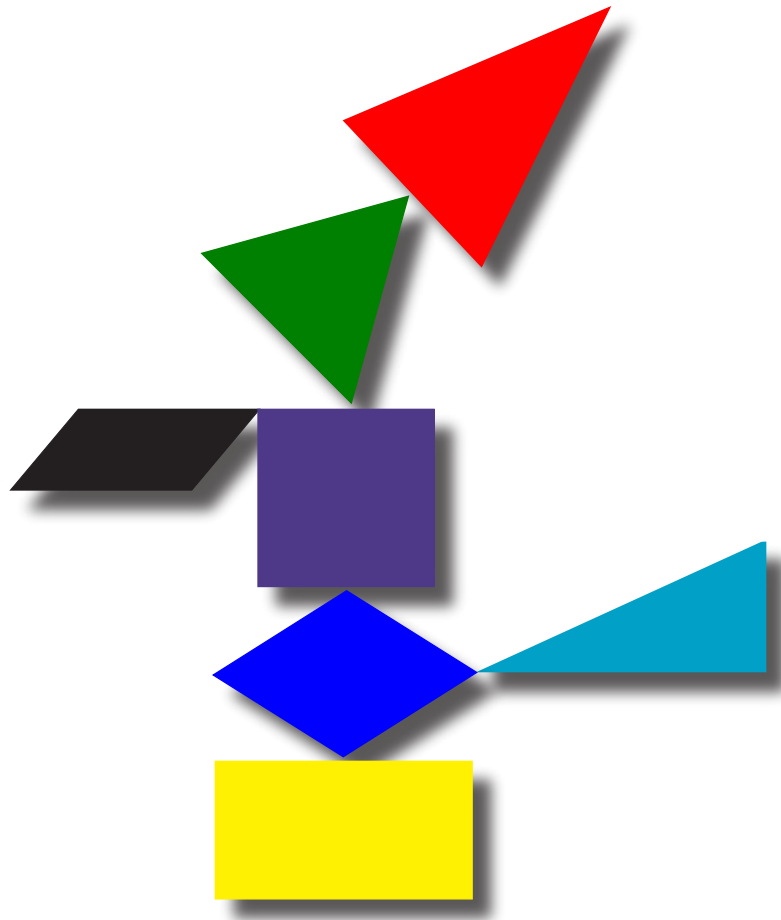


What is Geometry?



Exploring 2-Dimensional Shapes

Outcomes

- To sort, classify, name, and define 2-dimensional shapes.
- To connect activities in this session to national, state and/or local standards, as well as class room expectations.
- To provide a cooperative experience that promotes dialogue and diversity in thinking.

Overview

What is Geometry? has a main theme of sorting and finding attributes. It provides an opportunity for parents to explore the early foundations of geometric thinking. Participants start the session by brainstorming the meaning of geometry. After they have thought a little about what geometry is, they do a sorting activity with buttons. They sort the buttons in a way that makes sense to them, and then share the ways that they have discovered for sorting them. The sorting activity is setting the stage for exploring the attributes of 2-dimensional shapes. Participants are given a selection of 2-dimensional shapes to sort and are asked to share sorting strategies. This is an open-ended exploration with no right answers. It leads to the need for more specific means for defining shapes. The next activity uses correct definitions for sorting shapes.

Any children that are present are asked to leave at this point so that the participants can explore the attributes of the 2-dimensional shapes. They are asked to look at the definition of shapes like square, quadrilateral, rhombus, etc., and decide which of the shapes fit each category. It is from this activity that participants have a chance to discover that some shapes fit several categories. Plenty of time is given for the participants to do this in groups. Developing arguments for relationships is an important aspect of geometry. The processing of this activity involves letting the participants defend why they think that a shape fits a category.

To close the session, connections are made between the concepts of the module and the state or local standards as well as the district curriculum. At this point, facilitators share activities from their textbooks and explain the main concepts that are learned at the different grade levels in their schools. Activities are provided for parents to use at home with their children.

Mathematics Background

The main mathematical concepts of this module are:

- Sorting and classifying.
- Defining attributes.

