



CCGPS Frameworks Teacher Edition

Mathematics

Fourth Grade Unit Six
Geometry



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"Making Education Work for All Georgians"

Unit 6: GEOMETRY
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OVERVIEW

Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

In this unit students will:

- Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines
- Identify and classify angles and identify them in two-dimensional figures
- Distinguish between parallel and perpendicular lines and use them in geometric figures
- Identify differences and similarities among two dimensional figures based on the absence or presence of characteristics such as parallel or perpendicular lines and angles of a specified size
- Sort objects based on parallelism, perpendicularity, and angle types
- Recognize a right triangle as a category for classification
- Identify lines of symmetry and classify line-symmetric figures
- Draw lines of symmetry

Although the units in this instructional framework emphasize key standards and big ideas at specific times of the year, routine topics such as estimation, mental computation, and basic computation facts should be addressed on an ongoing basis. Ideas related to the eight standards of mathematical practice: making sense of problems and persevering in solving them, reasoning abstractly and quantitatively, constructing viable arguments and critiquing the reasoning of others, modeling mathematics, using appropriate tools strategically, attending to precision, looking for and making use of structure, and looking for and expressing regularity in repeated reasoning, should be addressed continually as well. The first unit should establish these routines, allowing students to gradually enhance their understanding of the concept of number and to develop computational proficiency.

Critical Areas are designed to bring focus to the standards at each grade by describing the big ideas that educators can use to build their curriculum and to guide instruction. Students describe, analyze, compare, and classify two-dimensional shapes. Through building, drawing, and analyzing two-dimensional shapes, students deepen their understanding of properties of two-dimensional objects and the use of them to solve problems involving symmetry.

VAN HIELE LEVELS OF GEOMETRIC THINKING

How students view and think about geometric ideas can vary greatly based on their past experiences. In order to set students up for success in geometry and to develop their ability to think and reason in geometric contexts, it is important to understand what research has to say about how students develop their understanding of geometric concepts.

According to the van Hiele Levels of Geometric Thought, there is a five-level hierarchy of geometric thinking. These levels focus on how students *think* about geometric ideas rather than focusing solely on geometric knowledge that they hold.

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Van Hiele Levels of Geometric Thought, Summarized (taken from <i>Teaching Student-Centered Mathematics: 3-5</i> , by John Van de Walle and Lou Ann Lovin)	
Level 0: Visual	<p>Students use visual clues to identify shapes.</p> <ul style="list-style-type: none"> • The objects of thought at level 0 are shapes and what they “look like.” • The appearance of the shape defines the shape • A square is a square because it “looks like a square.” • The products of thought at level 0 are classes or groupings of shapes that seem “alike.”
Level 1: Analysis	<p>Students create classes of shapes.</p> <ul style="list-style-type: none"> • The objects of thought at level 1 are classes of shapes rather than individual shapes. • Instead of talking about <i>this</i> rectangle, it is possible to talk about <i>all</i> rectangles. • All shapes within a class hold the same properties. • The products of thought at level 1 are the properties of shapes.
Level 2: Informal Deduction	<p>Students use properties to justify classifications of shapes and categorize shapes.</p> <ul style="list-style-type: none"> • The objects of thought at level 2 are the properties of shapes. • Relationships between and among properties are made. • “If all four angles are right angles, the shape must be a rectangle. If it is a square, all angles are right angles. If it is a square, it must be a rectangle.” • The products of thought at level 2 are relationships among properties of geometric objects.
Level 3: Deduction	<p>Students form formal proofs and theorems about shapes.</p> <ul style="list-style-type: none"> • This is the traditional level of a high school geometry course.
Level 4: Rigor	<p>Students focus on axioms rather than just deductions.</p> <ul style="list-style-type: none"> • This is generally the level of a college mathematics major who studies geometry as a mathematical science.

STANDARDS FOR MATHEMATICAL CONTENT

4.G Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

MCC. 4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

MCC.4.G.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

MCC.4.G.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

*****Mathematical Practices 1 and 6 should be evident in EVERY lesson*****

ENDURING UNDERSTANDINGS

- Geometric figures can be analyzed based on their properties.
- Geometric figures can be classified based on their properties.
- Parallel sides, particular angle measures, and symmetry can be used to classify geometric figures.
- Two lines are parallel if they never intersect and are always equidistant.
- Two lines are perpendicular if they intersect in right angles (90°).
- Lines of symmetry for a two-dimensional figure occur when a line can be drawn across the figure such that the figure can be folded along the line into matching parts.

ESSENTIAL QUESTIONS

- How are geometric objects different from one another?
- How are quadrilaterals alike and different?
- How are symmetrical figures created?
- How are symmetrical figures used in artwork?
- How are triangles alike and different?
- How can angle and side measures help us to create and classify triangles?
- How can shapes be classified by their angles and lines?
- How can the types of sides be used to classify quadrilaterals?
- How can triangles be classified by the measure of their angles?
- How can we sort two-dimensional figures by their angles?

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- How can you create different types of quadrilaterals?
- How can you create different types of triangles?
- How can you determine the lines of symmetry in a figure?
- How can you use only a right angle to classify all angles?
- How do you determine lines of symmetry? What do they tell us?
- How is symmetry used in areas such as architecture and art? In what areas is symmetry important?
- What are the geometric objects that make up figures?
- What are the mathematical conventions and symbols for the geometric objects that make up certain figures?
- What are the properties of quadrilaterals?
- What are the properties of triangles?
- What are triangles?
- What is a quadrilateral?
- What is symmetry?
- What makes an angle a right angle?
- What properties do geometric objects have in common?
- Where is geometry found in your everyday world?
- Which letters of the alphabet are symmetrical?

CONCEPTS/SKILLS TO MAINTAIN

It is expected that students will have prior knowledge/experience related to the concepts and skills identified below. It may be necessary to pre-assess in order to determine if time needs to be spent on conceptual activities that help students develop a deeper understanding of these ideas.

- Identify shapes as two-dimensional or three-dimensional
- Analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts
- Compose simple shapes to form larger shapes
- Compose two-dimensional shapes or three-dimensional shapes to create a composite shape
- Partition circles and rectangles into two, three, and four equal shares
- Recognize and draw shapes having specified attributes such as a given number of angles or a given number of equal faces
- Identify triangles, quadrilaterals, pentagons, hexagons, and cubes
- Partition a rectangle into rows and columns
- Understand that shapes in different categories may share attributes and that the shared attributes can define a larger category
- Recognize rhombuses, rectangles, and squares as examples of quadrilaterals
- Draw examples of quadrilaterals that are not rhombuses, rectangles, and squares
- Partition shapes into parts with equal areas

SELECTED TERMS AND SYMBOLS

The following terms and symbols are often misunderstood. These concepts are not an inclusive list and should not be taught in isolation. However, due to evidence of frequent difficulty and misunderstanding associated with these concepts, instructors should pay particular attention to them and how their students are able to explain and apply them.

Teachers should present these concepts to students with models and real life examples. Students should understand the concepts involved and be able to recognize and/or demonstrate them with words, models, pictures, or numbers.

The websites below are interactive and include a math glossary suitable for elementary children. It has activities to help students more fully understand and retain new vocabulary. (i.e. The definition for *dice* actually generates rolls of the dice and gives students an opportunity to add them.) **Note – At the elementary level, different sources use different definitions. Please preview any website for alignment to the CCGPS.**

<http://www.teachers.ash.org.au/jeather/maths/dictionary.html>

<http://intermath.coe.uga.edu/dictnary/>

The terms below are for teacher reference only and are not to be memorized by the students.

- acute angle
- angle
- equilateral triangle
- isosceles triangle
- line of symmetry
- obtuse angle
- parallel lines
- parallelogram
- perpendicular lines
- plane figure
- polygon
- quadrilateral
- rectangle
- rhombus
- right angle.
- scalene triangle
- side
- square
- symmetry
- triangle
- trapezoid
- vertex (of a 2-D figure)

STRATEGIES FOR TEACHING AND LEARNING

Angles

Students can use the corner of a sheet of paper as a benchmark for a right angle. They can use a right angle to determine relationships of other angles.

Symmetry

When introducing line of symmetry, provide examples of geometric shapes with and without lines of symmetry. Shapes can be classified by the existence of lines of symmetry in sorting activities. This can be done informally by folding paper, tracing, creating designs with tiles or investigating reflections in mirrors.

With the use of a dynamic geometric program, students can easily construct points, lines and geometric figures. They can also draw lines perpendicular or parallel to other line segments.

Two-dimensional shapes

Two-dimensional shapes are classified based on relationships by the angles and sides. Students can determine if the sides are parallel or perpendicular, and classify accordingly. Characteristics of rectangles (including squares) are used to develop the concept of parallel and perpendicular lines. The characteristics and understanding of parallel and perpendicular lines are used to draw rectangles. Repeated experiences in comparing and contrasting shapes enable students to gain a deeper understanding about shapes and their properties.

Informal understanding of the characteristics of triangles is developed through angle measures and side length relationships. Triangles are named according to their angle measures (right, acute or obtuse) and side lengths (scalene, isosceles or equilateral). These characteristics are used to draw triangles.

EVIDENCE OF LEARNING

By the conclusion of this unit, students should be able to demonstrate the following competencies:

- Draw points, lines, line segments, rays, angles (right, acute, obtuse) and perpendicular and parallel lines
- Identify points, lines, line segments, rays, angles (right, acute, obtuse) and perpendicular and parallel lines in two-dimensional figures
- Classify two-dimensional figures based on the absence or presence of parallel or perpendicular lines
- Classify two-dimensional figures based on the absence or presence of angles of a specified size
- Recognize right triangles as a category
- Identify right triangles
- Recognize a line of symmetry for a two-dimensional figure
- Identify lines-symmetric figures
- Draw lines of symmetry

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TASKS

The following tasks represent the level of depth, rigor, and complexity expected of all fourth grade students. These tasks or tasks of similar depth and rigor should be used to demonstrate evidence of learning. It is important that all elements of a task be addressed throughout the learning process so that students understand what is expected of them. While some tasks are identified as a performance task, they also may be used for teaching and learning.

Scaffolding Task	Constructing Task	Practice Task	Performance Tasks
Tasks that build up to the constructing task.	Constructing understanding through deep/rich contextualized problem solving tasks	Games/activities	Summative assessment for the unit

<u>Task Name</u>	<u>Task Type</u> <i>Grouping Strategy</i>	<u>Content Addressed</u>
What Makes a Shape?	Scaffolding Task <i>Partners/Groups</i>	Learning conventions for the parts of a shape
Angle Shape Sort	Practice Task <i>Partners</i>	Sorting shapes by angles
Is This the Right Angle?	Practice Task <i>Large Group/Individual</i>	Comparing angles
Be an Expert	Practice Task <i>Partners/Groups</i>	Refine/extend understanding of geometric objects
Thoughts About Triangles	Constructing Task <i>Partners/Groups</i>	Investigate and explain properties of triangles
My Many Triangles	Practice Task <i>Individual/Partner</i>	Classify triangles by their angles and lengths of side
Quadrilateral Roundup	Constructing Task <i>Partners/Groups</i>	Investigate and explain the properties of quadrilaterals
Superhero Symmetry	Scaffolding Task <i>Partners</i>	Explore the meaning of symmetry and symmetrical figures
Line Symmetry	Constructing Task <i>Partner/Groups</i>	Explore the meaning of symmetry and symmetrical figures
A Quilt of Symmetry	Constructing Task <i>Individual/Partners</i>	Using symmetry to design a quilt
Decoding ABC Symmetry	Practice Task <i>Individual/Partners</i>	Finding lines of symmetry in the alphabet
Geometry Town	Culminating Task <i>Individuals/Partners</i>	Using geometry knowledge to design a town of certain specifications

Scaffolding Task: What Makes a Shape?

STANDARDS FOR MATHEMATICAL CONTENT

MCC. 4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

As students begin their explorations of geometric figures and their properties, it is important to make sure that students have some common vocabulary. This lesson can be used at the onset of the unit to introduce and teach students conventions for notating certain properties of figures or it can be used throughout the unit as these different properties come up. You should keep an anchor chart clearly displayed in your classroom for the geometric terms that come up throughout the unit, as well as the mathematical conventions/symbols that are used to represent those geometric objects.

Ideally, we want students to have a purpose or need for these conventions before introducing them. This means that these terms must be explored in context by students in order for that need to exist. This task can serve as a context for helping to develop that common vocabulary and mathematical notation at the onset of the Geometry unit. Many of these geometric objects and parts will be developed in depth later in the unit. You may choose to wait until they are developed to provide the conventional notation to students.

ESSENTIAL QUESTIONS

- What are the geometric objects that make up figures?
- What are the mathematical conventions and symbols for the geometric objects that make up certain figures?

MATERIALS

- “Sorting Shapes” for each group
- Math journals/notebooks

GROUPING

Small group task

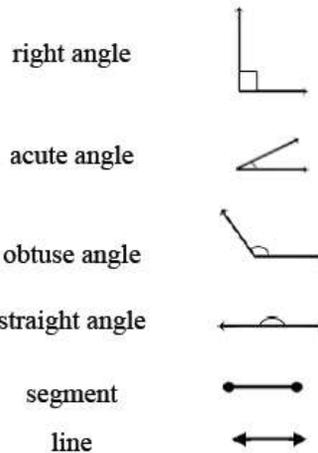
TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Task Directions

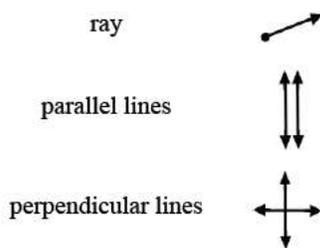
Students will sort the “Sorting Shapes” cards based on any attributes they choose. Have them share and discuss their sorts, highlighting the key vocabulary they use to describe their sorts (angles, number of sides) as students discuss these various parts and properties of the angles that they already know. Make sure they can answer the following questions.

- How did you group your shapes?
- What makes a shape a shape?
- What are the parts of a shape?
- How can you tell the differences between shapes?

Use this as a launching point for discussing the geometric objects listed below and their conventional notation. This would be a time to discuss the differences between lines, line segments, and rays. As students discuss these geometric objects, have them record the conventions that you are recording on an anchor chart into their math journal for reference throughout the unit. You may wish to show the notations below in several orientations. For instance, showing multiple orientations of a right angle (where one side of the angle is NOT parallel to the bottom of the paper)



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FORMATIVE ASSESMENT QUESTIONS

- What characteristics did you use to group your shapes?
- What are the geometric objects used to form various figures?
- Where do you see your geometric objects in the real world?
- Can students consider more than one attribute at a time?
- Can students justify the placement of the shapes in their groups?
- Are students able to recognize the difference between essential and non-essential properties of geometric object?

