“When a Line Bends… Mathematical Discourse Begins!”

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Session Description:

What happens when a line bends? A shape begins! In this session we explore how to utilize mathematical discourse to enhances student understanding of mathematical concepts. From construction of the social environment to pedagogical considerations, we tackle geometry standards, using discourse, children's literature, and innovative activities.

Mathematical Discourse: What is it and why should we take the time to do it?

- Class discussions in which students talk about mathematics in such a way that they reveal their understanding of concepts.
- Students learn to engage in mathematical reasoning and debate.
- Discourse involves asking strategic questions that elicit from students both how the problem was solved or how they arrived at an answer and why a particular method was chosen or why their answer makes sense.
- Students critique their own and other's ideas and seek out efficient mathematical solutions.
- It can be used to determine what students are thinking and understanding in order to build bridges between what they already know and what there is to learn.
- It can offer opportunities to develop agreed-upon mathematical meanings or definitions and explore conjectures.

Theory

- Constructivist views of learning: knowledge is created internally through interactions with the environment.
- Socio-cultural: students working together are able to reach new understandings that could not be achieved if they were working alone.
  - Mathematics is about reasoning, not rote memorization: It is not about remembering and applying a set of procedures but about developing understanding and explaining the processes used to arrive at solutions or answers.
  - Metacognition: thinking about their thinking!
    - Person knowledge – understanding one's own capabilities
    - Task knowledge – understanding of a task, the difficulties associated with it
    - Strategic knowledge – capability for using strategies to learn new information

Marilyn Burns:

"In language arts, it is not enough that students can read the words – they must comprehend the message. Likewise, in mathematics, it is not enough that students can manipulate numbers and symbols and read math words. To be proficient, students must draw connections between these symbols and what they represent. The standard for math should be the same as the standard for reading – bringing meaning to the printed symbols."

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How to Create a Classroom Culture that is Conducive to Mathematical Discourse

- Encourage differences in answers and solutions
- Expect students to explain and justify their answers, whether they are correct or not!
- Emphasize the importance of contributing to the discussion by explaining their strategies, not just giving an answer.
- Expect students to listen and attempt to understand others' explanations.
- Expect students to question one another to clarify explanations.
- You should comment upon or re-describe students' contributions, while noting the reasoning or solutions on the board.
- Expect students to explain why they accept someone's explanation or answer or why they do not believe it is correct.
- Use students' names to label answers.

Mathematical Discourse Sentence Starters…

- I'm wondering why/how…
- Can you please explain or clarify…
- I think it's interesting that…
- Where is the…
- What is the mathematical connection between…

Common Core State Standards of Mathematics, Mathematical Practices

- Make sense of problems and persevere in solving them
- Reason abstractly and quantitatively
- Construct viable arguments and critique the reasoning of others
- Model with mathematics
- Use appropriate tools strategically
- Attend to precision
- Look for and make use of structure
- Look for and express regularity in repeated reasoning