Geometry in the early grades is sometimes thought of as a lesson in identifying different shapes: squares, parallelograms, quadrilaterals, etc., and memorizing definitions. Geometry also includes spatial reasoning, developing arguments about relationships, using logic to justify statements, and perceiving an object from different perspectives.

The focus of this Geometry module is studying the characteristics and properties of 2-dimensional shapes and developing mathematical arguments about geometric relationships. Students need opportunities to sort items and defend their thinking about the sorting. In this module, the sorting idea is emphasized. It is important that this module does not become an exercise in vocabulary. That is not the intention. The intention is to provide opportunities for sorting, defending and then finally resorting 2-dimensional shapes according to attributes and definitions.

According to van Heile (1957), most students will sort visually at the K-2 level. When they do this, they are considering the overall impression of the shape. If it basically looks like a rectangle, it will be perceived as belonging to the rectangle group. There is a shape in the module that looks like a rectangle missing a square out of its corner. This shape will often be placed among the rectangles by children who sort visually. The object of the early schooling in geometry is to move these thinkers to where they can informally analyze attributes like the number of sides or the number of angles. Practice with sorting helps students move from a visual to an attribute basis for sorting and classifying.

The shapes in these units are called polygons. Polygons are closed figures with straight sides. These are polygons:



These are not polygons:



Many shapes belong to more than one category when being classified. For example, in this session, the square belongs to many different categories. It belongs in the **quadrilaterals** because it is formed by **4 sides**. It fits into the **parallelogram** category because it has **two sets of parallel sides**. It is a **rhombus** because it is a **parallelogram with all four sides equal in length**. It is a **rectangle** because it has **two pairs of parallel sides and has four right angles**. Students are taught the shapes of rectangle and square as if they are different. They are both rectangles. The square is a special version of a rectangle that has all sides of equal length.

Room Setup

- Desks or tables arranged in groups of 4-6
- Tables for sign-in, supplies, estimations, and snacks
- Overhead projector and screen
- Chart paper on easel
- Poster of the agenda

Materials

Facilitator	Transparencies
<ul style="list-style-type: none"> • Overhead projector • Overhead pens • Transparencies, blank • Chart paper • Chart markers • Masking tape • Timer (optional) 	<i>BLM 1: Welcome</i> <i>BLM 60: Shape-Pathway</i> <i>BLM 61: A Sorting Activity</i> <i>BLM 62: Sorting and Attributes</i> <i>BLM 65: Name of Shapes</i> <i>BLM 67: NCTM Geometry Standard</i>
Participant	Handouts
Individuals: <ul style="list-style-type: none"> • Pencil • Paper • Scissors • Glue sticks • Reflection Groups: <ul style="list-style-type: none"> • Chart paper • Chart Markers • Envelope for cut out shapes • Assorted buttons, 1 cup per group 	One per participant for class <i>BLM 62: Sorting and Attributes</i> <i>BLM 63.1-3: Shapes for Sorting</i> <i>BLM 64: List of Terms</i> <i>BLM 65: Name of Shapes</i> <i>BLM 66: Name of Shapes Answer Key</i> <i>BLM 67: NCTM Geometry Standard</i> One per participant for home <i>BLM 63.1-3: Shapes for Sorting</i> <i>BLM 68: Shape Activities for Home</i>

Timing

2 hours

Preparation and Timing (2 hours)

Part 1: Getting Started (10 minutes) - with children

Distribute to each participant:

Paper and pencils

Make transparency of:

BLM 1: Welcome

BLM 60: Shape-Pathway

Make copies for each participant:

BLM 60: Shape-Pathway

Part 2: Setting the Stage (20 minutes)

Distribute to groups:

Chart paper, markers, and glue sticks

Envelopes for cut-out shapes

Assorted Buttons, 1 cup per group

Part 3: An Introduction to Sorting and Shapes (30 minutes)

Make transparency of:

BLM 61: A Sorting Activity (cut-out faces)

BLM 62: Sorting and Attributes

Make copies for each participant:

BLM 62: Sorting and Attributes

Part 4: Sorting 2-Dimensional Shapes (30 minutes)

Copy, cut and distribute 1 set for each pair:

BLM 63.1-3: Shapes for Sorting

Part 5: Labeling the Shapes (30 minutes) - without children

Make transparency of:

