RESOURCES WE LOVE

Books:

- *Problem Solving for All Seasons PreK – 2* by Kim Markworth, Jenni McCool, and Jennifer Kosiak
- *Math Work Stations* by Debbie Diller
- *Mathematical Mindsets* by Jo Boaler
- *Developing Number Concepts* by Kathy Richardson
- *Working with Ten Frames* by Don Balka and Ruth Mile
- *Navigating Through Problem Solving and Reasoning in Grade 1* by Carol R. Findell, Mary Cavanagh, Linda Dacey, Carole E. Greenes, Linda Jensen Sheffield, and Marian Small
- *Games for Early Number Sense: A Yearlong Resource* by Antonio Cameron and Catherine Twomey Fosnot
- *The Double-Decker Bus: Early Addition and Subtraction* by Maarten Dolk, Catherine Twomey Fosnot, and Nina Liu
- *Bunk Beds and Apple Boxes: Early Number Sense* by Catherine Twomey Fosnot
- Books by Stuart J. Murphy (https://www.mathstart.net/)

Websites:

- https://gregtangmath.com/
- https://www.khanacademy.org/
- https://www.mathlearningcenter.org/home
- https://mathodology.com/
- https://www.youcubed.org/

Sherry Harris and Anna Scott
NCTM Conference 2019

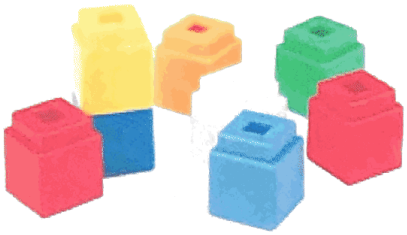
RESOURCES WE LOVE

Apps:

- Reflex
- DreamBox
- 10 Frame Fill
- Montessori Numbers
- Montessori 100 Board
- The Brainingcamp, LLC apps for teachers: Base Ten Blocks Manipulative, Linking Cubes, Two Color Counters, Pattern Blocks Manipulative, etc.
- Tangram
- Geoboard by The Math Learning Center
- Early Addition Math Facts

Other:

- Everyday Counts: Partner Games Kit
- *Shut the Box* game
- *Meta-Forms* game
- *Deck O' Dots – deck of cards for subitizing*



Unifix Trains Problem

Investigate:

Engage:

To introduce this lesson, read a book about trains to your children such as Freight Train by Donald Crews. Discuss the colors of the various cars.

Explore:

Present the following problem:

On one train, the engine is black and always goes first. The caboose is red and always goes last. The cars in the middle are green, blue, and yellow. How many different ways can you arrange the cars in the middle?

Using unifix cubes, build a train for the children to see. Then build a second train and change the order of the middle colors. Ask the children to think of other ways to arrange the colors in the middle so they are different from the first two. Have one or two children build trains that are different than the first two. Tell the children

that there are six different ways to arrange the cars in the middle of the train. Their job is to find as many as they can of the six possible ways. They may draw or use unifix cubes to represent the trains, but should find a way to keep track of the ones they already have to make sure that none are repeated. Have students share and compare solutions. Kindergarten students can solve this problem in small groups (some might need to be in a small group with the teacher if extra support is needed).

Extend:

This problem can be revisited in a number of ways. You may want to try having children show all the different ways three or four scoops of ice cream can be arranged on a cone, as in the following problem:

At the ice cream shop you order a scoop of chocolate, a scoop of vanilla, and a scoop of strawberry on your ice cream cone. How many ways might the ice cream cone be arranged?

Another idea is to find possible ways to organize the lineup for a pet parade:

There are three pets in the neighborhood pet parade. A rabbit, a cat, and a dog. How many different ways can all three animals line up for the parade? What would happen if there were four pets and a hamster was added?

Discussion:

The goal of this lesson is to encourage children to look to themselves for a sense of completion in an open-ended project. As children explore this problem, urge them to check for duplicates and also search for patterns in their solutions. Ask them how they know they have all the combinations, but be satisfied if a child is content even if they haven't found them all. Discuss the children's answers, and encourage them to share their thoughts. When sharing student samples, choose ones that have some kind of organization and planning.