DIFFERENTIATION

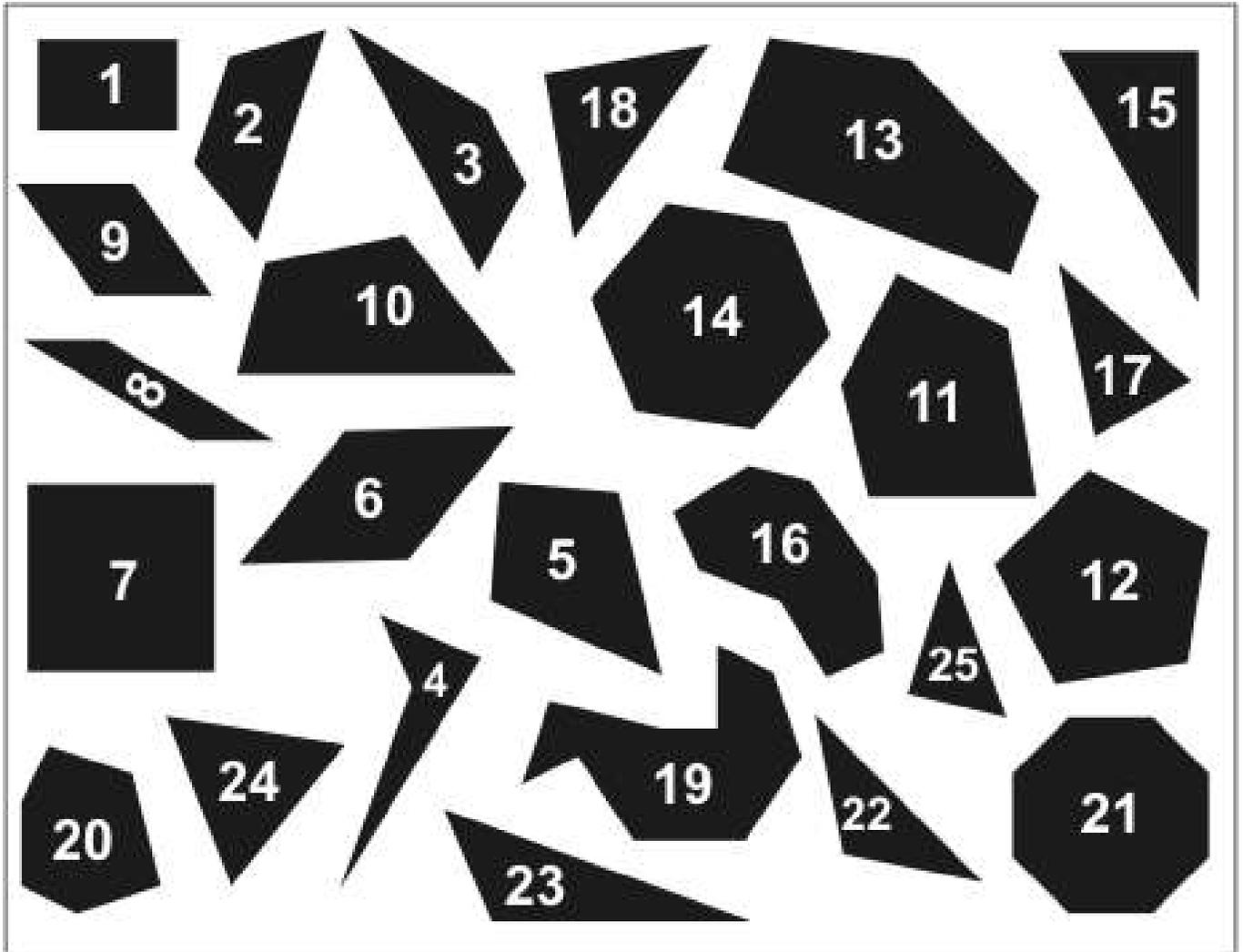
Extension

- Have students identify the geometric objects discussed in various shapes and record this in their journals.

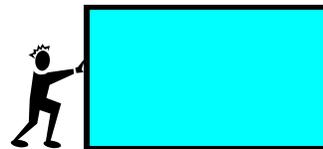
Intervention

- Have students use Wiki sticks or pieces of straw to create different shapes. Have them label the parts of the shape (line segments, points, etc.) and then mark these using the mathematical convention.

Sorting Shapes



Practice Task: Angle Shape Sort



STANDARDS FOR MATHEMATICAL CONTENT

MCC. 4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Students should have had prior experiences and/or instruction with plane figures and angles. A common misconception that many students have is that wide angles with short sides may seem smaller than a narrow angle with long sides. Students can compare two angles by tracing one and placing it over another. Students will then realize that the length of the sides does not determine whether one angle is larger or smaller than another angle. The measure of the angle is not dependent on the lengths of the legs.

ESSENTIAL QUESTIONS

- How can we sort two-dimensional figures by their angles?

MATERIALS

- 3 bendable straws/Wikki Sticks/Pipe Cleaners per student
- Paper shape cutouts
- Angle sorting student task sheet

GROUPING

Partners

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Part I

Tell students that today you will learn about something called angles. Remind students that an angle is formed when two lines or sides share a vertex. Show students several angles on the board. Ask students to look for angles throughout the room. After students have found several angles, tell students that there are three types of angles that we will discuss this year: acute, obtuse, and right.

Show students how sometimes you can create angles through different parts of your body, like your arms or your ankles. Show students a 90° angle with your ankle. Tell students that this is called a right angle. Next, show them an acute angle by pulling your toes up toward your shin. Last, show them an obtuse angle by pointing your toes and stretching them away from your shin. Allow the students to try showing the angles with their ankles as you say the words “right angle”, acute angle”, or “obtuse angle”. You can also do this with your arms. Have them make a strong bicep “muscle” to demonstrate a right angle. Then draw your fist closer to your shoulder to create an acute angle and extend your forearm moving the fist away from the shoulder to create an obtuse angle. Ask the students if the length of their foot or leg changes the size of the angle. How about the length of the arm? Why or why not? Talk with the students about the fact that an angle represents the size of the opening between your foot and leg or your upper and lower arm.

Part II

Review the three types of angles with students. Give each student three bendable straws, Wikki-Sticks, or pipe cleaners. Have students use the material to form each type of angle (acute, obtuse, or right). Have them show their angles to a partner to check. Then give each set of partners a set of sticks (coffee stirrers etc.) and ask them to play “pick up” sticks. Students will gather a fist full of straws and then carefully drop them from a kneeling position. Once all sticks have dropped, they should locate angles. The teacher should circulate and ask students to identify angles they found. This game time should only last a few minutes.

Part III

Give each student a sorting sheet and shape handout. Have students cut out each of the shapes. Then, give each student two straws/Wikki-sticks/pipe cleaners. Students can measure one straw using the corner of their paper and tape it at a 90° degree angle. Students can then manipulate the other straw to match the angles of each shape. Another option is to use an index card to locate a right angle. Next, they can compare the manipulated straw to the right angle straw to determine if the angle is right, obtuse, or acute. After measuring, encourage students to draw the shape in the correct section of the chart.

While students are working, ask questions like:

- What shape are you working with? How did you know its name?
- How many angles does your shape have?
- What types of angles does your shape have? How did you figure that out?
- Where will you place your shape on the chart?

- Did you have to use the straws each time? If not, how did you determine what the angle was?

Part IV

Have students come together to share the placement of each of the shapes. The teacher should prepare larger versions of each shape and the sorting sheet. Allow partner groups to place the shapes in the correct sections. Students should justify the placement of each shape by explaining their strategies for determining the types of angles. Encourage the audience to ask questions and make comments about the placement of the shapes.

FORMATIVE ASSESSMENT QUESTIONS

- Could students distinguish between the three types of angles?
- Were students able to determine the types of angles in each shape?
- Could students explain and justify their thinking as they sorted the shapes by types of angles?

DIFFERENTIATION

Extension

- Ask the students to write descriptors for a bingo style game using large student task sheet from this task.
- Students can take the angle hunt task sheet around school for a scavenger hunt. Challenge them to find various angles.

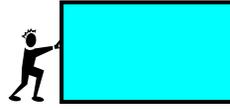
Intervention

- Play a bingo style game with different variations of task sheet.
- Partner students together for an Angle Hunt scavenger hunt around the school.

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Name _____ Date _____

Angle Shape Sort

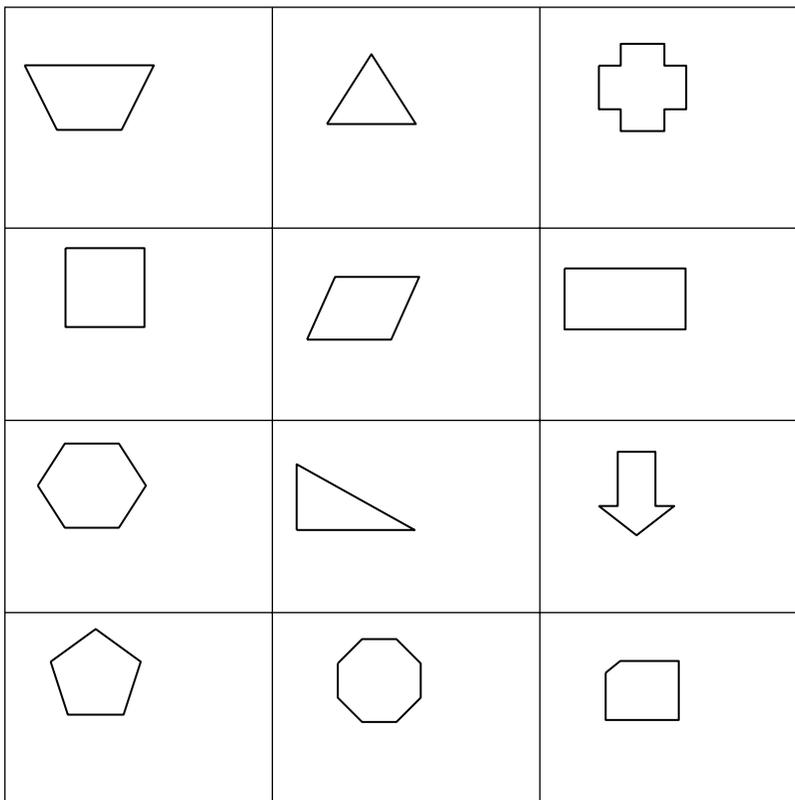


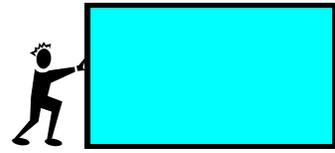
Only Right Angles	
Only Acute Angles	
Only Obtuse Angles	
Acute and Right Angles	
Acute and Obtuse Angles	
Right and Obtuse Angles	

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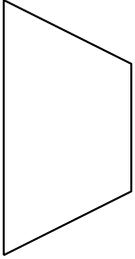
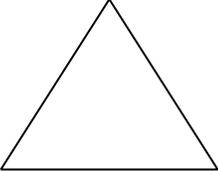
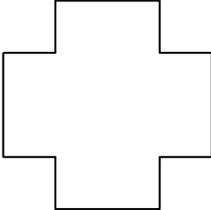
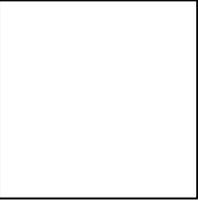
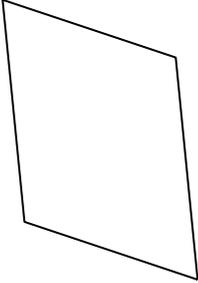
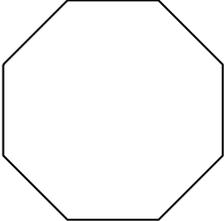
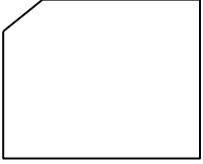
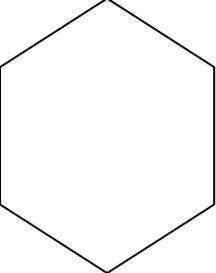
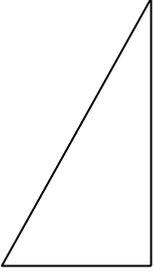
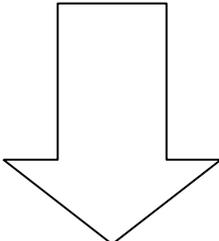
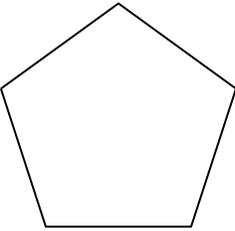


Cut the shapes out to place on the Sorting Angles Task Sheet.

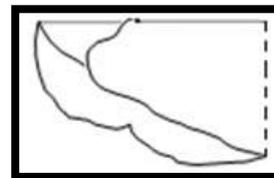




Determine the types of angles that make up each shape.

Constructing Task: Is This the Right Angle?



STANDARDS FOR MATHEMATICAL CONTENT

MCC. 4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
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BACKGROUND KNOWLEDGE

Students should know what a right angle is and have learned the terms right, acute, and obtuse angles and be able to locate some examples of each.

ESSENTIAL QUESTIONS

- What makes an angle a right angle?
- How can you use only a right angle to classify all angles?

MATERIALS

- One piece of irregularly shaped paper per student
- Is This the Right Angle? Task Sheet

GROUPING

Large Group, Individual

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

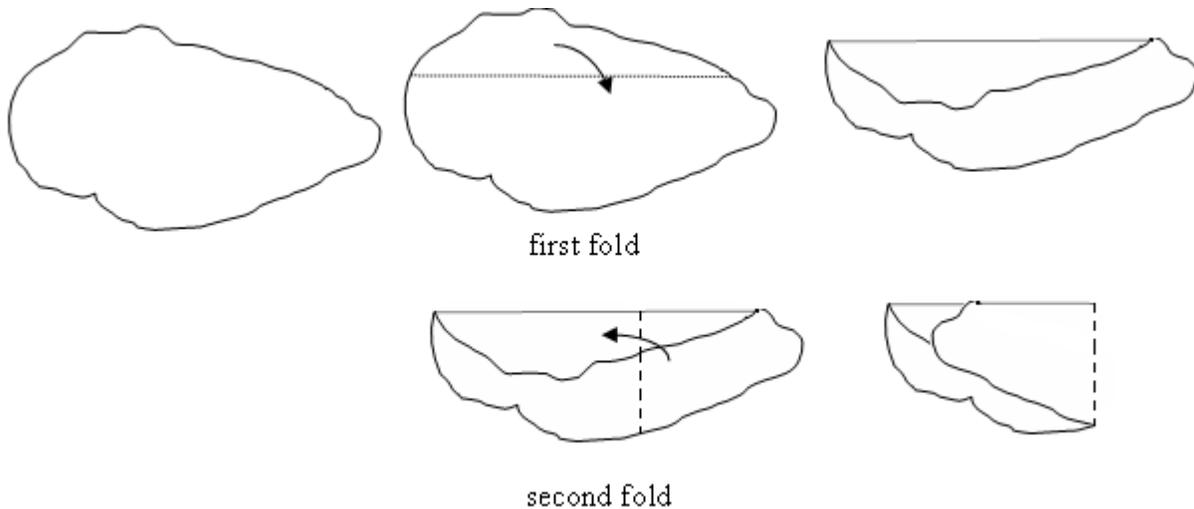
Comments

In this task, students will explore one way to make a right angle and to use that angle to classify other angles around them. This task gives students a chance to use previous knowledge. Square

corners are easily found in the classroom and in the school. An important element of this task is for students to use a square corner to measure the angles in their world.

Task Directions

Give each student a piece of irregularly shaped paper. Have them work to determine how to fold it to create a square corner. The students can create a square corner by making any two perpendicular folds. The figures show one way of folding the square corner:



Once students have folded their square corners, they can use this to find right, acute, and obtuse angles in the classroom (or take a right angle field trip throughout the school with cameras and record them on the chart.) If a student is having difficulty, encourage group members to help. When the students compare their angles to their group members' angles, they should notice all the right angles are the same size. The groups can present the angles they found to their classmates to make sure they agree on the comparative sizes of the angles. Let students discuss the angle that was easiest to find. Ask them to tell why they think this angle is so common. Generally, students will have the easiest time finding right angles.

