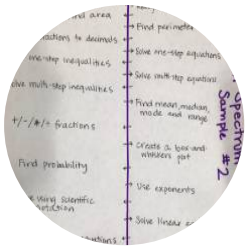

Walking the Line: The Math Spectrum

A Mathematical Growth Mindset

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Grade Level	6th – 12th Grade	**Time Frame**	1-2 class period(s)
Subject	Mathematics	**Duration**	90 minutes
Course	Algebra 2, Geometry, Middle School Mathematics, Precalculus		

Essential Question

What is the relationship between students' mathematical knowledge and their perception of mathematics? How can this perception be used to develop a growth mindset?

Summary

This lesson focuses on eliminating the emotional fear of mathematics by allowing students to evaluate where they are on the math spectrum and identify their goals moving forward. Students explore math concepts taught in past years and analyze their math knowledge to assess their relationship with mathematics. By allowing students to understand their emotional relationship with mathematics, set goals, and identify barriers, the lesson fosters a growth mindset moving forward. This lesson can be implemented at many different grade levels ranging from middle school through high school. This lesson includes optional modifications for distance learning. Resources for use in Google Classroom are included.

Snapshot

Engage

Students reflect on a video and place their initial self-assessment of their mathknowledge on a spectrum line.

Explore

Students research mathematical concepts learned in previous courses to expand theirknowledge on the topic.

Explain

Students present their findings to a peer and then to the whole class.

Extend

Students create a plan with strategies to promote individual growth and success in the math classroom in the coming school year. Students also identify their past barriers in order to overcome them in thefuture.

Evaluate

Students assess their newfound relationship with math through an Exit Ticket.

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.4: Develop Mathematical Reasoning: Explore and communicate a variety of reasoning strategies to think through problems. Students will apply their logic to critique the thinking and strategies of others to develop and evaluate mathematical arguments, including making arguments and counterarguments and making connections to other contexts.
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.

Attachments

- Brain Dump Handout - Spanish.docx
- Brain Dump Handout - Spanish.pdf
- Brain Dump Handout.docx
- Brain Dump Handout.pdf
- Exit Ticket Handout - Spanish.docx
- Exit Ticket Handout - Spanish.pdf
- Exit Ticket Handout.docx
- Exit Ticket Handout.pdf
- Math Concepts Handout - Spanish.docx
- Math Concepts Handout - Spanish.pdf
- Math Concepts Handout.docx
- Math Concepts Handout.pdf
- Math Goals Handout - Spanish.docx
- Math Goals Handout - Spanish.pdf
- Math Goals Handout.docx
- Math Goals Handout.pdf
- Walking the Line Lesson Slides .pptx

