RECOGNIZING AND CREATING SHAPES

2.GM.A.1

CONTENTS

The types of documents contained in the unit are listed below. Throughout the unit, the documents are arranged by lesson.

LEARNING MAP INFORMATION	An overview of the standards, the learning map section, and the nodes addressed in this unit
TEACHER NOTES	A brief discussion describing the progression depicted in the learning map section with research-based recommendations for focusing instruction to foster student learning and an introduction to the unit's lessons
OVERVIEW OF INSTRUCTIONAL ACTIVITIES	A table highlighting the lesson goals and nodes addressed in each lesson of this unit
INSTRUCTIONAL ACTIVITY	A detailed walkthrough of the unit
INSTRUCTIONAL ACTIVITY STUDENT HANDOUT	A handout for the guided activity, intended to be paired with the Instructional Activity
INSTRUCTIONAL ACTIVITY SUPPLEMENT	A collection of materials or activities related to the Instructional Activity
STUDENT ACTIVITY	A work-alone activity for students
STUDENT ACTIVITY SOLUTION GUIDE	A solution guide for the work-alone activity with example errors, misconceptions, and links to the learning map section

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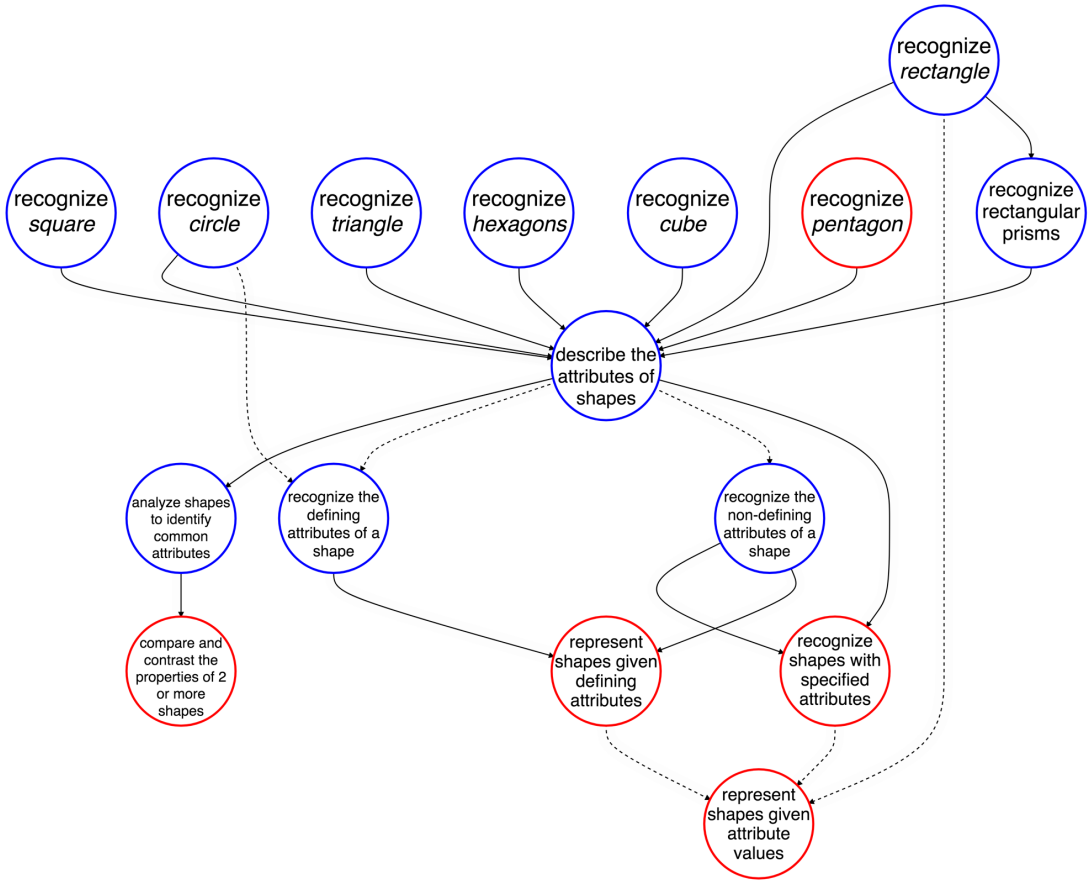
RECOGNIZING AND CREATING SHAPES

LEARNING MAP INFORMATION

STANDARDS

2.GM.A.1 Recognize and draw shapes having specified attributes, such as a given number of angles or sides. Identify triangles, quadrilaterals, pentagons, hexagons, circles and cubes. Identify the faces of three-dimensional objects.