FORMATIVE ASSESSMENT QUESTIONS

- Can you make a right angle using anything? How?
- Which angle is the easiest to find? Why?
- Why is a right angle an important angle to know?
- How can you use the right angle to help you determine whether other angles are acute or obtuse?
- Were students able to construct the right angle from the paper?
- Can students accurately determine whether an angle is right, acute, or obtuse?

DIFFERENTIATION

Extension

- Using a digital camera, have students go on a scavenger hunt and take pictures of different angles. Use the pictures to create a slide show of angles.

Intervention

- Pair students to work together and compare answers. Give students a hand-made angle (two strips of paper and a brad) to use when searching for angles.

Name _____ Date _____

Is This the Right Angle?

Directions: Find right, acute, and obtuse angles in the classroom
(or take a right angle field trip throughout the school with
cameras and record them on the chart.)



Angles that are right angles	Angles that are smaller than right angles	Angles that larger than right angles

Practice Task: Be an Expert!



STANDARDS FOR MATHEMATICAL CONTENT

MCC. 4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

In previous lessons, students should have been introduced to the geometric objects that make up the parts of various figures. Therefore, they should be able to identify an example of each. Student should also be able to sort and classify the objects and use simple graphic organizers.

ESSENTIAL QUESTIONS

- What properties do geometric objects have in common?
- How are geometric objects different from one another?

MATERIALS

- “Be an Expert! Geometric Characteristics Graphic Organizer” student recording sheet
- Electronic version or poster of “Be an Expert! Geometric Characteristics Graphic Organizer” student recording sheet
- “Geometric Objects” cards

GROUPING

Small group task

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Comments

As an introduction, each group of students can be given a set of geometric object cards. Students can sort the cards into groups. They may also be asked to identify additional items in or out of the classroom that might fit into each group they create. Students can describe their sort to their classmates, defending their placement of each figure. (Students could draw a circle around each group so that other students can see the objects and how they were sorted.)

Once groups have finished their graphic organizer, allow each group to share what they learned about their figure and post their work in the classroom as a reference for the students.

Task Directions

Students will follow directions below from the “Be an Expert! Geometric Characteristics Graphic Organizer” student recording sheet.

Your task is to become an expert on a geometric object. Each group will have a geometric object. You will need to complete the following parts of this task in order to become an expert on your geometric object. Then you will need to share your expertise with your classmates.

You will be given a picture of your geometric object. With your materials, determine the following:

- Write the name (names) of your geometric object in the center of your graphic organizer.
- Complete the graphic organizer for your figure.
- For “Examples” and “Non-examples” think about objects in the real world.
- Be able to defend any information on your graphic organizer.
- Post your graphic organizer in the classroom, plan how you will share your expertise with your classmates.

Geometric Characteristics Graphic Organizer:

Essential (Must Have) Properties	Nonessential (Might Have) Properties
Examples	Non-examples



FORMATIVE ASSESSMENT QUESTIONS

- What characteristics did you use to group your objects?
- What other items could be added to this group? Why?
- What are the properties of your geometric objects?
- Where do you see your geometric objects in the real world?
- Would a (triangle, rectangle, circle) have an example of your objects? Why? Why not?
- Can students consider more than one attribute at a time?
- Can students justify the placement of the objects in their groups?
- Which students can complete the graphic organizer accurately?
- Which students can show how their object is similar to/different from other objects?
- Are students able to recognize the difference between essential and non-essential properties for their geometric object?

DIFFERENTIATION

Extension

- Have students identify the geometric objects in various figures. Students can create a list of figures which have their objects and ones that do not.

Intervention

- Have students create Venn diagrams between several of the objects to focus on their similarities and differences.

Name _____ Date _____

Be an Expert!

Task Directions

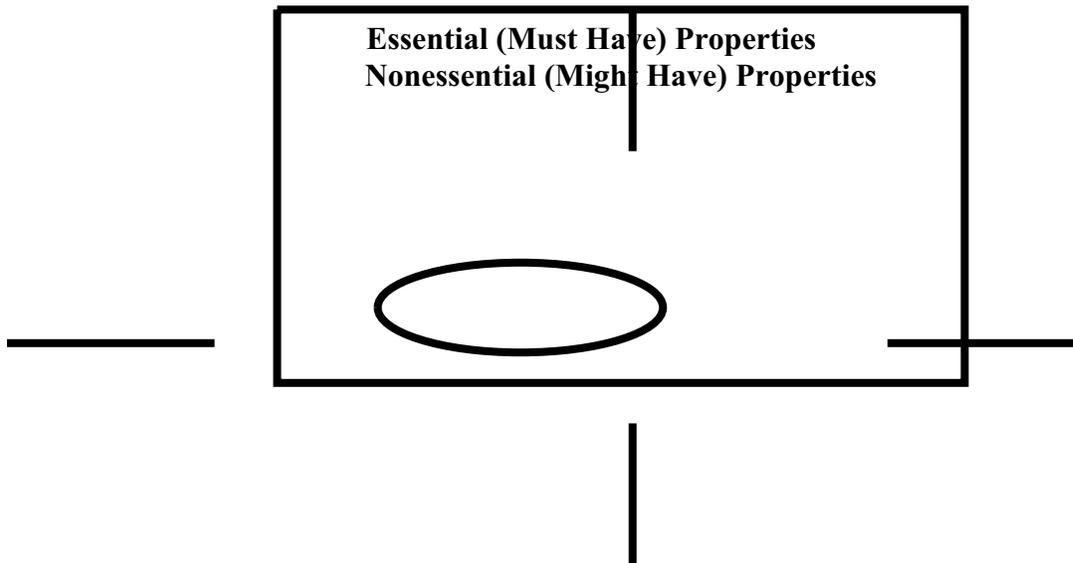


Your task is to become an expert on a geometric object. Each group will have a geometric object. You will need to complete the following parts of this task in order to become an expert on your geometric object. Then you will need to share your expertise with your classmates.

You will be given a picture of your geometric object. With your materials determine the following:

- Write the name (names) of your geometric object in the center of your graphic organizer.
- Complete the graphic organizer for your figure.
- For “Examples” and “Non-examples” think about objects in the real world.
- Be able to defend any information on your graphic organizer.
- Post your graphic organizer in the classroom, plan how you will share your expertise with your classmates.

Geometric Characteristics Graphic Organizer:



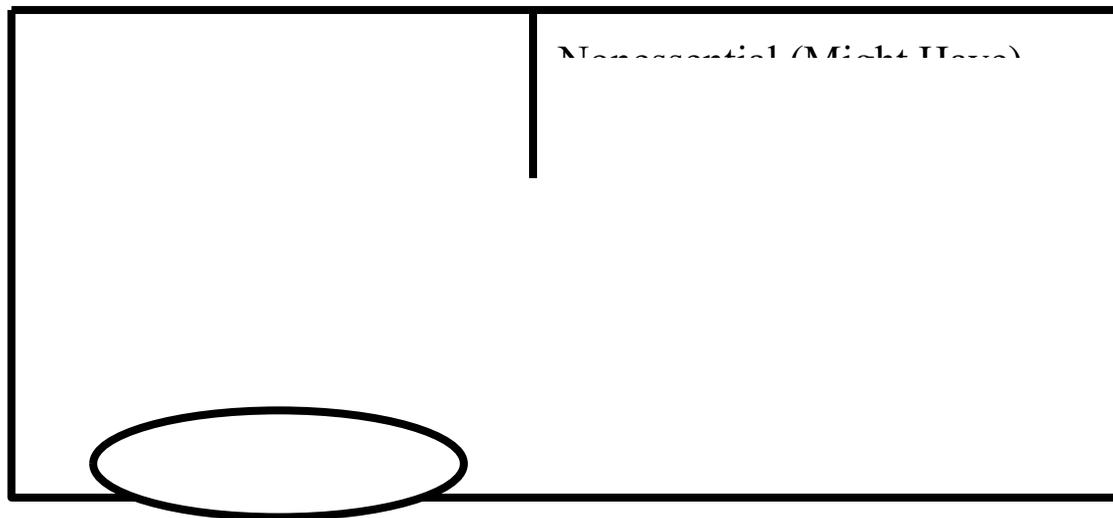


Group Members _____ Date _____

Be an Expert!

Essential (Must Have)

Nonessential (Might Have)



Essential

Non-essential

Geometric Object Cards

point	line
line segment	ray
angle	acute angle
obtuse angle	right angle
parallel lines	perpendicular lines

Constructing Task: Thoughts About Triangles

Adapted from a lesson in Navigating Through Geometry in Grades 3-5 by NCTM

STANDARDS FOR MATHEMATICAL CONTENT

MCC. 4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

MCC.4.G.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Students should have the following background knowledge.

- Be able to use a straight edge or ruler to draw a straight line.
- Know how to use a ruler, and how to identify right angles (90 degrees), obtuse angles, and acute angles (using the corner of an index card or another object with a known angle of 90 degrees).
- Understand that the side across from an angle on a triangle can be described as an opposite side
- Know parallel means that lines will never intersect or cross over each other no matter how long they are extended.
- Understand that perpendicular means lines or segments intersect or cross forming a right angle. (Some students may use a known 90 degree angle to show an angle is a right angle.)
- Know that a property is an attribute of a shape that is always going to be true. It describes the shape.
- Be able to use a ruler to measure sides to verify they are the same length.

Some properties of triangles that should be discussed are included below. As students draw conclusions about the relationships between different figures, be sure they are able to explain

their thinking and defend their conclusions. Much of the information below may come out as a result of students' explorations. This is information to look for and highlight as they explore the triangles to pull out, not a list of understandings that you must teach them beforehand.

- A shape is a triangle when it has exactly 3 sides and is a polygon. (To be a polygon the figure must be a closed plane figure with at least three straight sides and having no curved lines.)
- A right triangle is a triangle with one angle that measures 90 degrees. A right triangle can be either scalene or isosceles, but never equilateral.
- An obtuse triangle has one angle that measures greater than 90 degrees. There can only be one obtuse angle in any triangle.
- An acute triangle has three angles that measure less than 90 degrees.
- An equilateral triangle has three equal angles and three sides of equal length.
- An isosceles triangle has two equal angles and two sides of equal length.
- A scalene triangle has three sides that are not equal and no angles that are equal.

ESSENTIAL QUESTIONS

- What are triangles?
- How can you create different types of triangles?
- How are triangles alike and different?
- What are the properties of triangles?
- How can triangles be classified by the measure of their angles?

MATERIALS

For Each Group:

- Geoboard with one rubber band for each student
- A copy of "Geodot Paper for Geoboard"
- Paper
- Pencils

GROUPING

Partner/Small Group Task

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Comments

Make sure that students complete this activity in partners or small groups to encourage mathematical discussion while they make their triangles and test conjectures. You may wish to have students explore some on their own and then come together to discuss their findings. Students can then explain and defend their conclusions as a group.

The purpose of this task is for students to become familiar with the properties of triangles.

Working in pairs, students will create the following triangles: right triangles, obtuse triangles, acute triangles, isosceles triangles, scalene triangles, and equilateral triangles. They will identify the attributes of each triangle, then compare and contrast the attributes of different triangles. Though the standards only specifically state that students are to identify right triangles as a category for classification, the exploration of the attributes of all triangles is vital to students differentiating between right triangles and all other triangles.

Task Directions

This task is a collection of investigations into triangles through the use of guiding questions. For each question students should (1) make a conjecture, (2) explore, using their geoboards, and (3) discuss their findings as a group. The class should come to a general consensus during their discussion. As students and the class come to a consensus about triangles, keep an anchor chart or running list of “true” ideas about triangles.

Make sure to guide discussion during explorations and discussion time through the use of questioning rather than intervening by answering their questions. For example, if students incorrectly identify a polygon as a right triangle, rather than telling them it’s not a right triangle, ask them to explain how they know it is a right triangle and then discuss together the definition of a right triangle.

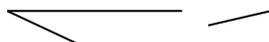
These questions lend themselves nicely to student reflection in math journals. The journal entries can be used as evidence of learning for the students. There is a sample journal entry question at the end of each exploration.

Question #1: Is it possible to make a three-sided polygon that is not a triangle?

- Have students make their conjectures and record the conjectures as a group.
- Have students explore answering and explaining their answer using their geoboards explorations.
- If students make a three-sided figure like the one below, ask students if their figure is closed with no lines crossing.



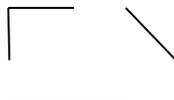
- If students make a figure like the one below, refer students back to the origin of the word triangle (three angles).



- At closing discussion, make a class list of all the properties of triangles, including triangles having three angles, three sides, and being classified as a polygon.
- Journal Reflection Question: What have you learned about triangles from this investigation?

Question #2: Is it possible for a triangle to have two right angles?

- Have students make their conjectures and record the conjectures as a group.
- Have students explore answering and explaining their answer using their geoboards explorations.
- Students may use the corner of an index card or another known right angle to tests for right angles.
- If students create a figure like the one shown below that has 2 right angles, ask students if their figure has all the properties of a triangle.

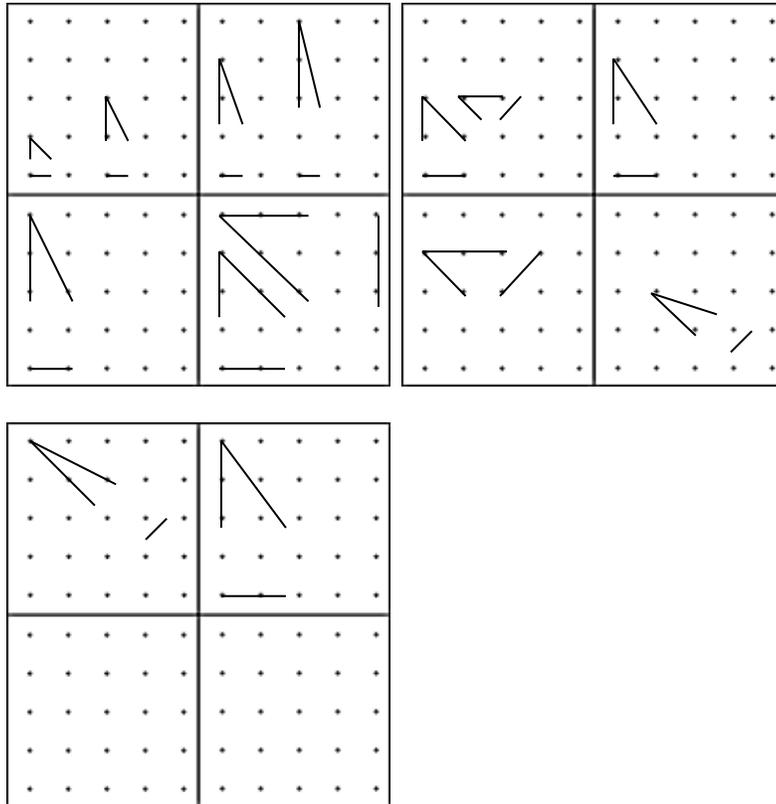


- At closing discussion, guide students to determine that there is a category of triangles referred to as right triangles because these have one right angle.
- Journal Reflection Question: If you could make a triangle that was as large as you wanted, would you be able to make one that has two right angles? Explain your thinking.