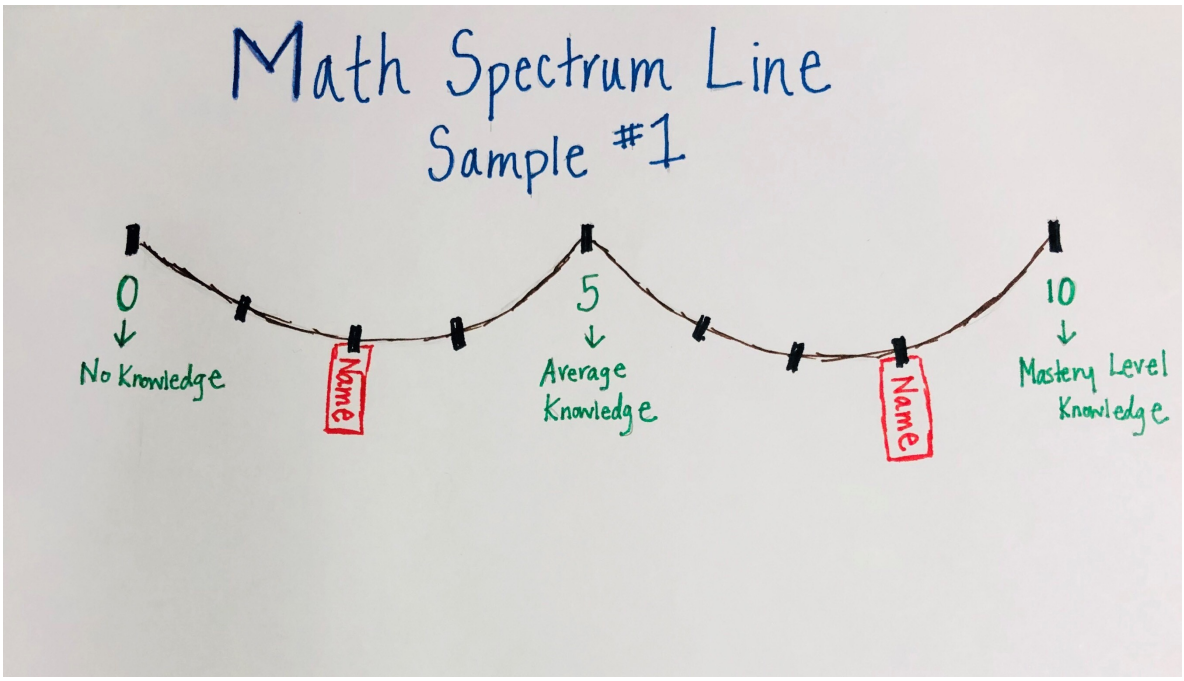
Materials

- Lesson Slides (attached)
- Math Goal Setting handout (attached)
- Math Concepts Research and Presentation handout (attached)
- Brain Dump handout (attached)
- Exit Ticket handout (attached; optional)
- Spectrum line (tape, string, interactive whiteboard, etc., or whatever you choose)
- Student devices with internet access
- Sticky notes
- Markers

