their metaphor, ask them to sit in groups of three.

Allow each person in the group to take turns sharing their metaphors, giving the other group members time to respond.

This process should take about 15 minutes, allowing about 5 minutes for each student.

Extend

After students have written and shared their metaphors, they can now extend their learning by creating a visual representation.

This process can potentially be quite open-ended. Students can draw, color, fold paper, make an online slide show, or use any other medium.

Give students about 30 minutes to create a visual representation for their metaphor and let them know that the products will be displayed in the classroom.

After students have written, shared, and created a visual for their metaphor, have students attach their metaphor to their visual representation. Collect their assignments to display in the classroom.

Pride

When you let students know that you will be displaying the visuals for student metaphors, students will generally try to aspire to quality work that they can be proud of. This small motivating factor can be the difference in students putting their all into an assignment or completing it because "they have to."

Evaluate

Ask students to reflect on their day's work using the What? So What? Now What? strategy.

What? What did you do today?

So What? What did you find meaningful in today's assignment? About yourself? About others?

Now What? How does understanding others' perspectives impact our classroom community?

Resources

- K20 Center (n.d.) What? So what? Now what?. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/b30762a7557ba0b391f207f4c6002113
- K20 Center (n.d.) Window notes. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/fc74060730ea745c8c4f356aa2015ac0
- Wells, C. (2018). Metamathematics: Three approaches to reflective writing in math classrooms. Manuscript submitted for publication.