Question #3: How many different right triangles can be made on the geoboards?

- Have students make their conjectures and record the conjectures as a group.
- In the introduction of this exploration, discuss what different means. For the purposes of this exploration, if a triangle can be flipped or turned and matched up, it is not “different.”
- For this exploration, it would be helpful for students to record all their triangles on dot paper so that they can compare their right triangles.
- Use guided questions to keep students on track during the exploration.
 - Have you found all of the right triangles that can be made? How do you know?
 - What is your strategy to make sure you have them all?
- If your students have difficulty coming up with a strategy for ensuring they find them all, model your approach. For example, “I started with a right triangle with a base of one and a height of one. Then I changed the height by one...”
- Teachers should attempt this task before students do in order to devise your own strategy for making sure all solutions are found and to experience what the students will experience and see during the exploration.
- Journal Reflection Question: Write everything you know that is true about all right triangles.

The 14 right triangles that can made on a 5 by 5 pin geoboard are shown below.



Question #4: How many different types of triangles can you find?

- Have students make their conjectures and record the conjectures as a group.
- Show the students examples of a right triangle to review the definition of a right triangle. Show non-examples of a right triangle to stimulate discussion about differing length of sides and angle size. Encourage students to use a known right angle and rulers (if needed) to differentiate between angle size and lengths of sides. (Students have not necessarily learned to measure angles to the degree yet, so having them simply classify the angles as acute, right, or obtuse using a known right angle is sufficient for this exploration.)
- Have students record their triangles on dot paper.
- NOTE: It is not possible to make an equilateral triangle on a geoboard. Some students may claim that some are, but if you measure the sides they will find them to have differing lengths.
- Have students share the triangles with each other in a group. Have students cut out the triangles and sort them into piles that are the same and label them with their defining characteristic. In order to help guide students to grouping, beyond just having the exact same measurements, feel free to set restrictions on the sorting rules such as there must be at least 3 piles and at least 3 triangles in each pile.
- Students should create posters with triangles displayed by category and should present and explain their groupings to the class. After the presentations, have a class

discussion and introduce the terms *acute*, *obtuse*, *scalene*, and *isosceles*. DO NOT introduce these terms until after the presentations. These geometric terms will come about naturally from the student classifications.

- Journal Reflection Question: Write in your own words the definitions for the new geometric terms we have found (*acute*, *obtuse*, *scalene*, and *isosceles*).

Summary

- After all explorations, have students complete the following journal entries with as many different answers as possible:
 - All triangles have....
 - Some triangles have...

FORMATIVE ASSESSMENT QUESTIONS

- What make a triangle a triangle?
- How do you know which triangles are right triangles?
- How can you classify or group triangles?
- Were students able to easily create the different types of triangles?
- Were students able to identify similarities and differences between two triangles?
- Were students able to identify right angles, obtuse angles, and acute angles within the triangles?

DIFFERENTIATION

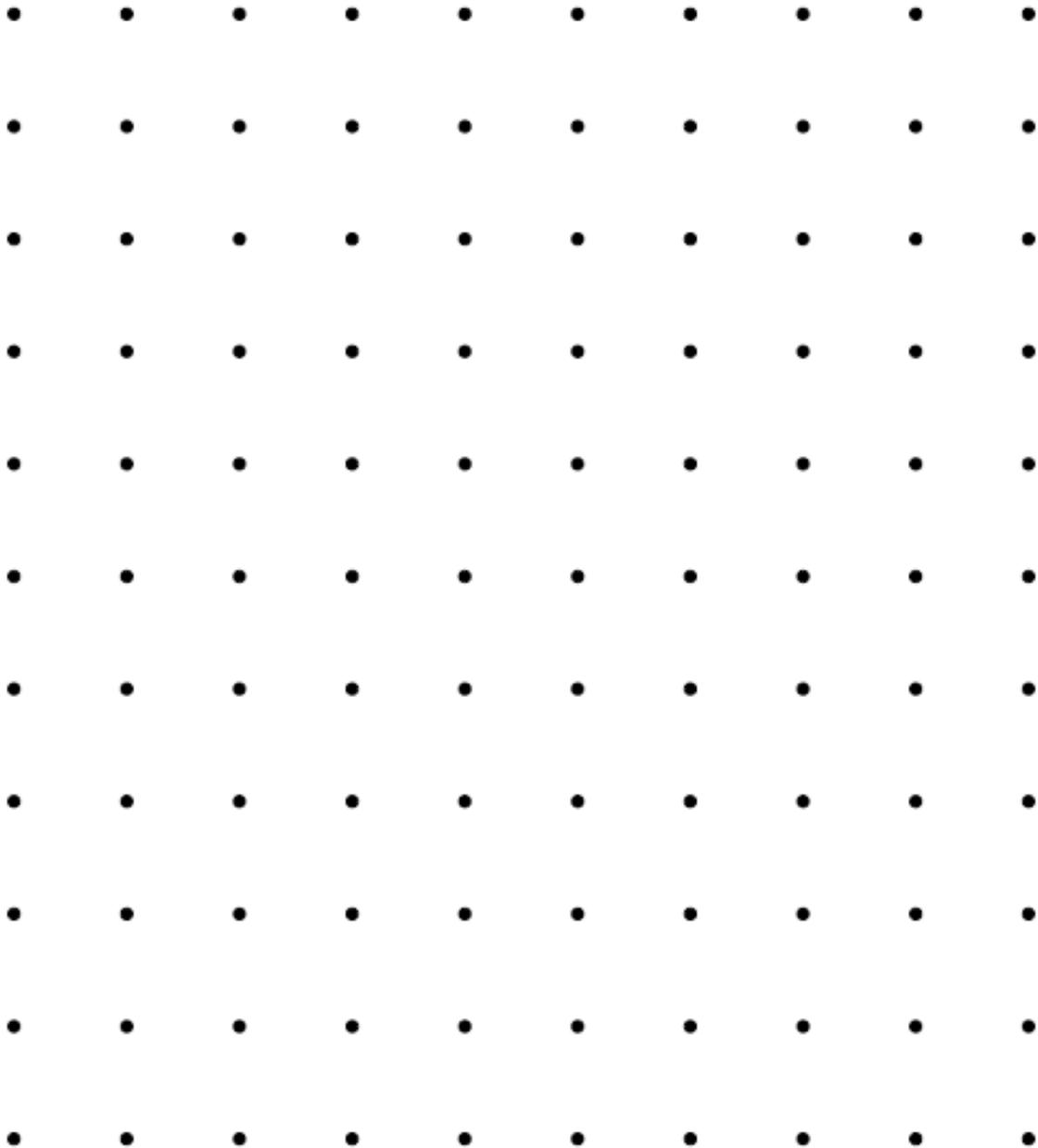
Extension

- Using straws of different length or a computer geometry program such as The Geometer's Sketchpad, students can consider and explore the following questions:
 - Can a triangle be made with segments measuring five, six, and seven units? Can more than one triangle be made? Why or Why not?
 - If you are given any three lengths, can you always make a triangle? Why or why not?
 - Using several different sets of three lengths, try to make triangles. Can you make up a rule about the lengths of the sides of the triangles?

Intervention

- Have students create the triangles using straws of different lengths rather than geoboards so they can more easily compare side lengths.

Thoughts About Triangles
Dot Paper



PRACTICE TASK: My Many Triangles

Adapted from Van De Walle, J.A., Karp, K. S., & Bay-Williams, J. M. (2010). *Elementary and Middle School Mathematics: Teaching Developmentally* 7th Ed. Boston: Pearson Education, Inc., p. 413-414.



STANDARDS FOR MATHEMATICAL CONTENT

MCC. 4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

MCC.4.G.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

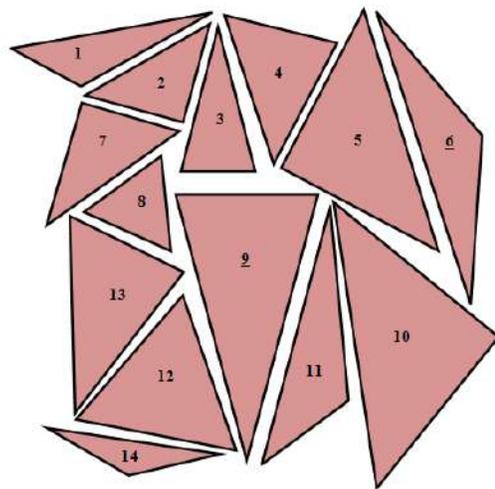
BACKGROUND KNOWLEDGE

Students should be able to identify triangles by the lengths of their sides (isosceles, equilateral, and scalene) as well as by the measure of their angles (right, obtuse, and acute) by using a right angle as a benchmark.

The type of each triangle on the “My Many Triangles, Triangles to Cut and Sort” student sheet are shown below.

- #1, #11 – obtuse scalene
- #2, #7 – right scalene

Allow students to struggle a little bit with this part of the task. Students may need to try out a few possibilities before finding that lengths of sides and measures of angles are two ways to sort these



triangles so that each triangle belongs to exactly one group when sorted.

Sorted according to side lengths

Equilateral triangles: 8, 12
Isosceles triangles: 2, 3, 5, 6, 9, 14
Scalene triangles: 1, 4, 7, 10, 11, 13

Sorted according to angle measures

Acute triangles: 3, 4, 8, 9, 12, 13
Right triangles: 2, 5, 7, 10
Obtuse triangles: 1, 6, 11, 14

Students will need to be able measure the sides and use 90 degrees as a benchmark for determine the angle classification in order to create the required triangles (using a right angle as a benchmark and/or tracing angles to see if they are congruent).

Of the nine triangles, two are not possible.

- An equilateral right triangle is not possible because an equilateral triangle also has equal angle measures (equiangular). A triangle can have no more than 180° , and $90^\circ \times 3 = 270^\circ$ which is more than 180° .
- An equilateral obtuse triangle is not possible because an equilateral triangle has equal angle measures (equiangular).

ESSENTIAL QUESTION

- How can angle and side measures help us to create and classify triangles?

MATERIALS

- “My Many Triangles” student recording sheet
- “My Many Triangles, Triangles to Cut and Sort” student sheet
- White construction paper (one sheet per student or per pair of students)
- Colored construction paper cut into strips $\frac{1}{4}$ " wide (each student will need approximately 10 strips of paper)

GROUPING

Individual/Partner Task

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

This task requires students to sort triangles according to common attributes and then create triangles according to two properties. This performance task may be used as formative assessment following the “Thoughts About Triangles” task.

Part 1

Task Directions

Cut out the triangles below. Sort the triangles into groups where there are no triangles that do not fit into a group and there are no triangles that belong to more than one group. Then sort the triangles in a different way. Again, there should be no triangles that do not fit into a group and no

triangles that belong to more than one group. Record how you sorted the triangles and the number of the triangles in each group. Be able to share how you sorted the triangles.

Part 2

Comments

Students may need some assistance using the chart to identify the triangles they need to create. Be sure students understand they need to attempt to make nine different types of triangles, two of which are not possible to create. Encourage students to try to make an equilateral obtuse angle and an equilateral right triangle so that they can see that it is not possible to create a three-sided closed figure with two obtuse angles or two right angles. (See below.)



Task Directions

Use the strips of construction paper to create the triangles described in each box below. Use the row label and the column label to identify the properties required for each triangle. For example, the box labeled “A” needs to be acute and isosceles because the row label is “Acute” and the column label is “Isosceles.”

	Equilateral	Isosceles	Scalene
Acute			
Right			
Obtuse			

Two triangles are not possible; for those, explain why each triangle is not possible on the lines below.

Glue each triangle onto the construction paper and label it.

FORMATIVE ASSESSMENT QUESTIONS

Part 1

- How do you know this is a(n) _____ (isosceles, right, equilateral, etc.) triangle?
- Are there any triangles that don't belong in a group?
- Are there any triangles that belong to more than one group?
- Can you think of another way to sort the triangles?
- What are some properties of this triangle? Can you use one of those properties to think of a way to group all of your triangles?

Part 2

- Can you create an equilateral right triangle? An equilateral obtuse triangle? How do you know?
- Is there a scalene equilateral triangle? How do you know?
- How do you know this is a _____ (i.e. scalene obtuse) triangle?
- How can you prove to us that this is a _____ (i.e. scalene obtuse) triangle?
- If it is a _____ (i.e. scalene obtuse) triangle, what is true about the length of its sides? The measures of its angles? Prove that the triangle you created has those attributes.
- Are students able to identify the seven different types of triangles?

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- Are students able to identify the attributes of the “Triangles to Cut and Sort” and use that information to sort them accurately?
- Are students able to describe why an obtuse equilateral triangle and a right equilateral triangle are not possible? Can they use what they know about the sum of the measures of the angles of a triangle to explain their thinking?
- Which students were successful at making the seven triangles with the strips of paper?
- Which students were able to measure segments and angles accurately?

DIFFERENTIATION

Extension

Challenge students to write directions for a triangle that they choose so that someone else could follow their directions and create the same triangle. Allow a partner to try these directions to see how successful they were at describing how to create their triangle.

Intervention

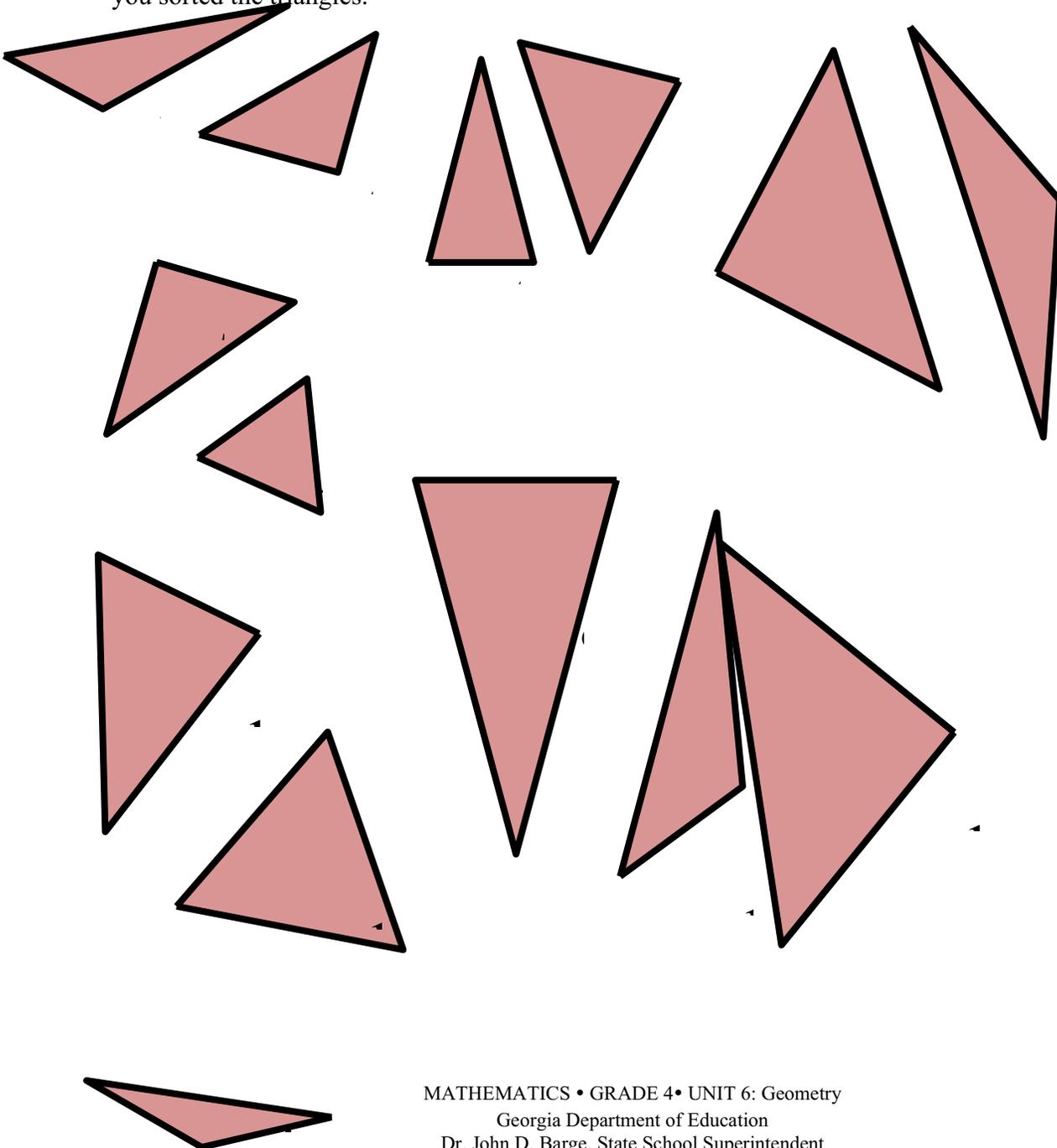
Allow students to use a picture glossary or the triangles from Part 1 of this task to help them create the triangles for Part 2.