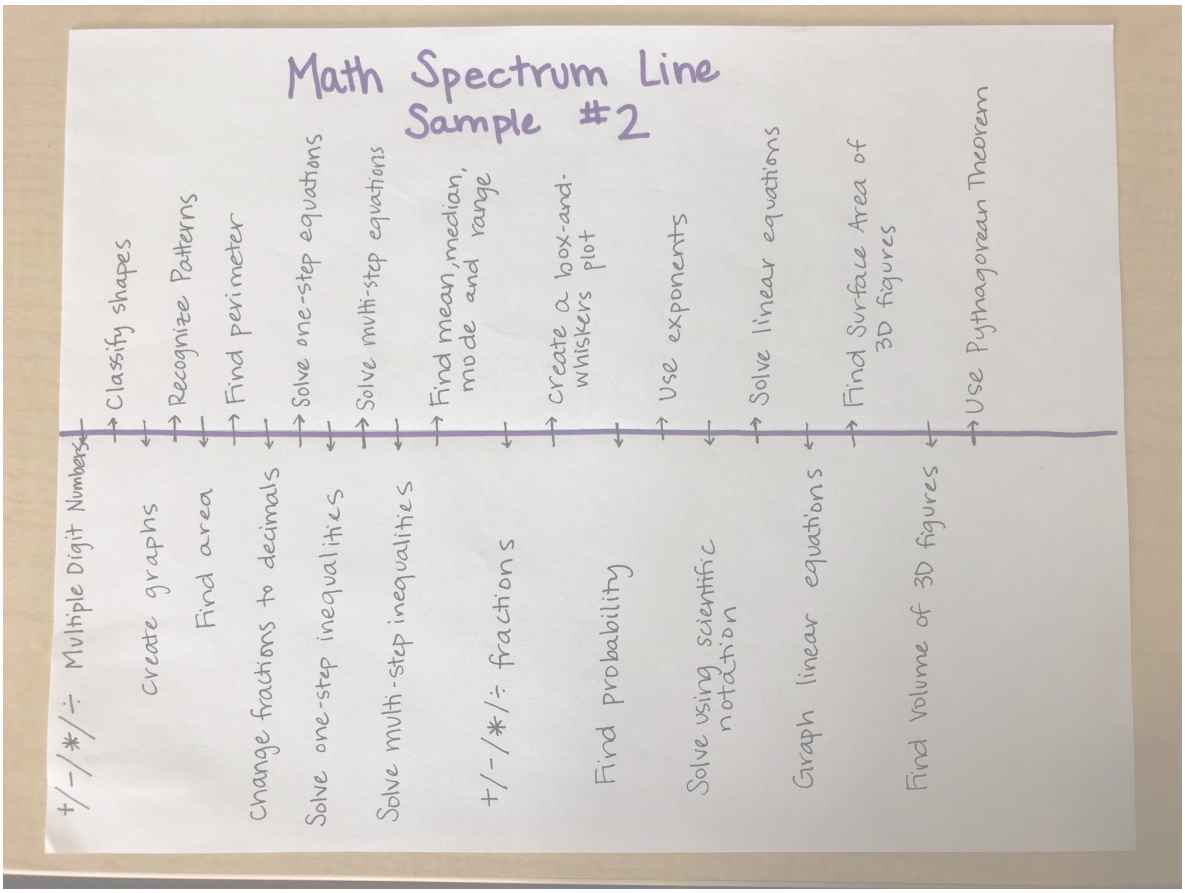
Engage

Teacher's Note: Lesson Preparation

Prior to the lesson, create a math spectrum line for use during the Engage. You may use tape or string to create an interactive line displayed in the classroom, or create a virtual line on n interactive whiteboard. A couple of examples are shown below. You may choose to create a line with a simple continuum from no knowledge to mastery (see Math Spectrum Line Sample #1) or one that includes math standards, from elementary level through middle school and beyond (see Math Spectrum Line Sample #2). If using math standards, make sure you also have some high school concepts on your spectrum for students who are more advanced. Use whatever method you prefer to create a line that is right for you and your students.



Math Spectrum Line Sample #1: Does not have any standards associated with it and is created using rope or string and displayed in your room. During the Engage, students will place a sticky note where they think they belong.



Math Spectrum Line Sample #2: Lists various math standards in a more straight-line spectrum. During the Engage, students will place a sticky note or their name where they think they belong.

Begin the lesson by showing students the "With Math I Can" video found on **slide 5**. Links are available here and in the slide presentation. The full URL of the video can also be found in the Resources at the end of the lesson.

Embedded video

https://youtube.com/watch?v=sLPFaOvhlKw

Give students a couple of minutes to reflect on the video and introduce a modified Collective Brain Dump strategy. Distribute the **Walking the Line Brain Dump** handout (attached) and ask students to write down a takeaway they got from the video. The cloud on the handout will be a place for them to write down thoughts they have throughout the lesson.

Transition to **slide 6**. After students have written their takeaway on the Brain Dump handout, use an Elbow Partner strategy to facilitate student conversations. Give students time to reflect on the video by discussing their takeaway with an elbow partner.

Reflection Prompts:

Slide six contains some questions to prompt student conversations with their Elbow Partner: *"What did you like about the video?", "What did you not like about the video?",* and *"What one takeaway really caught your attention?"*

Next, display **slide 7** and ask students, “How much mathdo you know?” If your math spectrum line is physically on display in your classroom, instruct the students to take a sticky note, write their name on it, and placeit where they believe they lie on the math spectrum that you've created for the class. If you chose to make your math spectrum line on an interactive whiteboard, instruct the students to write their names on the line using the interactive whiteboard pens. In the slide graphic, the far left side represents being not very knowledgeable and the far right side is a master at the subject.

Optional Modification For Distance Learning

To make use of this lesson in an online or distance learning environment, you can make your own digital math spectrum line in an application like Google Docs or Padlet and have students respond there. The Collective Brain Dump can also be recreated in Google Docs by having each group collaborate in shared documents. Alternatively, students can send their completed handouts to their partners and discuss them. Download all attachments to use this lesson in Google Classroom.

Explore

Display **slide 9**. After students have analyzed where they are on the math spectrum, ask them to return to their Brain Dump Handout and list every math concept they can remember learning in elementary and middle school. Once they have written down a list of math concepts, have them to select two to start exploring online.

Distribute the **Math Concepts Research and Presentation handout** (attached) and Introduce a Stop and Jot strategy to guide students in taking key notes while they are researching their topics. The students will read through different resources, stop to process the information, and then jot down any key terms on their Math Concepts handout. Inform the students that they will be explaining the topics they research to another student, so it is important to take good notes.

Teacher's Note: Concept Coaching And Math Term Prompting

You may have to guide students through this process by asking them what they have learned in the past. If they say nothing, give them an example of a math concept you are sure they know. Or if they are vague, guide them to the guide to the mathematical term for the concept. For example, if a student says they learned how to add up all the sides of a rectangle, you can tell them to start researching the perimeter of an object.