Measuring Neil's Table

Investigate:

Engage:

To help introduce the idea of using nonstandard objects for measurement read the book The Line Up Book by Marisabina Russo. In this story, a young boy is called for lunch by his mother while he is lining up objects from his room throughout the house. Each time he runs out of an object (books, toy trucks, blocks), he changes to another form of measurement. Ask the children if they can estimate the size of their table if they measured it with unifix cubes. Then ask them if they think the number would change if they used crayons to measure it.

Explore:

As you write the problem on the Smartboard, tell the children about the problem. As a group brainstorm ways they might find the answer. Before you dismiss the children to begin their work, be sure that they know they are to draw a picture, write, and/or dictate to an adult the results of their measuring. With kindergarten

children, have them draw their picture and then have them dictate their results.

Extend:

For assessment purposes, keep in mind that young children may require several experiences with an idea or concept before they can internalize it and apply it in their own framework. The children need to have several measurement lessons before they can make generalizations. To provide children with additional measurement experiences with nonstandard objects of different lengths, the following problem can be used:

Katie measured herself (with a friend helping her). First, she used toothpicks. Then she used wooden cubes. Last she used pencils. Estimate the number she may have counted for each object. Explain why the numbers are different.

Discussion:

This problem was presented so that children could select what aspects of the desk to measure (length, width, perimeter, surface area). Interestingly, most kindergarten students students chose to measure the entire distance around the desk rather than the length, width, or surface area.

Another important aspect of this problem is that children can be disappointed when their estimate does not match the actual number. It is natural that young children will attempt to change their estimates to match the actual number so they can get the "right" answer. Be sure to let children know that you are not concerned that the estimate is correct. You may want to tell them that an estimate is "a good thinking guess" and the more information we have, the closer our guess will become.

The expectations for solving this problem vary with the age and the experience of the child. Younger children often worked with the measurement task and were only able to say which tool resulted in the largest measurement. Older children were able to state which measurement tool produced the lower and highest numbers, and also could be specific about exact measurements for the desk. Many of the oldest children were also able to make the generalization that longer measuring tools resulted in smaller numbers, and smaller tools produced larger numbers.

Name:_____ Date:_____

Measuring Neil's Table Problem

Neil measured his table. First he used unifix cubes. Then he used his new crayons. He got different numbers each time. Try measuring your table with unifix cubes and then crayons. Did you get different numbers? Why do you think the numbers are different?

Shape Families Problem

Investigation:

Engage:

Have the students sit in a circle. Place the shape cards face up in the middle of the circle. Name particular shapes, and call on students to find the cards that show the shapes and then give justifications for their selections. For example, ask, "Who can find a triangle?" When a student correctly identifies a triangle, ask, "How do you know that this is a triangle?"

Direct the students' attention again to the shape cards in the circle, and ask, "Can you find any more triangles?" Next, have a student identify the circle, and ask, "How do you know it's a circle? How is it different from the triangle?"

Explore:

Place all the shape cards face up in the middle of the circle. Hold up the square, and ask, "Who can find a shape that is like this shape?" After someone correctly identifies a similar shape, probe your students' reasoning by asking a sequence of questions:

- How are they alike?
- Can anyone find another shape that is like this one?

- How is this new shape like the first one?

Follow a similar line of questioning with a shape that is different from the square.

Place the shape cards for the circle, the square, and the triangle in the center of the circle. Say, "One of these shapes doesn't belong here," and ask, "Which shape is it?" Ask, "Why doesn't the circle belong with the others?"

Next, place the square, the rhombus, and the triangle where they are visible to all the students. Point to the square and rhombus, and ask, "Why do these shapes belong together?" Ask, "Why doesn't the triangle belong with the others?"

Shape Families Problem

For each of the following collections of shapes, ask the students to identify a shape that doesn't belong and give a rationale for their choices. Sample selections and rationales are given in parenthesis.