My Many Triangles

Triangles to Cut and Sort



Cut out the triangles below. Sort the triangles into groups where there are no triangles that do not fit into a group and there are no triangles that belong to more than one group. Then sort the triangles in a different way. Again, there should be no triangles that do not fit into a group and no triangles that belong to more than one group. Record how you sorted the triangles and the number of the triangles in each group. Be able to share how you sorted the triangles.



Constructing Task: Quadrilateral Roundup

STANDARDS FOR MATHEMATICAL CONTENT

MCC. 4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

MCC.4.G.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Students should have the following background knowledge.

- Be able to use a straight edge or ruler to draw a straight line.
- Know how to use a ruler, and how to identify right angles (90 degrees), obtuse angles, and acute angles (using the corner of an index card or another object with a known angle of 90 degrees).
- Understand that the side across from an angle on a triangle can be described as an opposite side
- Know parallel means that lines will never intersect or cross over each other no matter how long they are extended.
- Understand that perpendicular means lines or segments intersect or cross forming a right angle. (Some students may use a known 90 degree angle to show an angle is a right angle.)
- Know that a property is an attribute of a shape that is always going to be true. It describes the shape.
- Be able to use a ruler to measure sides to verify they are the same length.

ESSENTIAL QUESTIONS

- What is a quadrilateral?
- How can you create different types of quadrilaterals?
- How are quadrilaterals alike and different?
- What are the properties of quadrilaterals?
- How can the types of sides be used to classify quadrilaterals?

MATERIALS

For Each Group:

- Three pieces of yarn or three plastics hoops
- A set of “Quadrilateral Pieces” for each group of students
- Labels for each group from “Labels”
- Blank index cards
- Markers
- Measuring tools such as rulers and index cards for students to test for right angles

GROUPING

Partner/Small Group Task

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Students will be using Venn diagrams to classify figures, so it is advisable to review Venn diagrams with students beforehand by modeling a sort, such as those quadrilateral pieces having no right angles and those having at least 1 right angle.

The purpose of this task is for students to become familiar with the properties of quadrilaterals and their defining characteristics as a context for classifying figures by the absence or presence of angles of a specified size and/or parallel and perpendicular lines. This task is meant to elicit discussion about not only the size of the angles in each type of quadrilateral, but the types of lines used to make the sides. While students may sort the quadrilateral pieces in many ways, keep in mind that the focus is on the types of angles and the types of lines used to make the sides of the quadrilaterals.

Some properties of quadrilaterals that may be discussed are included below. As students draw conclusions about the relationships between different figures, be sure they are able to explain their thinking and defend their conclusions. Much of the information below may come out as a result of students’ explorations. This is information to look for and highlight as they explore the quadrilaterals, not a list of understandings that you must teach them beforehand.

- A shape is a quadrilateral when it has exactly 4 sides and is a polygon. (To be a polygon the figure must be a closed plane figure with at least three straight sides.)
- A rectangle is a parallelogram with 4 right angles and 2 sets of parallel sides.

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- A square is a rectangle with sides of equal length.
- A parallelogram is a quadrilateral with 2 sets of parallel sides.
- A rhombus is a parallelogram with sides of equal length.

Task Directions

PART I

The students will place all 16 quadrilateral pieces in a Venn diagram they create from pieces of string or three hoops. They will use the labels from the “Label” sheet to direct their sorts. Students may leave shapes outside of the rings. Encourage them to think of a label that could be placed for the entire group if there was one big circle around both rings and the ones that fall outside of the rings. The same set of pieces can be used for several sorts using the different labels and/or several sets can be recreated so that students can glue their sorts onto mats or posters for sharing.

During the sorting, circulate among groups and ask students to explain and defend their placement of the figures in the different rings. After each sort use the following questions to guide discussion.

- Why did you place any shapes at all in the intersection there? What characteristics does it have?
- What do all the shapes on one ring have in common? The other?
- How much are the shapes in the ring different?
- What different label would eliminate one or more shapes from the ring?
- What different label for the one of the rings would allow you to include a new shape?

PART II

Give students the “Unknown Labels” figures to reverse this investigation. On this sheet, students are given the pre-sorted shapes in rings and then asked to determine which label could go above each ring. Students must then use the properties of the shapes (angles and parallel or perpendicular lines) to defend their labels.

Possible Solutions for “Unknown Labels”

Set 1: At least one pair of parallel sides (left), no side parallel (right)

Set 2: All sides the same length (inner), At least one pair of parallel sides (outer)

Set 3: At least one obtuse angle (left), At least one right angle (right)

FORMATIVE ASSESSMENT QUESTIONS

- Why did you place any shapes at all in the intersection there? What characteristics does it have?
- What do all the shapes on one ring have in common? The other?
- How much are the shapes in the ring different?
- What different label would eliminate one or more shapes from the ring?
- What different label for one of the rings would allow you to include a new shape?
- How can you be sure that label for the Unknown group is correct? What if your proof?

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- Were students able to use the presence or absence of certain angles to classify the figures?

DIFFERENTIATION

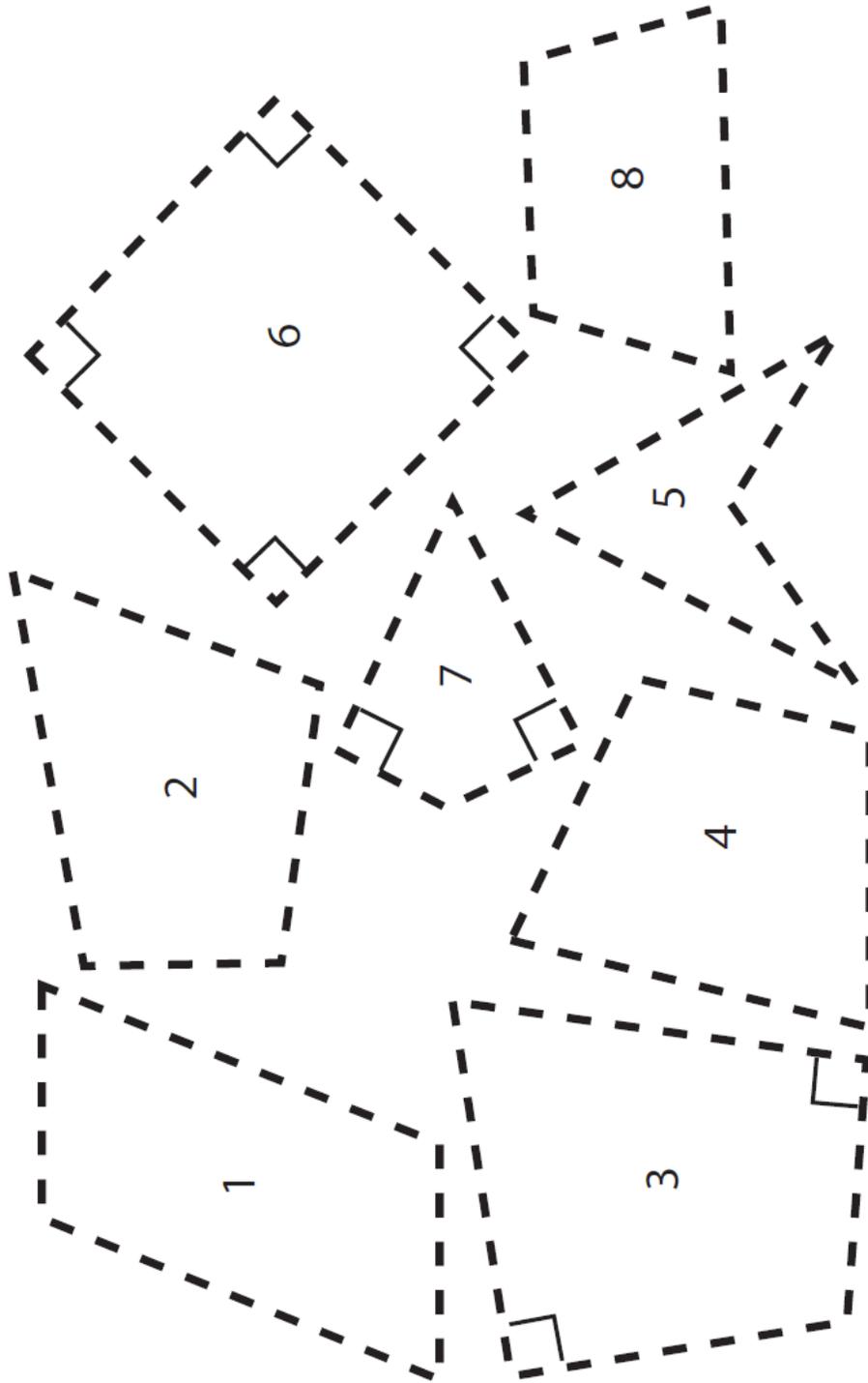
Extension

- Students can create their own label and challenge a partner to sort the shape using their labels.
- Students can create their own “Unknown Labels” samples for other students to label.

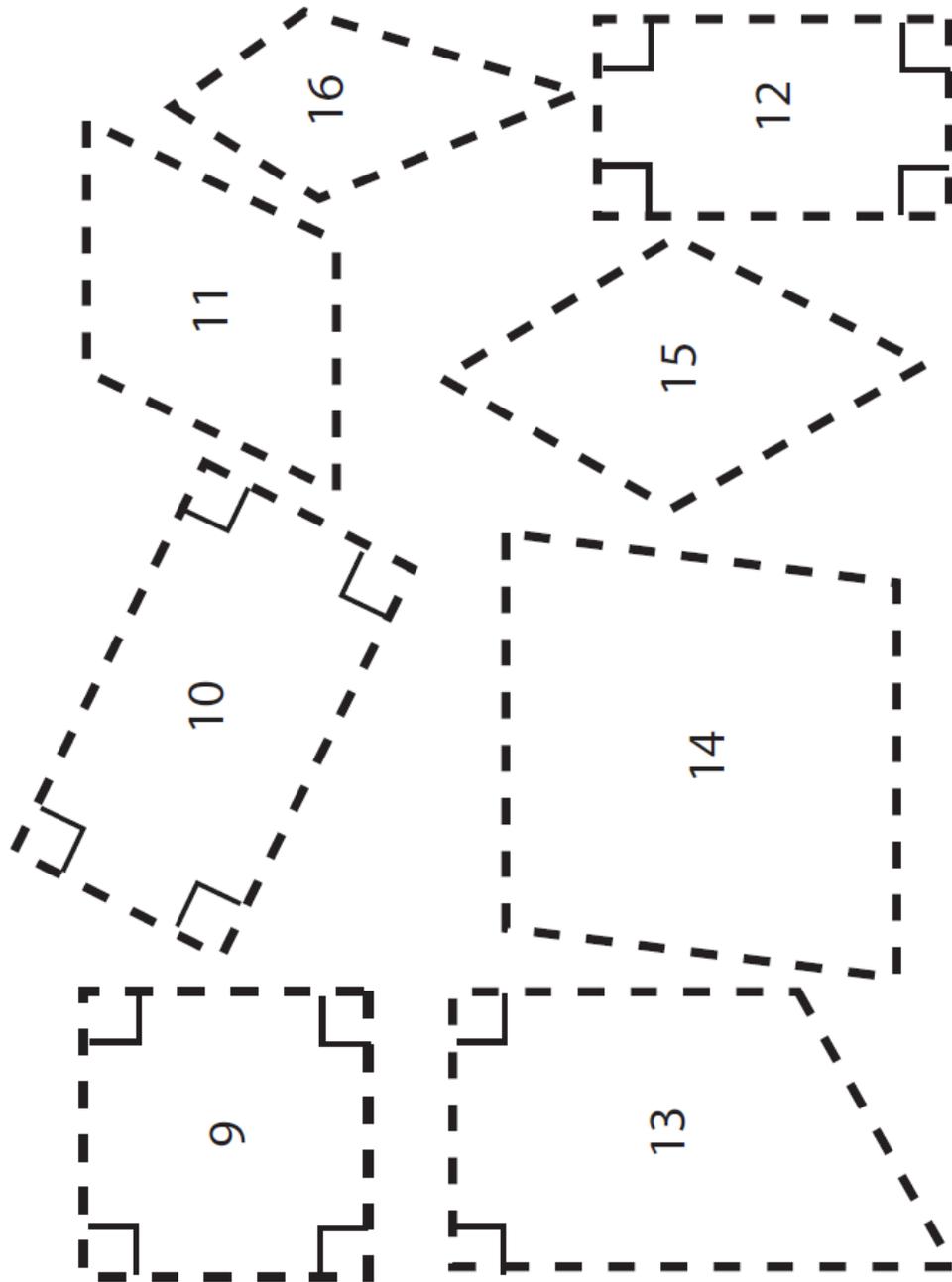
Intervention

- Have students label each shape with its known properties (perpendicular lines, 1 right angle), etc. and use those as an aid when sorting.

Quadrilateral Pieces: Page 1



Quadrilateral Pieces: Page 2



Labels

Use hoops or yarn string to make circles. Then cut out each card for each task, and place it near one of the rings. Sort your “Quadrilateral Pieces” unto each ring according to the label. You may need to overlap some rings to form intersections.

TASK 1	At least one right angle	No right angles
TASK 2	All sides the same length	At least one acute angle
TASK 3	At least one set of parallel sides	At least one obtuse angle
TASK 4	At least one pair of congruent sides	All pairs of opposite sides congruent
TASK 5 (three rings)	All sides are the same length	At least one obtuse angle
	At least one right angle	

Name _____ Date _____

Unknown Labels

Directions: Create each set of Unknown rings, make an appropriate label and explain your reasoning.