BLM 65: Name of Shapes

Make copies for each participant:

BLM 64: List of Terms

BLM 65: Name of Shapes

BLM 66: Name of Shapes Answer Key

Part 6: Connections (15 minutes)

Make transparency of:

BLM 67: NCTM Geometry Standards

Make copies for each participant:

BLM 67: NCTM Geometry Standards

Optional: Make copies of the appropriate geometry parts of state and local standards

Part 7: Applications for Home (15 minutes)

Make copies for each participant:

BLM 63.1-3: Shapes for Sorting

BLM 68: Shape Activities for Home

Part 8: Closing (5 minutes)

No Handouts or Transparencies

Distribute evaluations and estimation prizes

Facilitator Resources

Articles

Fuys, David J. and Liebov, Amy K. *Concept Learning in Geometry: Teaching Children Mathematics*, January 1997, p. 248-251.

Lehrer, Richard and Chazan, Daniel. *Designing Learning Environments for Developing Understanding of Geometry and Space*. Mahwah, New Jersey: Lawrence Erlbaum Associates, 1998.

Oberdorf, Christine D. and Taylor-Cox, Jennifer. *Shape Up! Teaching Children Mathematics*, February 1999, p. 340-345.

Shifter, Deborah. *Learning Geometry: Some Insights Drawn from Teacher Writing, Teaching Children Mathematics*. February 1999, p. 360-365.

National Council of Teachers of Mathematics. *The Van Hiele Model of Thinking in Geometry among Adolescents: Journal for Research in Mathematics Education*. Monograph Number 3

Books

Standards 2000 Project, *Principles and Standards for School Mathematics*, The National Council of Teachers of Mathematics, Inc (NCTM), 2000, p. 96, ISBN 0-87353-480-8, www.nctm.org

Instructional Programs

Investigations in Number, Data, and Space, TERC, Kindergarten: *Making Shapes and Building Blocks* (Exploring Geometry), Dale Seymour Publications.

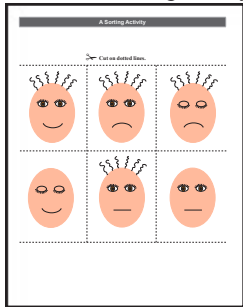
Investigations in Number, Data, and Space, TERC, Grade 1: *Quilt Squares and Block Towns* (2-D and 3-D Geometry), Dale Seymour Publications.

Investigations in Number, Data, and Space, TERC, Grade 2: *Shapes, Halves, and Symmetry* (Geometry and Fractions), Dale Seymour Publications.

Activities

Preparation of Classroom	Notes
<ol style="list-style-type: none"> 1. Set up a table with a sign-in sheet, name tags, and snacks. On another table set up estimation activities. Arrange desks or tables in groups of 4-6. 2. Display the transparency of BLM 1: Welcome!. 3. On the participant tables, distribute pencils, paper and BLM 60: Shape-Pathways. 4. Prepare and display a poster with the agenda and purpose of the session. 	<p>BLM 1: Transparency BLM 60: Transparency / Handout</p> <div data-bbox="1008 331 1247 638"> <p>MAPPs Math And Parents Partnerships Math Awareness Workshop</p> <p>WELCOME! Please do the following:</p> <ol style="list-style-type: none"> 1. Sign in and complete any necessary paper work. 2. Do the estimation activity located on the table by the door. 3. Help yourself to refreshments and enjoy. 4. Please find a seat and wear your name tag. </div> <div data-bbox="1268 331 1507 638"> <p>Shape-Pathways</p> <p>Find a pathway along the shapes from Start to Finish.</p> <ol style="list-style-type: none"> 1. Start from the circle with a star in it. Draw a pathway of your own design. 2. Do not touch the shapes to your own design, but you may use them as a guide. 3. The path must be a continuous line. You may not skip over or go between the shapes. 4. If the path does not have at least one shape the same as the previous shape then go back to start and choose a different path. 5. You may not remove your pathway, but you may cross over it. <p>See how many solutions you can do!</p> <p>Start</p> <p>Finish</p> </div>
Part 1: Getting Started (10 minutes) - with children	
<p>This module can begin with or without children. (See Part 2) As the participants begin to arrive, direct them to the Shape-Pathways problem on their tables. Ask them to find one or more pathways. This is a good starter problem to begin looking at shapes.</p> <p>Introductions</p> <ol style="list-style-type: none"> 1. Introduce yourselves and then have the participants introduce themselves. 2. Briefly explain the MAPPs program. Have participants who are involved in the program share their experiences. 3. Go over the agenda and purpose for the session. 4. After participants have completed the Shape-Pathway handout ask for a volunteer to show a solution on a transparency of BLM 60: Shape-Pathways. Ask if anyone has a different solution and have them illustrate the solution using a different color. See Note A. 	<p>A. NOTE: Some solutions to the Shape Pathway puzzle.</p> <div data-bbox="1013 835 1495 1507"> <p>Shape - Pathways Solutions</p> <p>3 possible solutions out of many</p> <p>Start</p> <p>Finish</p> </div>
Part 2: Setting the Stage (20 minutes)	
<ol style="list-style-type: none"> 1. Let parents know that today we will be engaged in activities that involve geometric concepts. Their children will be participating in some of the activities with them. Let them know that when their children are involved, it is a chance for them to see what their children know and how they think about the particular concepts. Instead of teaching them, it is a good opportunity to listen. 	