- Circle, semicircle, square (The square doesn't belong because none of its sides are curved)
- Square, rhombus, triangle (The triangle doesn't belong because it has three sides and the other shapes have four sides)
- Rectangle, trapezoid, square (The square doesn't belong because its sides are equal)

Extend:

Students, who need a greater challenge, may enjoy the following tasks:

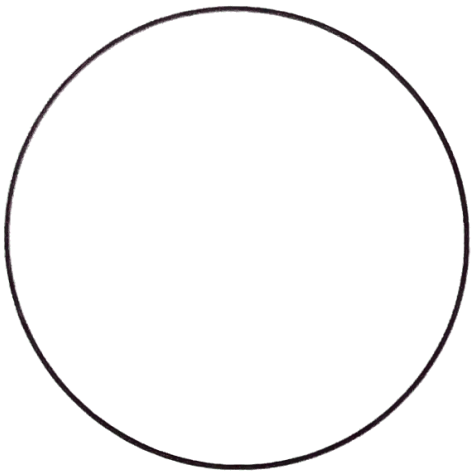
1. Put the shapes into two piles. The shapes in each pile must be alike in some way.

   The students might, for example, place the circle and the semicircle in one pile because their sides are curved and the other shapes in a second pile because their sides are straight.

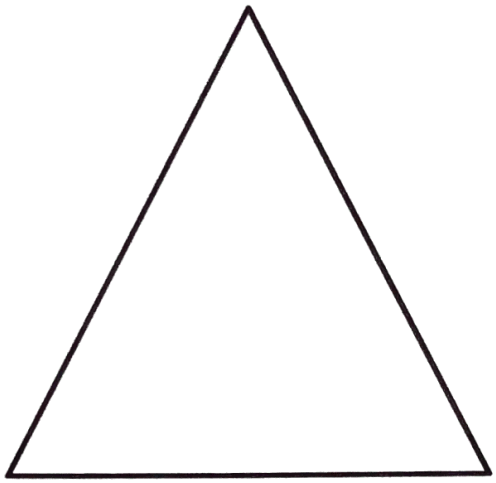
2. Have students work in pairs. Give each student an attribute block. Have them state one thing that is the same as their partner's block and one thing that is different than their partner's block.

Discussion:

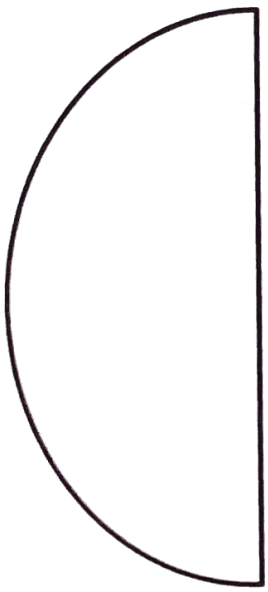
When you begin this investigation, some students may be able to point to shapes that are alike or different in some attributes, but they may not be able to describe those attributes. For example, some students may perceive that the square and the rhombus are different, but they may not be able to tell you that the difference is that one has right-angled corners and the other doesn't. If students cannot explain the differences among the shapes, state the relationships for them (The square has corners with right angles. The corners of the rhombus do not have right angles). With experience, the students' descriptions will become more mathematical.