Unknown Rings 1

Left Ring: 1, 6, 8, 9, 10, 11, 12, 13, 14, 15

Center: None

Right Ring: 2, 3, 4, 5, 7, 16

Unknown Rings 2

Left Ring: None

Center: 6, 9, 11, 15

Right Ring: 1, 8, 10, 12, 13, 14

Outside All Rings: 2, 3, 4, 5, 7, 16

Unknown Rings 3

Left Ring: 1, 2, 3, 4, 5, 8, 11, 14, 15, 16

Center: 7, 13

Right Ring: 3, 6, 9, 10, 12,

Scaffolding Task: Super Hero Symmetry

STANDARDS FOR MATHEMATICAL CONTENT

MCC.4.G.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Pattern blocks are used to introduce and show symmetry in this lesson. Many of the pattern blocks, such as the blue rhombus and yellow hexagon, can be divided down the middle into two congruent pieces that show symmetry. For instance, when two green triangles are placed on top of a blue rhombus, the line between the two triangles is the line of symmetry. As students trace the pattern blocks for their masks, it may be helpful to have them trace them on isometric dot paper to keep it neat.

ESSENTIAL QUESTIONS

- What is symmetry?
- How are symmetrical figures created?

MATERIALS

- Pattern blocks
- Paper
- Pencils
- Copies of “Isometric Dot Paper”

GROUPING

Partner/Small Group Task

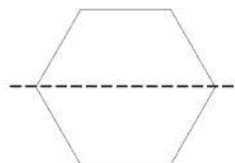
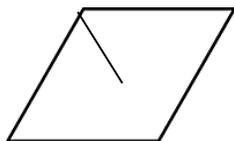
TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

The purpose of this task is for students to begin exploring congruency and symmetry by recognizing points where a shape has been reflected over a line of symmetry.

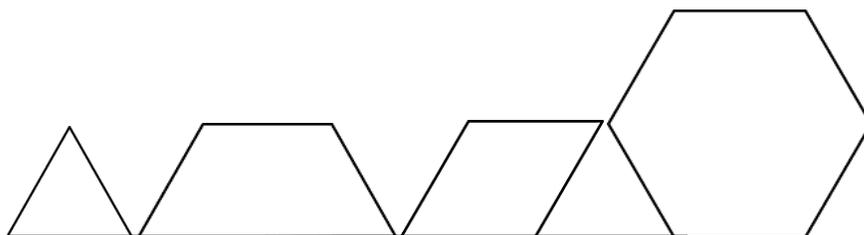
Task Directions

PART I

- Introduce the problem scenario below as a context for this task.
Seth wants to make the mask of his favorite super hero to wear to his super hero birthday party. He tore the mask he wore to last year's party and only has half of it. He's hoping to use that half as a pattern for making his new mask. Use what you know about symmetry to help Seth create a new mask using the half he has from last year.
- Discuss with students what symmetry is by modeling with pattern block.
- Have each student trace a blue rhombus on their paper and decide what two pattern block can be placed inside of it so that there are two, congruent parts. Have them draw in the triangles and the lines that divide them. Explain that this shows a line of symmetry in the blue rhombus because it would be folded over that line and the two triangles would overlap exactly. Repeat using the hexagon and trapezoid pieces.



- Tell students that they can create a group of shapes with symmetry, too. Have students fold a sheet of paper in half and draw the line down the middle. They should place pattern blocks along one side of the line and trace them. Then, a partner should match up the shapes that belong on the other side of the line of symmetry.



- Have students fold along the line of symmetry to make sure the lines from the partner match up with the lines of the original pattern
- After looking at, examining, and explaining how they know their patterns are symmetrical, use the following guiding questions to facilitate discussion:
 - How did you know what you filled in on your partner's paper would make a symmetrical image?
 - What is a mirror image?
 - What mistakes (if any) did you make as you completed the patterns?
- Revisit the original problem about Seth's mask. Have students create their own masks by folding paper along the center and placing pattern blocks along the fold. Have them trace their design and then unfold the paper. Have students use pattern blocks to complete the other

half of the mask. Student should cut out their masks and be prepared to explain how they know their masks are symmetrical.

•

FORMATIVE ASSESSMENT QUESTIONS

- How do you know that your mask has symmetry?
- How can you test your mask for symmetry?
- How did you use symmetry to create the mask when you only knew what half of it looked like?
- Were students able to create symmetrical image by matching pattern blocks over a line of symmetry?
- Could students explain what symmetry is and how to prove something is symmetrical?

DIFFERENTIATION

Extension

- Have students fold their paper into four squares and create a mask that is symmetrical across both folds in the paper.

Intervention

- As students trace a pattern block on one side of the line of symmetry, have them immediately flip the block over the line of symmetry and trace it right then. This will help them see the mirror image immediately.

Isometric Dot Paper



CONSTRUCTING TASK: Line Symmetry

STANDARDS FOR MATHEMATICAL CONTENT

MCC.4.G.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

In this task, students will develop an understanding of line symmetry and how it is related to transformations. Opportunities for exploring symmetry should be given to students. Teachers should also support good student dialogue and take advantage of comments and questions to help guide students into correct mathematical thinking.

Students should discuss how line symmetry makes a picture or shape look balanced. It is important for students to understand that each half of a figure is a mirror image of the other half. Students may demonstrate this understanding by folding a figure along the axis of symmetry to see if the figure lines back up with itself. Students may also use a transparent mirror by placing the beveled edge along the axis of symmetry to see if the figure lines back up with itself.

While students are exploring the symmetry of these various shapes, use questioning to guide their thinking when they mark a line of symmetry that is incorrect. For example, “How do you know that is a line of symmetry?” or “How can you prove that shape is symmetrical?” could be used to probe students to explain their work and correct any misconceptions.

ESSENTIAL QUESTIONS

- How do you determine lines of symmetry? What do they tell us?
- How is symmetry used in areas such as architecture and art? In what areas is symmetry important?

MATERIALS

- Mira or transparent mirrors
- scissors
- paper
- pattern blocks (optional)

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Part I.

- Provide students with a plain sheet of paper and a pair of scissors. Ask students to fold the sheet of paper in half and cut out a shape of their choosing along the fold. Next, ask students to open the paper. The fold line will be a line of symmetry.
- Ask students to discuss each half of their figure.
- Students may also use transparent mirrors or MIRAS to further explore line symmetry.
- Ask students to discuss each half of their figure.
- Use these discussions to allow your students to construct an understanding of line symmetry. Students should understand that half of the figure is a mirror image of the other half and together they re-create the original figure. If the figure is symmetrical, one side of the figure will fall on top of the other side of the figure. This demonstrates that one side of the figure is reflected onto the other side.
- Students should also explore figures that are asymmetrical.

Part II

- Provide students with the *Nature* handout.
- Ask students to respond to the following question:
 - *What characteristics does each object have that makes it look balanced or symmetrical?*
- Instruct students to draw all lines of symmetry on each figure.
- Have them cut out the shapes and fold along those lines of symmetry to prove their thinking.
- Ask students to discuss how they determined each line of symmetry and what it tells them.
- Ask students to respond to the following question:
 - *Where can you find other examples of symmetry in your environment?*

Part III

- Provide students with the *World Flags* handout.
- Ask students to respond to the following question:
 - *What characteristics does each flag have that makes it look balanced?*
- Instruct students to draw all lines of symmetry on each flag.
- Students benefit from folding each flag or using a Mira to determine a line of symmetry.
- Ask students to discuss how they determined each line of symmetry and what it tells them.

- Ask students to respond to the following question:
 - *Where can you find other examples of symmetry in other areas such as architecture or art?*

Part IV

- Provide students with the *Shapes* handout.
- Ask students to respond to the following question:
 - *What characteristics does each shape have that makes it look balanced?*
- Instruct students to draw all lines of symmetry on each shape.
- Ask students to discuss how they determined each line of symmetry and what it tells them.

FORMATIVE ASSESSMENT QUESTIONS

- How do you know that a figure has symmetry?
- How can you test a figure for symmetry?
- How can you be sure you've found all the lines of symmetry for a figure?

DIFFERENTIATION

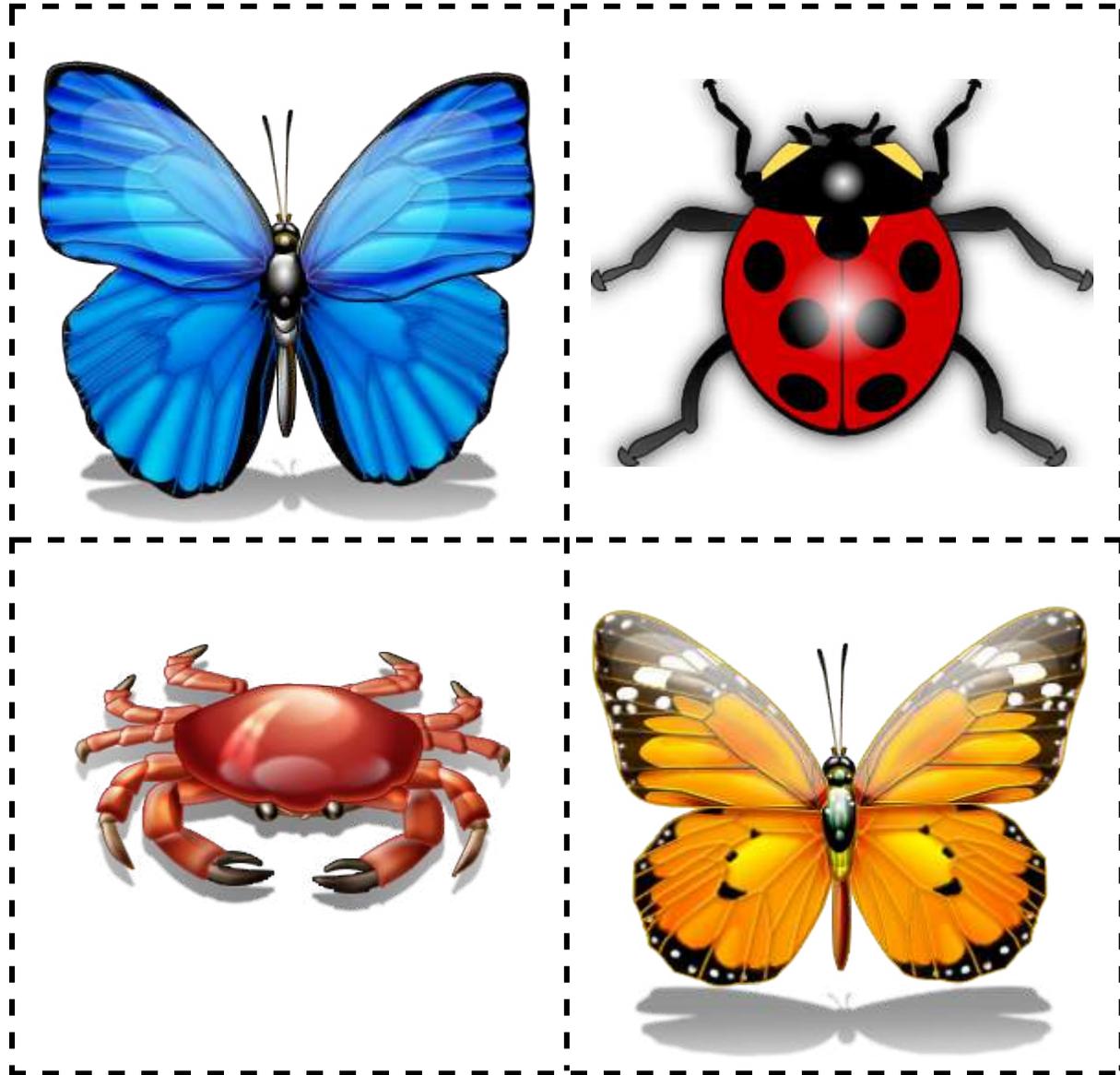
Extension

- Students may use Geometer's Sketchpad or the "draw tool" in word processing software or a "paint" program in order to draw quadrilaterals with a specified number of lines of symmetry. Students may work in pairs and then report to the whole class.

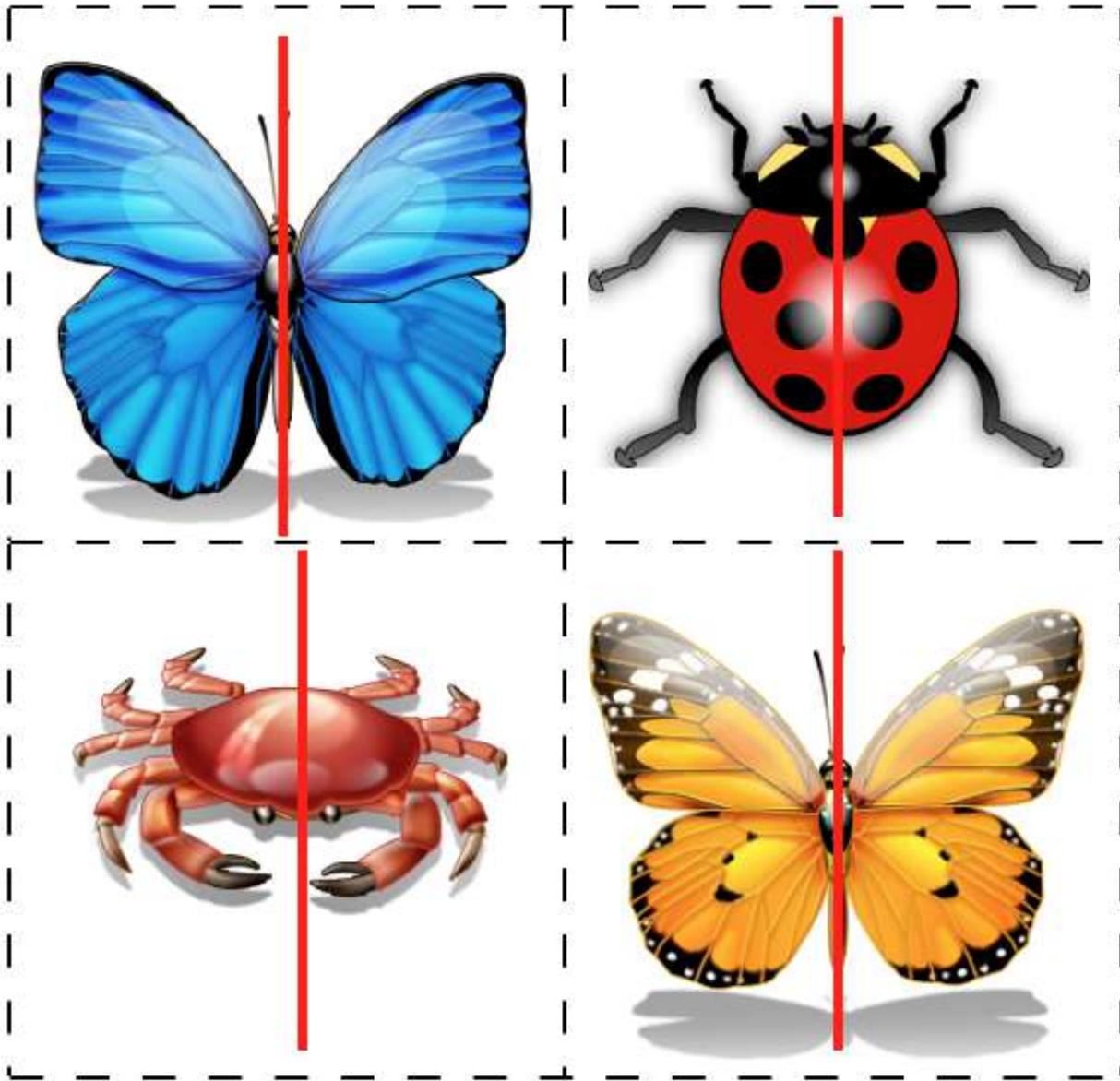
Intervention

- Give students paper pattern blocks to fold and have them draw lines of symmetry directly on the paper blocks.
- Ask students to draw the second half of a given symmetrical figure with only one line of symmetry.
- Ask students to draw the second half of a given symmetrical figure with two lines of symmetry.