Activities

Part 2: Setting the Stage (continued)	Notes
<p>Let them know that it is okay if their children do not know everything at this point; it may not be part of the grade level curriculum or their children may not have been taught these concepts yet. At the end of the session, we will talk about what their children did.</p> <p>2. Have participants begin to think about geometry by saying: <i>“Write some ideas or talk to your partner about what you think of when you hear the word <u>geometry</u>.”</i></p> <p>Give participants a few minutes to individually write down or share some ideas with a partner. If parents are working with children and the children cannot write, they can draw pictures or have the parents write for them. Ask them to share their ideas with the whole group and record the ideas on chart paper.</p> <p>Let participants know that the purpose of this session will be to spend time exploring some geometric concepts, namely flat (2-dimensional) shapes. It is not necessary to come to a “textbook” definition of geometry at this time. The purpose of this is to find out participants’ prior knowledge as well as focus the session.</p>	
Part 3: An Introduction to Sorting and Shapes (30 minutes)	
<p>1. Introduce sorting. Say: <i>One of the important concepts of geometry is sorting. We are going to do a sorting activity.</i></p> <p>Display the cut-out faces from BLM 61: A Sorting Activity. Ask:</p> <ul style="list-style-type: none"> • <i>What are some of the attributes/features of these faces?</i> (Some have hair, some have open eyes, others closed; etc.) • <i>Which have some common features?</i> • <i>Which of these faces can be sorted together? Why?</i> (The ones with hair, the ones with no hair; the ones with open eyes, the ones with closed eyes, etc.) <p>As participants answer, group the faces using the described sorting process. Ask for other sorting methods.</p> <p>2. Have participants find a partner or work with their child. Handout a container of buttons to each partnership. Ask participants to put the buttons in groups based on something they have in common. Give them a few minutes to do this.</p>	<p>BLM 61: Transparency</p> 

Activities

Part 3: An Introduction to Sorting and Shapes (continued)

3. Have the participants share their strategies for sorting the buttons while you record the strategies on chart paper. Some strategies for sorting may be: color, number of holes, shapes, sizes, materials, etc. Point out that these similarities can be called attributes. Write the word, attribute, on chart paper. Adding the word, characteristic next to it would be helpful.

4. Tell the participants:

Tonight's focus is on sorting and finding attributes or characteristics. Sorting is an important activity for students because it helps them develop the ability to recognize how things are the same and how things are different. This leads to understanding attributes or characteristics of an item.

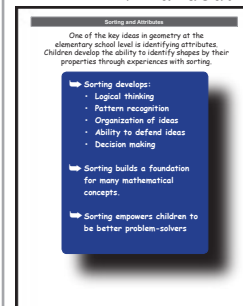
5. Display and distribute the transparency and handout of **BLM 62: Sorting and Attributes** as you review the importance of sorting.

6. Say:

We have just sorted buttons, but most of us think of geometry in terms of shapes.