Common Core State Standards of Mathematics, K-2, Geometry

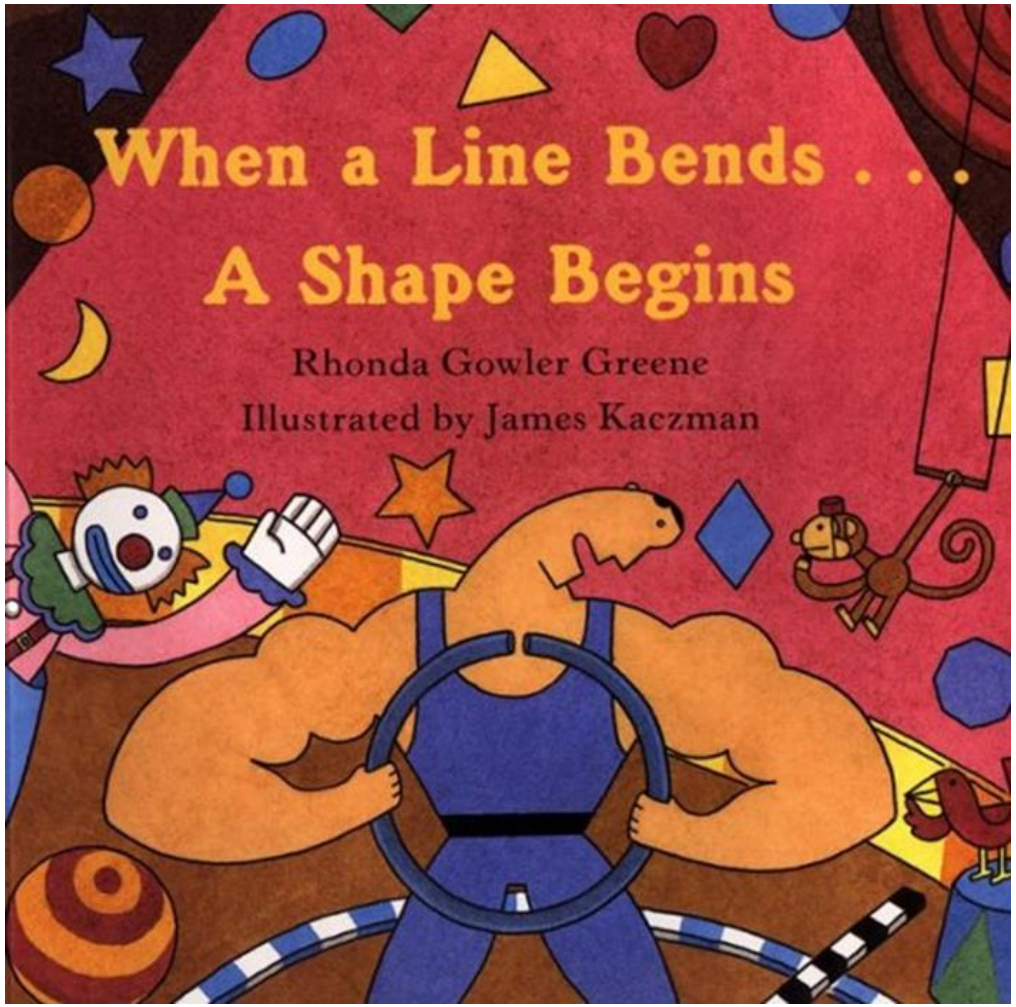
- Identify and describe shapes. (K)
- Analyze, compare, create, and compose shapes. (K)
- Reason with shapes and their attributes. (1, 2, 3)
  - Distinguish between defining attributes versus non-defining attributes (1)
  - Compose two-dimensional shapes or three-dimensional shapes to create composite shapes (1)
  - Partition circles and rectangles into equal shares and define with fractional name (1)
  - Recognize and draw shapes with specific attributes (2)
  - Partitioning a rectangle into rows and columns (precursor to area) (2)
  - Partitioning circles and rectangles into fractional parts (2)
  - Understanding that shapes in different categories may share attributes (rhombus, rectangles, squares = quadrilaterals) (3)
  - Partitioning shapes with equal areas (3)

Types of Discourse:

- Correcting – what
- Eliciting – what and how
- Probing – what, how, and why
- Responsive – what, how, why, and connections

Project AIM, 2012)

When a Line Bends…A Shape Begins by Rhonda Gowler



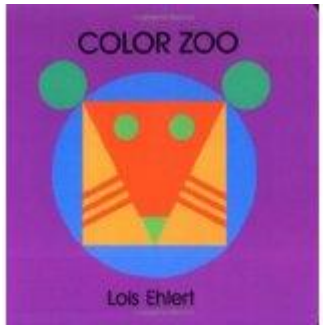
Activity: "Shape Our World"

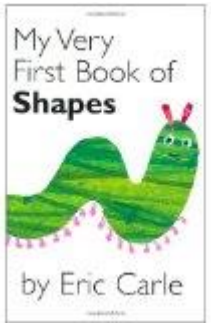
- Shape Booklet: Each shape has a separate page; write name at top and identify the shape somewhere in the environment – walk around the room, the school, the playground and ask students to identify shapes around them. Draw pictures of the shapes in their environment. Focus your discussion and discourse on the attributes.
  - Is it still a rectangle if it is turned a different way?
  - Will it still be a circle, no matter what the size?
  - Are there different kinds of triangles? Do they always look the same?
- Shape Art: Create a picture using construction paper, glue, etc. (or attribute blocks!). Students must identify the shapes they have used to construct their art.