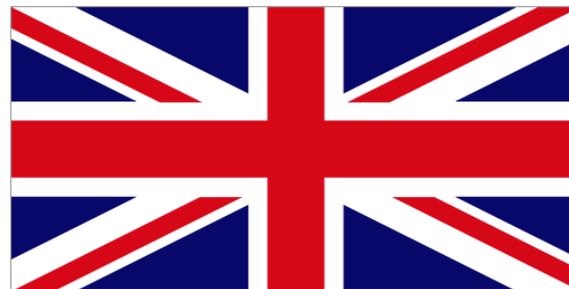
Nature



Key

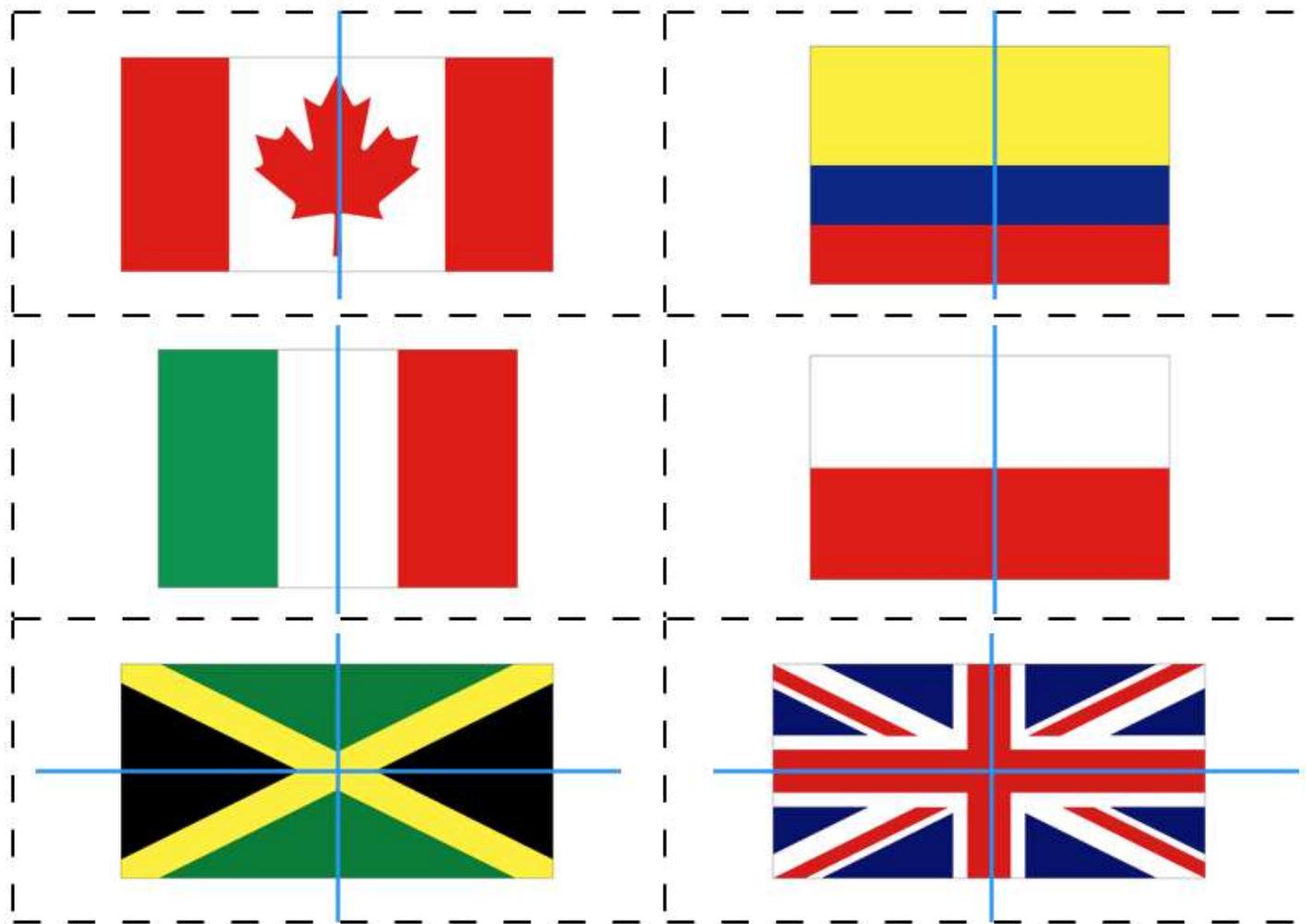


World Flags

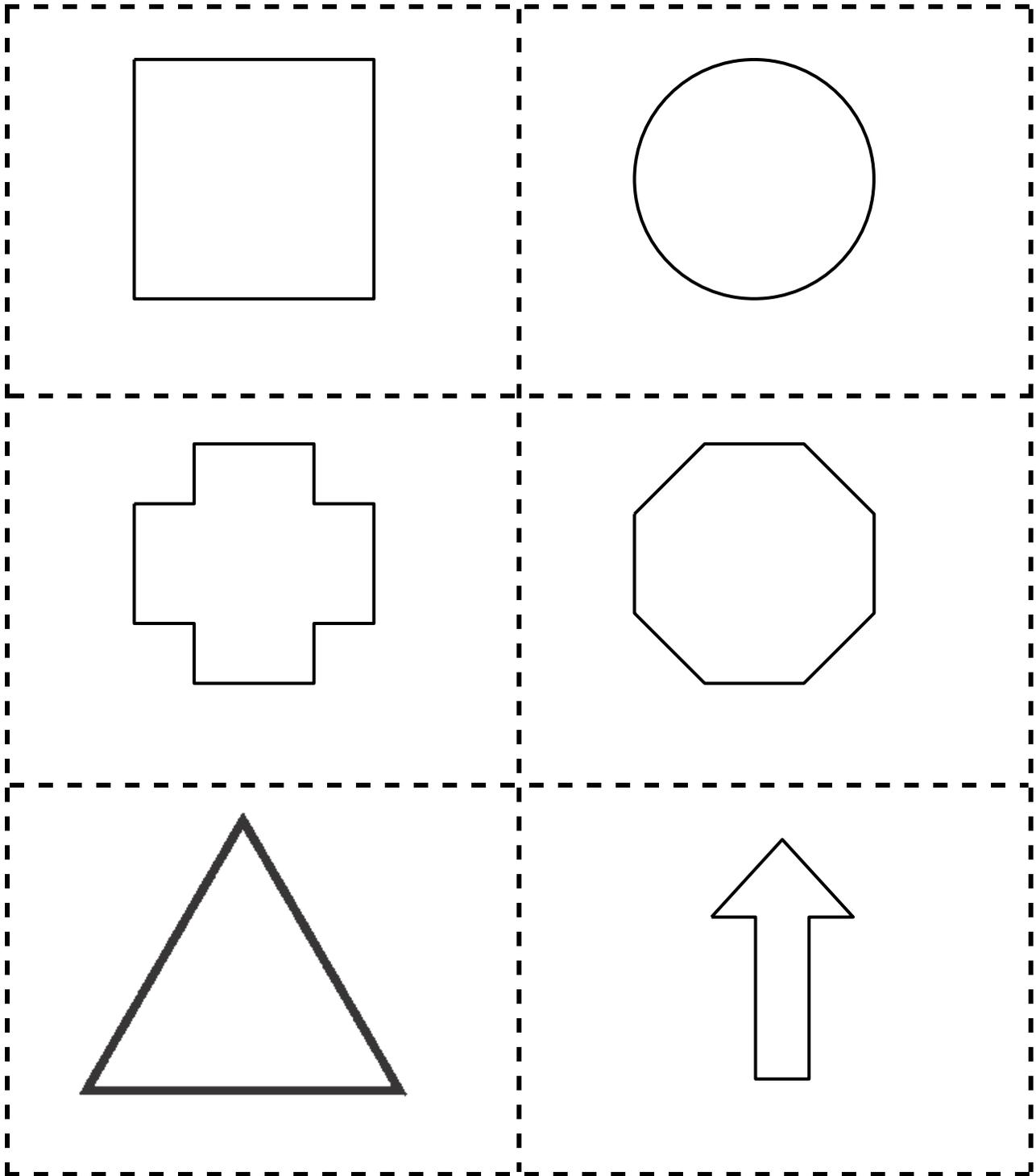


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Key

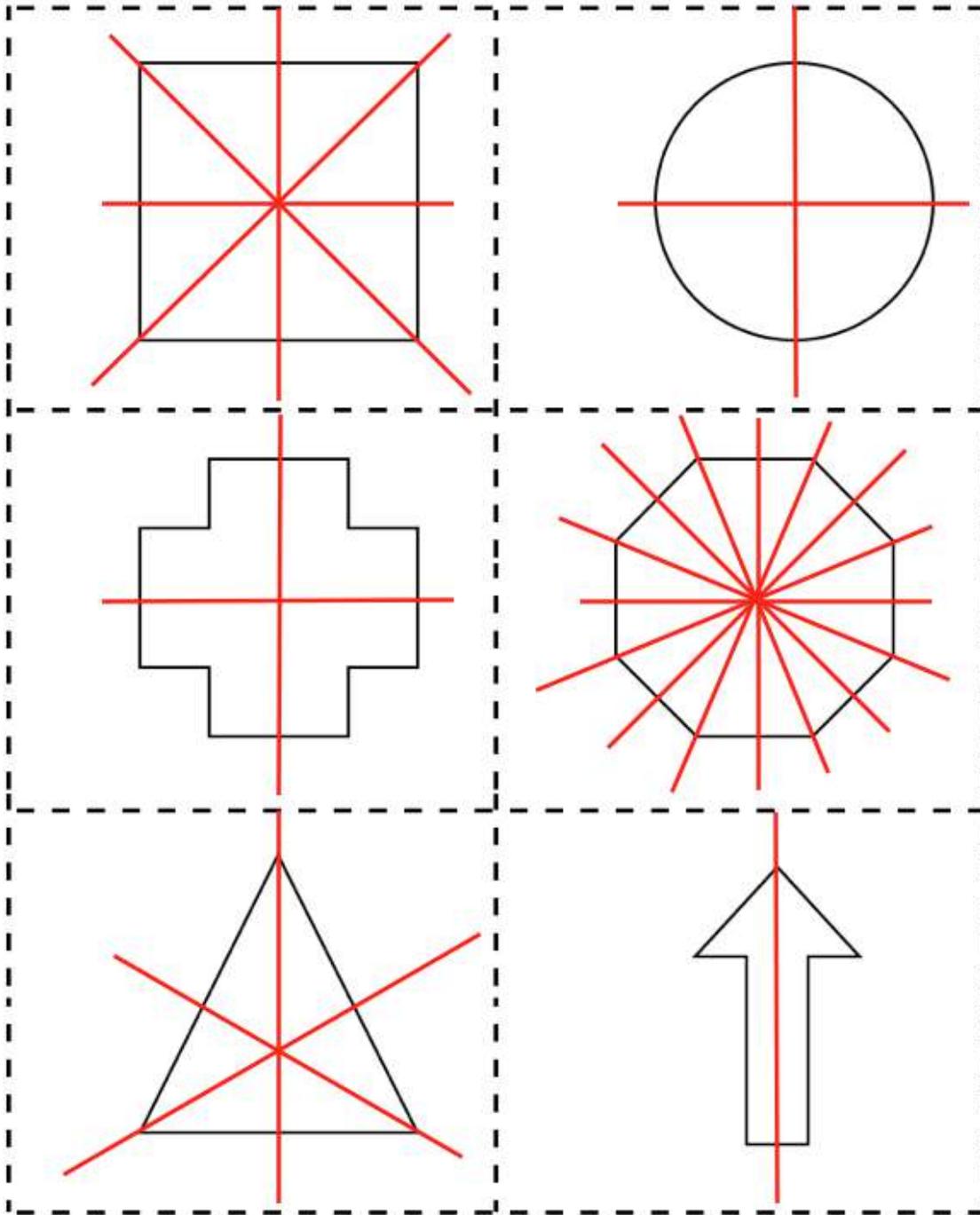


Shapes



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Key



Constructing Task: A Quilt of Symmetry

STANDARDS FOR MATHEMATICAL CONTENT

MCC.4.G.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Students should have previous experiences with symmetry and finding lines of symmetry prior to this task. This task focuses on creating a class symmetry quilt made up of paper “quilt squares” that has exactly one line of symmetry.

This task links with many children’s literature books about quilting, including *The Patchwork Quilt* or *Sam Johnson and the Blue Ribbon Quilt*. Opening this task by reading a book about quilting will help students make a real-world connection between math, literature, art, and history.

ESSENTIAL QUESTIONS

- How do you determine lines of symmetry? What do they tell us?
- How are symmetrical figures used in artwork?

MATERIALS

- Pattern blocks
- “Quilt of Symmetry Patchwork Squares” Sheet for each student
- Paper pattern blocks to glue on squares (optional)

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Student Directions:

Our class is creating a class symmetry quilt. Your job is to create two identical squares for our quilt. The design of your square is up to you, but it must fulfill the following criteria:

- You may use up to 10 pattern blocks to create your square.
- Your square must have only 1 line of symmetry.
- Your design must fit inside the patchwork square provided.

After completing your design on one square, you must recreate the exact design on the second.

- On one of your squares, use a marker or pencil to draw the line of symmetry. On the back of the square, explain how you know that line is a line of symmetry. Also, explain the strategy you used when you designed your square.
- Give the other square to a partner to verify the line of symmetry. Your “unmarked” square will be used to construct our class quilt.

Students can either trace pattern blocks directly on the squares or they can color and glue on paper pattern blocks. All of the unmarked squares can be glued on bulletin board paper or hole punched and tied together like a quilt.

FORMATIVE ASSESSMENT QUESTIONS

- How do you know your square had symmetry?
- How do you know your square had only one line of symmetry?
- Were students able to identify lines of symmetry?
- What strategies did students use for verifying their lines of symmetry?
- Were students able to explain their strategies for finding symmetry?

DIFFERENTIATION

Extension

- Students may use Geometer’s Sketchpad or the “draw tool” in word processing software or a “paint” program in order to draw their quilt squares.

Intervention

- Give students paper pattern blocks to fold and place on their quilt squares.
- Allow students to use mirrors or fold their “marked” squares to verify symmetry.