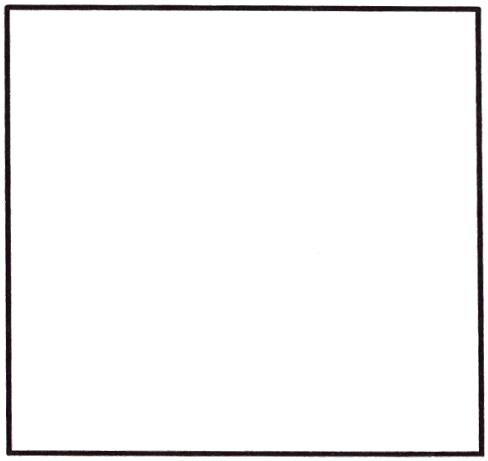
Circle



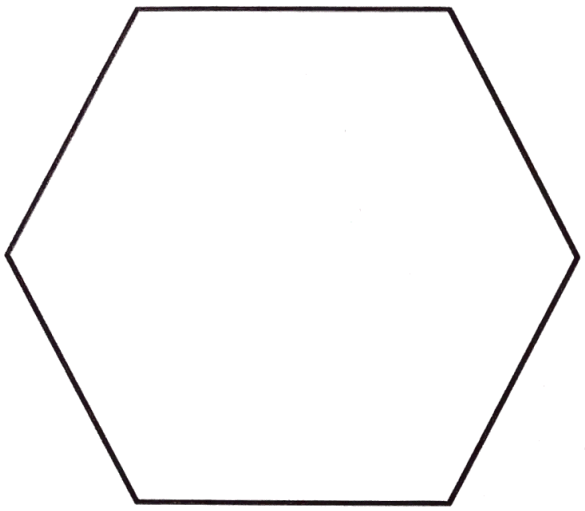
Triangle



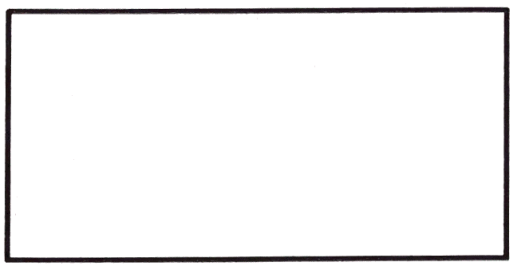
Semi-Circle



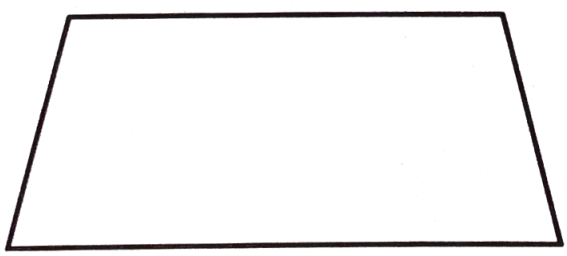
Square



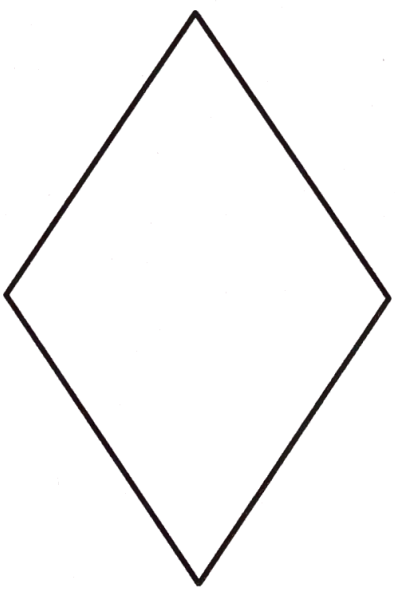
Hexagon



Rectangle



Trapezoid



Rhombus

STUDENTS WORKING ON OPEN-ENDED PROBLEMS

Problem Solving

Ways to Support Your Problem-Solver at Home

Make Mathematics Part of Your Child's Lives.
Notice patterns and shapes in your environment. Look for numbers all around: price tags, scores in sports, speed limits, etc. Think aloud. Let your child hear your strategies when problem solving.

Be Positive About Math.
Your attitude is critical. Be interested and excited about mathematics. Play games at home. We want to pass along a positive and enthusiastic attitude towards math.

Praise Effort, Not Answers.
Focus on the strategies your child is using, rather than how fast a question is answered or if it is right or wrong. Your most powerful question is, "How did you get that answer?"

Ask Open-Ended Questions.
Open-ended problem solving is not limited to math. You can use open-ended questions in daily conversations with your child to build their thinking and explaining skills. Avoid asking questions that warrant one-word responses. Check out some of the alternatives below.

Try One of These:

- Tell me about _____.
- Can you help me think this through?
- Why do you think ____?
- Do you have any other ideas?
- How could we make it work?
- What did you like best about ____?
- How did that happen?
- What do you think would happen if you ____?
- How did you know that?
- How did you work it out?
- How might you do it differently?
- What do you think would happen if you ____?
- What did you learn

Recommended Resources

Bedtime Math is a fun and engaging resource, designed to get students excited about math. It can be downloaded as an app, or you can visit the website at www.bedtimemath.org for games, stories, and puzzles.

Your Fantastic, Elastic Brain by JoAnn Deac is a great read for children and adults to gain more information about this topic.