Notes

BLM 62: Transparency / Handout

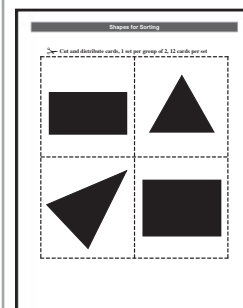


Part 4: Sorting 2-Dimensional Shapes (30 minutes)

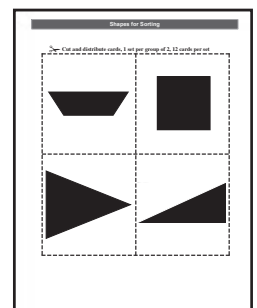
1. Give the participants the cut-outs from **BLM 63.1-3 Shapes for Sorting**. With a partner (or with their child) have them sort the shapes (put them in groups) in any way that makes sense. There is no limit to the number of categories they need to have. If children are present remind parents that they should let their children do the sorting because this is a time to discover what their child is thinking and not a time to teach.

2. Once they have sorted the shapes, ask them to label each category with the appropriate attribute. (If some participants finish this activity before others, encourage them to think of a different way to group them). Give each group chart paper and glue sticks. Have them glue their shapes on the chart paper and label the categories that they used when sorting the shapes.

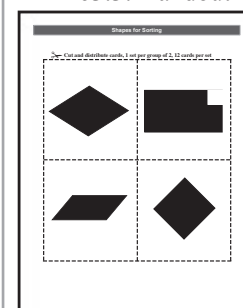
BLM 63.1: Handout



BLM 63.2: Handout



BLM 63.3: Handout



Activities

Part 4: Sorting 2-Dimensional Shapes (continued)	Notes
<p>3. Have two or three groups prepare to share their categories. Ask the participants to come to a designated place in the room to share (an empty table, the floor, etc.) to discuss/question what they see. At this point, terminology associated with geometric concepts will surface. As this happens, make sure to ask participants questions such as:</p> <ul style="list-style-type: none"> • “What do you mean by _____”? • “What were you thinking when you grouped these together”? <p>Below are some categories participants may use or terms you may hear, but do not teach these terms at this time: See Note B.</p> <ol style="list-style-type: none"> a) Number of sides (three sides, four sides, etc.): It is not uncommon to hear participants refer to a side as an “edge”. As a point of clarification, edges are found on 3-dimensional shapes (the point at which two faces meet). b) Number of vertices (“points”) (three points, four points, etc.): A vertex is the point at which two sides meet (students often refer to this as a “point”). More than one vertex is referred to as vertices. Vertices are commonly called corners by young children. c) Quadrilaterals vs. non-quadrilaterals: A quadrilateral is a four-sided shape (e.g., a square). d) Parallelograms vs. non-parallelograms: A parallelogram has two pairs of parallel sides. e) Symmetrical vs. non-symmetrical: Symmetrical figures can be divided into two parts that are mirror-images of each other. <p>4. If children are present have them leave at this time. If children are not present have a brief conversation about doing this same activity at home with their children.</p>	<p>B. NOTE: These are only a few examples of what you might hear. You are not limited to just these concepts nor is it necessary to cover all of them at this point. This is a time to generate dialogue and not to teach.</p>
Part 5: Labeling Shapes (30 minutes) - without children	
<p>1. If children were present, ask the participants to think about the following questions:</p> <ul style="list-style-type: none"> • <i>What did you see your child do?</i> • <i>What was easy for your child?</i> • <i>What was hard for your child?</i> <p>Have them share their thoughts in small groups.</p>	

Activities

Part 5: Labeling Shapes (continued)

2. Let participants know:

"We have spent time sorting our shapes in many different ways and labeling categories. We now want you to think about what you would call each shape?"

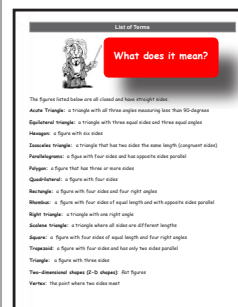
3. Distribute **BLM 64: List of Terms**, and **BLM 65:**

Name of Shapes. Have the participants work together to name each one of the shapes on **BLM 65** using the list of terms on **BLM 64** as references. Be sure to emphasize the notes introducing the terms which states that all these figures have straight sides and are closed.