Name _____ Date _____

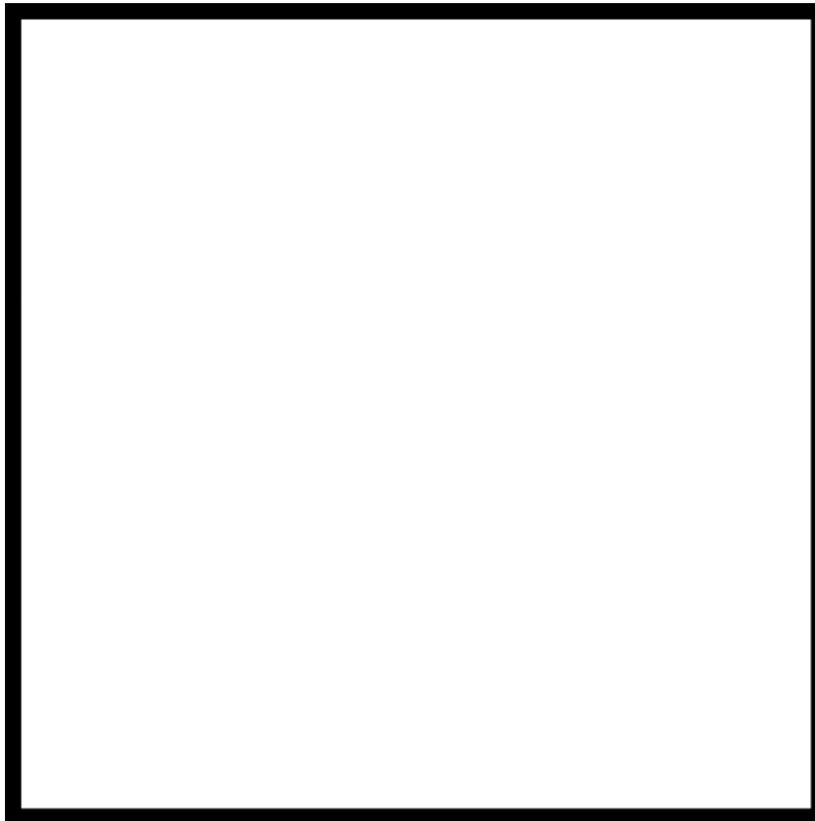
A Quilt of Symmetry

Our class is creating a class symmetry quilt. Your job is to create two identical squares for our quilt. The design of your square is up to you, but it must fulfill the following criteria:

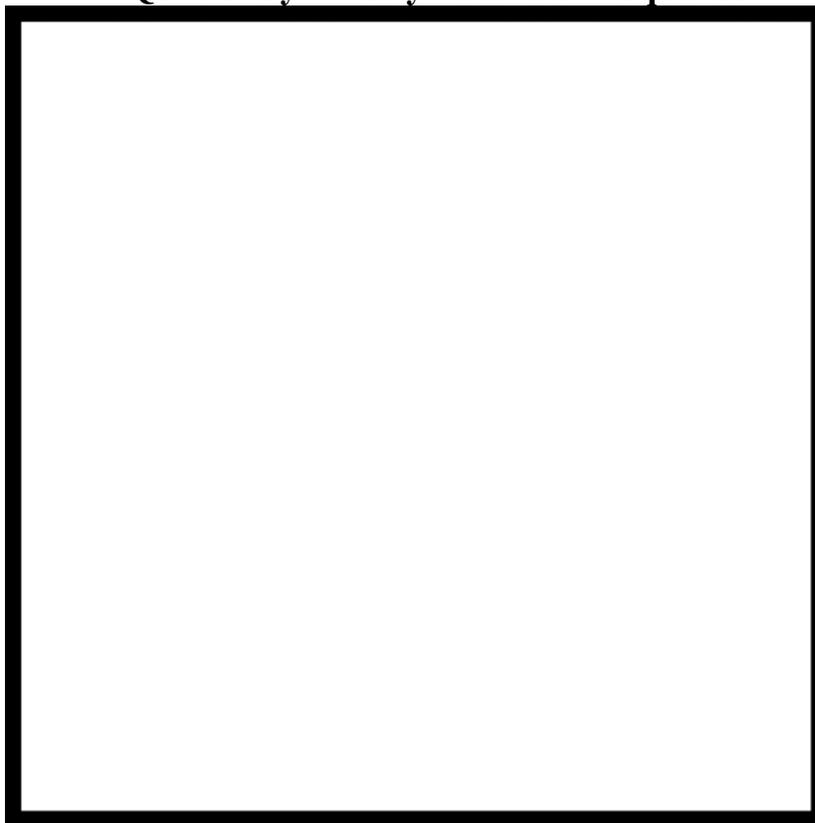
- Your design must fit inside the patchwork square provided.
- You may use up to 10 pattern blocks to create your square.
- Your square must have only 1 line of symmetry.

After completing your design on one square, you must recreate the exact design on the second.

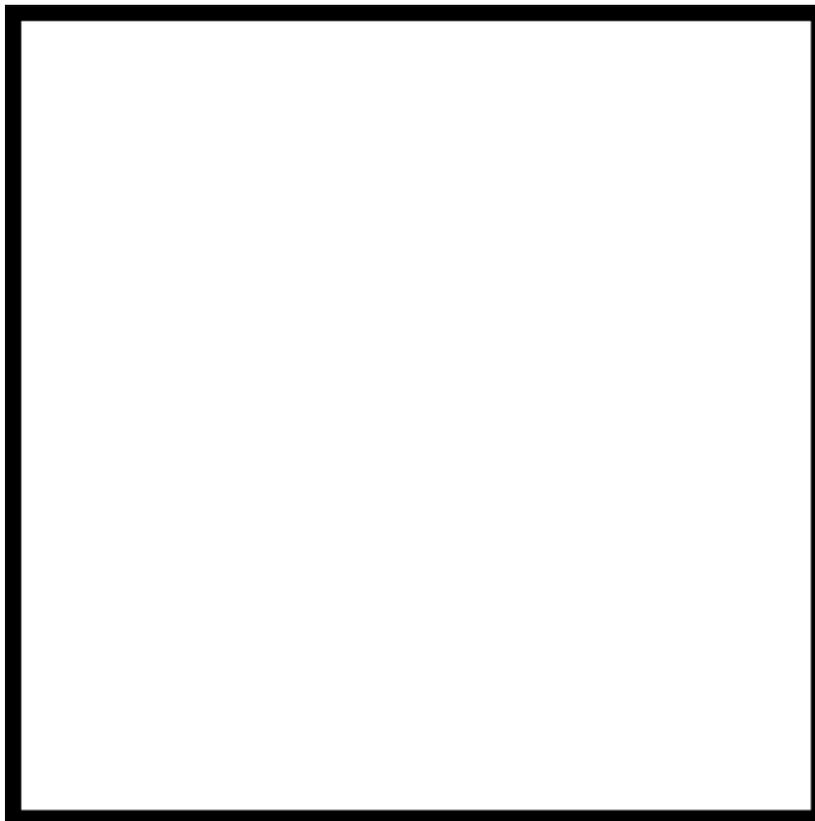
- On one of your squares, use a marker or pencil to draw the line of symmetry. On the back of the square, explain how you know that line is a line of symmetry. Also, explain the strategy you used when you designed your square.
- Give the other square to a partner to verify the line of symmetry. Your “unmarked” square will be used to construct our class quilt.



A Quilt of Symmetry Patchwork Squares



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Practice Task: Decoding ABC Symmetry

STANDARDS FOR MATHEMATICAL CONTENT

MCC.4.G.3_ Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Students should have previous experiences with symmetry and finding lines of symmetry prior to this task. This task focuses on finding lines of symmetry on the letters of the alphabet and using these to create a secret code for others to decipher.

ESSENTIAL QUESTIONS

- Which letters of the alphabet are symmetrical?

MATERIALS

- “ABC Symmetry” letters for each student
- “ABC Symmetry Chart” Sheet for each student
- Pencils
- Scissors
- Glue

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Part I

Distribute copies of “ABC Symmetry” and “ABC Symmetry Chart”. Tell students that today they will be detectives who write secret codes using symmetry as the key to the code breaking. Have student work through all the letters of the alphabet and sort them by letters with no symmetry, one line of symmetry, two lines of symmetry, or more than two lines of symmetry. They can cut out and fold the letters if needed. As they determined the number of lines of symmetry, they should label them on the cards and write the letters in the appropriate part of the “ABC Symmetry Chart.”

Once students have completed this portion of the task, facilitate discussion by using the following questions:

- Which letters have only one line of symmetry? (A, B, C, D, H, M, T, V, W, and Y)
 - Which letters have no lines of symmetry? Why? (E, F, G, J, K, L, N, P, Q, R, S, and Z)
 - Which letters have two lines of symmetry? (I, O, and X)
 - Which letters have more than two lines of symmetry? (none)
- If we used a different font or style to print these letters, would the symmetries stay the same? Why or why not?

PART 2

Tell students that the chart and letters can help them write a “secret” symmetry code. For the code, students only write one half of a letter that has symmetry and the person receiving the code must write in the other half of the letter to complete the code (letters with no lines of symmetry should be written as usual.) Model on the board how to write a few letters in “code”.



(secret code for MATH)

Have students practice writing one word codes at first and then give the word to a partner to “decode.” As students gain confidence, they can write longer messages on “code”

As students decipher each others’ codes, focus discussion on their strategies for filling in the rest of each letter and how they check their work.

FORMATIVE ASSESSMENT QUESTIONS

- How did you know which letters had symmetry?
- How did you know you found all the lines of symmetry for a letter?
- What strategies did you use for deciphering each other’s’ symmetry codes?
- Were students able to identify lines of symmetry?
- What strategies did students use for verifying their lines of symmetry?
- Were students able to explain their strategies for finding symmetry?
- Where students able to complete the drawing of the letters to make a symmetrical object?

DIFFERENTIATION

Extension

- Give students alphabets printed in other styles or fonts to complete and “ABC Symmetry Chart”. Have them investigate if any of the letters move places on the chart when written in a new font and then examine the font to see what changed. They can present their findings to the class.

Intervention

- Give students multiple copies of the letters to cut along the lines of symmetry to write their code. Their partner can give them the pieces that were cut off when the code was made to match up and complete the letter as they break the codes.

ABC Symmetry Cards

A	B	C
D	E	F
H	I	J
K	L	M
N	O	P
Q	R	S
T	U	V
W	X	Y
Z		

Name _____ Date _____

ABC Symmetry Chart

Write the letters of the alphabet in the proper column on the chart.

Letters with No Lines of Symmetry	Letters with 1 Line of Symmetry	Letters with 2 Lines of Symmetry	Letters with More than 2 Lines of Symmetry

Unit 6 Culminating Task



Performance Task: Geometry Town

STANDARDS FOR MATHEMATICAL CONTENT

MCC. 4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

MCC.4.G.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

MCC.4.G.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

As a culminating task, students will need to utilize the understanding and skills developed during this unit. Grade level teachers can create the rubric, or students can participate in the creation of the assessment tool.

ESSENTIAL QUESTIONS

- Where is geometry found in your everyday world?
- How can shapes be classified by their angles and lines?
- How can you determine the lines of symmetry in a figure?

MATERIALS

- “Geometry Town” student sheet.
- Poster paper or chart paper with 1 inch grid
- Notebook or copy paper
- 1” x 24” Strips of black or brown construction paper for streets, avenues, and roads (approximately 12 strips per city model)
- Markers, crayons, and/or colored pencils
- Protractors, rulers, yardsticks

GROUPING

Individual/Partner Task

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Students create a plan for a city using geometric figures. Also, students represent the features of the town graphically.

Comments

A review of vocabulary would be an effective way of leading into this culminating task. One of the most important aspects of this task is for the children to demonstrate the mastery of the meaning of each term and show how to use and recognize these terms in their everyday lives.

Students may need extra time getting started on this task because it requires planning and cooperation. This task does take a considerable amount of time to complete; therefore, teachers should allow students the time required to discuss their project as they plan and create their model.

It may be helpful to create a rubric that can be used to assess the city model students will develop and describe in this task.

Task Directions

Students will follow the directions below from the “Geometry Town” student sheet.

In your role as city planner, you have been asked to plan a new part of your city. Create a model of your plan, including 2-D models of the buildings, to present to the committee.

You are required to meet the following specifications.

- 4 streets that are parallel to each other
- 1 road that is perpendicular to the 4 parallel streets
- 1 avenue that intersects at least 2 streets but is not perpendicular to them
- 8 buildings that are the shape of any polygons and color coded by the following requirements
 - 2 different shaped red buildings that have at least one right angle and at least one set of parallel sides

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- 2 different shaped green buildings that have at least one obtuse angle
- 2 different shaped blue buildings with no parallel or perpendicular sides
- 2 different shaped yellow buildings that are right triangles
- 1 park shaped like a right triangle with the following features:
 - A swimming pool in the shape of a figure that has only acute angles
 - A right triangular sandbox
 - A triangular shaped sandbox with an obtuse angle
- 1 park that has at least 4 different geometric figures inside of it but has a symmetrical design (a line of symmetry could be drawn through the park)
- Name the park and the streets, the road, and the avenue.

Plan your city on a sheet of paper first. Once your plan is complete, create your model. Build your model on 1" grid chart paper. Use paper strips to create the streets, road, and avenue, and draw your buildings. Add the required features to the park by creating the appropriate 2-D shapes for your park.

FORMATIVE ASSESSMENT QUESTIONS

- How do you know that your color-coded building match the requirements?
- How do you know that the angles in your figures are acute, obtuse, or right?
- How do you know the line segments are perpendicular? Parallel? Intersecting?
- Which students accurately completed all parts of the task?
- Which student demonstrated an understanding of:
 - ~ Parallel, perpendicular
 - ~ Describing properties of figures
 - ~ Acute, obtuse, and right angles
 - ~ Symmetry

DIFFERENTIATION

Extension

- Students may add a new part to the city using their own rules for things to add to the map.
- Invite an architect to the classroom to talk about planning and the models they build in their work.
- Encourage students to prepare a presentation to the committee regarding their city plan. Students should try to persuade city planning committee members to choose their plan.

Intervention

- Pre-made 2-D shapes could be made available to students.
- Offer each requirement of the town one step at a time. Have students add the parts as they go.



Name _____ Date _____

Geometry Town

In your role as city planner, you have been asked to plan a new part of your city. Create a model of your plan, including 2-D models of the buildings, to present to the committee.

You are required to meet the following specifications.

- 4 streets that are parallel to each other
- 1 road that is perpendicular to the 4 parallel streets
- 1 avenue that intersects at least 2 streets but is not perpendicular to them
- 8 buildings that are the shape of any polygons and color coded by the following requirements
 - 2 different shaped red buildings that have at least one right angle and at least one set of parallel sides
 - 2 different shaped green buildings that have at least one obtuse angle
 - 2 different shaped blue buildings with no parallel or perpendicular sides
 - 2 different shaped yellow buildings that are right triangles
- 1 park shaped like a right triangle with the following features:
 - A swimming pool in the shape of a figure that has only acute angles
 - A right triangular sandbox
 - A triangular shaped sandbox with an obtuse angle
- 1 park that has at least 4 different geometric figures inside of it but has a symmetrical design (a line of symmetry could be drawn through the park)
- Name the park and the streets, the road, and the avenue.

Plan your city on a sheet of paper first. Once your plan is complete, create your model. Build your model on 1" grid chart paper. Use paper strips to create the streets, road, and avenue, and draw your buildings. Add the required features to the park by creating the appropriate 2-D shapes for your park.