Optional Modification For Distance Learning

To make use of this lesson in an online or distance learning environment, you can have students submit digital lists before they research in order to check students' topics. Allow research and note-taking to proceed as normal. Consider assigning students to pairs as you review their topics in order to prepare for the next activity. Download all attachments to use this lesson in Google Classroom.

Explain

Display **slide 11**. Once the exploration is completed, have students find a partner who did not research the same topic as them. Give the students roughly five minutes to pair-share their findings with a partner. In doing so, they will explain the math concepts they researched. A space is provided on the Math Concepts handout to take notes about their partner's presentation. Once each person has shared, ask students to use the box at the bottom of the Math Concepts handout to write one summary statement that describes a connection between one of their concepts and one of their partner's concepts. Finally, have students share their summary statement with the class.

This activity will allow students to recall previous knowledge and help them to realize that they remember more concepts than they may have initially thought.

Optional Modification For Distance Learning

You can distribute the Math Concepts handout to pairs in Google Docs. This allows each pair to work in a collaborative workspace. Download all attachments to use this lesson in Google Classroom.

Extend

After each pair presents the summary statement, display **slide 13** and ask students, "How much math do know NOW?" The students will reevaluate their position on the math spectrum by moving their name if they deem it appropriate. The students will more than likely move their name to the right (towards mastery) after they hear different presentations about math concepts they had previously learned.

Transition to **slide 14** and distribute the Math Goals handout (attached). After allowing students to move their name, continue to promote a growth mindset by giving students the opportunity to write a math plan for the school year. The plan will include a reflection of past successes and failures and goals moving forward. This is important for the student to create a vision for their learning.

Teacher's Note: Facilitating Math Goals

Be sure to include a discussion about the things that students can and cannot control when they are making their math plans. Concentrate on ways to improve their current practices and make positive changes this year.

Display **slide 15**. Once everyone has created a math plan, students will identify barriers they believe could stand in the way of their success. On a separate sheet of paper, have students write down the barriers that have stopped them from reaching their full potential in math in the past. If students feel comfortable, have them share out some of their barriers.

Sample Student Responses

Some barriers the students might mention are having a fear of failure in math, their family not being good at math, or not asking questions when they don't understand, among others.

Once everyone who wishes to do so has shared, transition to **slide 16**. Tell the students to raise their paper on which they've written their barriers, rip it up, and toss the remains in the trash. This will symbolize that their past barriers can no longer hinder their future.

Optional Modification For Distance Learning

For online or distance learning, distribute the Math Goals handout digitally. Then, create a space for students to share and discuss through video. The application Padlet is an option for short student share-outs with the class. Download all attachments to use this lesson in Google Classroom.

Evaluate

To end the activity in reflection, have the students complete an Exit Ticket on a piece of paper or on the attached Exit Ticket handout. Have students respond to the following question and statement:

1. What did you learn about your relationship with math today?
2. This year in math will be a success if...

Teacher's Note: Technology Option

To introduce a technology component to the lesson, have students complete the Exit Ticket question and statement using Google Forms.

The Exit Ticket question will give students time to reflect and the statement will give them a focus for future success. Both will give you a starting point to understand where the students are emotionally so you can help them break down their barriers and misconceptions throughout the year.

Teacher's Note: Lesson Timing And Repetition

This is a great activity to do not only in the first days of school but also to revisit multiple times a year. The Extend can serve as a repeat reflection tool to help students see their mathematical and emotional progress throughout the school year.

Optional Modification For Distance Learning

The Exit Ticket can be distributed digitally and collected as needed. Download all attachments to use this lesson in Google Classroom.

Resources

- K20 Center. (n.d.). Bell Ringers and Exit Tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). Collective Brain Dump. Strategies. https://learn.k20center.ou.edu/strategy/111
- K20 Center. (n.d.). Elbow Partners. Strategies. https://learn.k20center.ou.edu/strategy/116
- K20 Center. (n.d.). Google Classroom. Tech Tools. https://learn.k20center.ou.edu/tech-tool/628
- K20 Center. (n.d.). Padlet. Tech Tools. https://learn.k20center.ou.edu/tech-tool/1077
- K20 Center. (n.d.). Stop and Jot. Strategies. https://learn.k20center.ou.edu/strategy/168
- With Math I Can. [#withmathIcan]. (2016, February 02). "With Math I Can." [Video file]. https://youtu.be/sLPFaOvhlKw