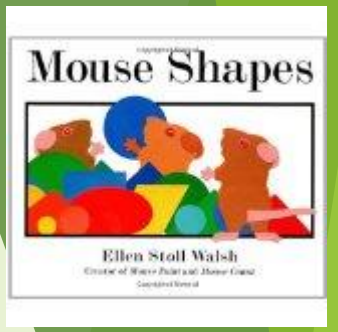
Activity: “Shape to the Music!”

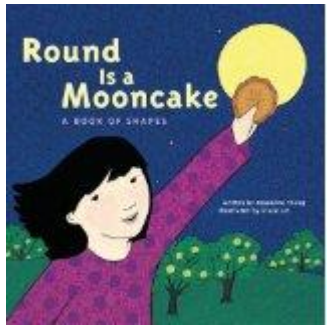
- Cut out enough large pictures of the shapes (or use attribute blocks!) that you are learning about in your class so that each child has one shape. (Example, the 10 shapes in the book *When a Line Bends…)* Make them different colors, sizes, etc.
- Ask the students to stand on or beside a shape.
- Students should turn in the same direction and begin moving when the music begins.
- When the music stops, each student will stand on the shape nearest to him or her.
- Now the teacher calls out the attributes of one of the shapes. The student on that shape identifies his/her shape by name.
- Whoever is standing on that shape is out. Those students sit in the middle of the circle and must watch their peers as each additional set of attributes is called out to insure that the person with the attributes called, recognizes their shape.

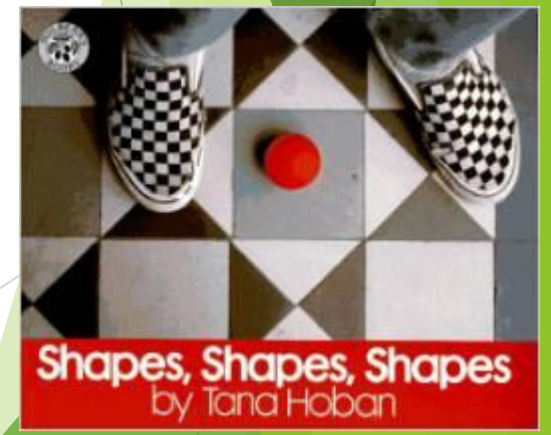
Other Recommended Pieces of Children's Literature

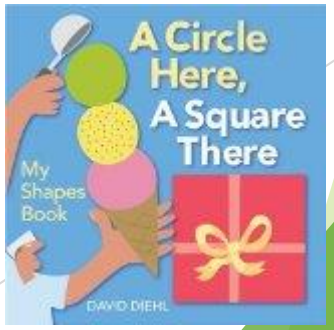












- *Mouse Shapes* by Ellen Stoll Walsh
- *Shapes, Shapes, Shapes* by Tana Hobson
- *My Very First Book of Shapes* by Eric Carle
- *Round is a Mooncake* by Roseanne Thong & Grace Lin
- *The Shape of Me and Other Stuff* by Dr. Seuss
- *Shape Up!* By David Adler & Nancy Tobin
- *Captain Invincible and the Space Shapes* by Stuart J. Murphy
- *A Circle Here, A Square There: My Shapes Book* by David Diehl
- *Color Zoo* by Lois Ehlert

Other Activities:

- Shape Sorts: Provide students with a set of 2-d or 3-d shapes
  - Students randomly select 2 shapes. How are they alike? How are they different? Compare to peer's shapes.
  - Groups: select 1 shape, but in center of workspace. Then have students find similar shapes, following 1 rule. Ex.: Curved sides.
  - Students can sort shapes into different large groups. Share their sorting rules.
  - Secret Sort: sort shapes; another student must state the rule.
  - What's My Shape? While looking at an assortment of shapes, 1 student describes attributes of their shape. Others must figure out which shape s/he is talking about.
- Shape Dissection: Give students a large shape (Ex. a rectangle); using pattern blocks, they are to figure out how they can fill the shape with pattern blocks. Can anyone do it differently? This can also be done on a geoboard.
- Shape Construction: 1 student construct 3-d shapes with pipe cleaners, hidden behind a barrier. The student then describes the attributes of that shape to another student who must construct their own, using pipe cleaners.
- Shape Bingo: students draw their own board or you draw for them.

Discussion, Questions, Comments