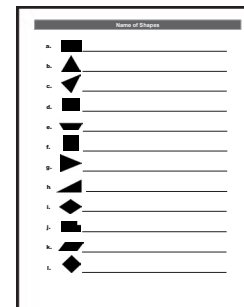
4. When groups have finished, process the work using a transparency of **BLM 65: Name of Shapes**. Have a participant volunteer the answer to "a". See if anyone has a different answer. Accept all answers and write them on the transparency. Continue in this manner through "l". The completed answer sheet will be handed out next and participants will have an opportunity to check for errors and omissions at that time. After the processing, distribute **BLM 66: Name of Shapes Answer Key** and have them compare their work to the correct answers. Ask if there were any surprises or questions.

Notes

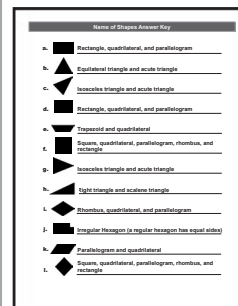
BLM 64: Handout



BLM 65: Transparency / Handout



BLM 66: Handout



Part 6: Connections (15 minutes)

1. Help participants make connections by asking:

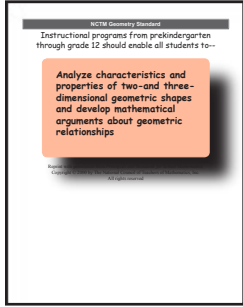
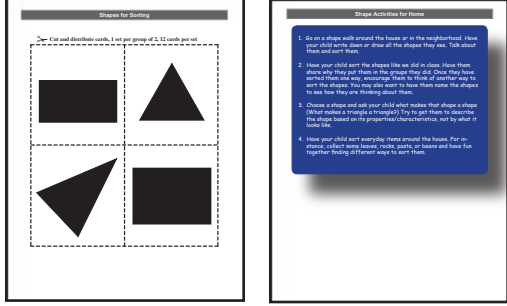
- *What kind of mathematics have we been doing?* (geometry)
- *What were we learning about geometry?* (sorting, attributes, recognizing shapes, naming and defining shapes)

Have participants go back to the list generated in part 2 when you asked: What do you think of when you hear the word "geometry"? and say:

- *Let's go back and read or think your thinking about geometry at the beginning of this class. Is it different now? How is it different?*
- *Do you have some ideas now about how you might help your child learn geometry?* (accept all ideas)

Have participants brainstorm.

Activities

Part 6: Connections (continued)	Notes
<p>2. Optional but highly suggested: Share a page or activity from the mathematics program the school district uses that relates to the work done during this session.</p> <p>3. Have participants review the appropriate state or district standards, especially if their children will be taking state tests based on the standards. Share:</p> <ol style="list-style-type: none"> District or state geometry standards. Information on state testing on geometry standards. The geometry students study at different grade levels. <p>4. An alternative is to discuss national standards. Distribute handout and display the transparency of BLM 67: NCTM Geometry Standard. Tell participants that:</p> <ol style="list-style-type: none"> The goal of geometry is for students to be able to study the similarities and differences of geometric shapes. This leads to reasoning and simple proofs about why the shapes are called what they are. Geometry offers ways to think about our physical world. Geometry develops tools that are used in other topics in mathematics and science. 	<p>BLM 67: Transparency / Handout</p> 
Part 7: Applications for Home (15 minutes)	
<p>Distribute handouts BLM 63.1-3: Shapes for Sorting and BLM 68: Shape Activities for Home. There are several activities for participants to try with their children such as:</p> <ol style="list-style-type: none"> Go on a shape walk and discuss/record or draw the various shapes you see. Have their children sort the shapes as we did in class from the Shapes for Sorting handouts. Have them ask their children: “What makes a _____ a _____?” 	<p>BLM 63.1-3: Handout BLM 68: Handout</p> 
Part 8: Closing (5 minutes)	
<p>1. If your district does not have an evaluation form to use, have them answer one of the following questions:</p> <ul style="list-style-type: none"> What did you learn tonight? What will you do with your child as a result of this session? What did you find interesting tonight? <p>2. Distribute any prizes from estimations or drawings.</p>	