**Learning map model of* 2.G.1

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Node Name	Node Description
ANALYZE SHAPES TO IDENTIFY COMMON ATTRIBUTES	Analyze and compare shapes using informal language to describe their similarities, differences, parts, and other attributes.
COMPARE AND CONTRAST THE PROPERTIES OF 2 OR MORE SHAPES	Compare two or more shapes by describing their shared and different geometric properties (e.g., rectangles and rhombuses both have four congruent sides, but their angles' properties are different).
DESCRIBE THE ATTRIBUTES OF SHAPES	Describe different attribute values of shapes (e.g., identify how many sides a shape has).
RECOGNIZE *CIRCLE*	When presented a set of different shapes, select the circle.
RECOGNIZE *CUBE*	When presented a set of different shapes, select the cube.
RECOGNIZE *HEXAGONS*	When presented a set of different shapes, select the hexagon.
RECOGNIZE *PENTAGON*	When presented a set of different shapes, select the pentagon.
RECOGNIZE *RECTANGLE*	When presented a set of different shapes, select the rectangle.
RECOGNIZE *RECTANGULAR PRISMS*	Identify or name rectangular prisms.
RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES	Identify or name shapes with specified attributes.
RECOGNIZE *SQUARE*	When presented a set of different shapes, select the square.
RECOGNIZE THE DEFINING ATTRIBUTES OF A SHAPE	When presented with a shape, correctly communicate its defining attributes.
RECOGNIZE THE NON-DEFINING ATTRIBUTES OF A SHAPE	When presented a shape, correctly communicate its non-defining attributes.
RECOGNIZE *TRIANGLE*	When presented a set of different shapes, select the triangle.
REPRESENT SHAPES GIVEN ATTRIBUTE VALUES	Through drawing or an appropriate assistive technology, create shapes with given specific attribute values such as number of congruent sides.
REPRESENT SHAPES GIVEN DEFINING ATTRIBUTES	Through writing or an appropriate assistive technology, represent shapes when given defining attributes such as number of sides.

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RECOGNIZING AND CREATING SHAPES

TEACHER NOTES

This unit includes the following documents:

- Learning Map Information
- Instructional Activity (three lessons)
- Instructional Activity Student Handout (for Lessons 1 – 3)
- Instructional Activity Supplement (for Lessons 1 – 3)
- Student Activity
- Student Activity Solution Guide

In this unit, students will learn to recognize, draw, and describe shapes such as squares, rectangles, triangles, quadrilaterals, pentagons, and hexagons based on their attributes.

RESEARCH

In second grade the expectation for students is that they are able to recognize and draw shapes when given specific attributes. In order to do this, students need to develop spatial sense, which is developed through consistent, meaningful experiences with shapes and spatial relationships (Van de Walle, Lovin, Karp, Bay-Williams, 2014). Strong spatial sense provides a solid foundation for geometric reasoning and developing geometric thought. Because students have many ideas about common shapes, it is important to be familiar with the van Hiele levels of geometric thought in order to determine where students are in their thinking and help move them forward in their understanding. Ideally students in second grade should be working toward understanding in the second level of geometric thought. The following table outlines Levels 0 through 2 of van Hiele's theory of geometric thought, as well as an additional level, *Pre-Recognition*, added by Clements and Battista (1992; Van de Walle, et al., 2014).

Level	*Description*	*Example*
Pre-Recognition	Thought focuses on specific visible or tactile objects. Students can often distinguish between circles and squares, but not between squares, rectangles, and triangles.	"This is a triangle because it has a point."
Level 0 Visualization	Thought focuses on shapes and what the shapes look like.	"This is a triangle because it looks like a triangle."
	Students start to recognize how shapes are alike and different.	"I will put these shapes together in a group because they are all 'skinny' (or 'long' or 'pointy')."

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Level 1 Analysis	Thought focuses on classes of shapes as opposed to individual shapes. Students become familiar with properties of individual shapes.	"All squares have four sides of equal length and four right angles." "This is a triangle because all triangles are closed figures with three sides."
Level 2 Informal Deduction	Thought focuses on expanding understanding of properties among different shapes. Students begin to consider relationships among different properties of shapes.	"If it has four sides, and there are two sets of parallel sides, it must be a parallelogram. If it is a square, it must have four sides and two sets of parallel sides. If it is a square, it must be a parallelogram."

It is important to be aware that these levels are not age dependent, but they are sequential (Van de Walle, et al., 2014). For example, a second-grade student may be operating at Level 1 while another second-grade student may be operating at the pre-recognition level, and in order for either student to move forward in their geometric understanding, they must do so one level at a time. Furthermore, a student must begin at Level 0 and progress through each level in order to move through the levels of geometric thought (Van de Walle, et al., 2014).

Because engaging in meaningful experiences is integral to increasing student understanding, it is significant to recognize that many activities can be modified to span two levels of geometric understanding in order to teach students at their level of thought (Van de Walle, et al., 2014). For example, an activity targeted for students in Level 0 can be adapted and presented to students in Level 1. In addition, Clements and Sarma (2000) highlight the importance of expanding the range of how shapes are presented to students. After researching toy stores, teacher-supply stores, and catalogs for materials, Clements and Sarma (2000) found that "Most triangles are equilateral or isosceles triangles with horizontal bases. Most rectangles are horizontal or vertical between two and three times as long as wide. Most squares have horizontal bases" (p. 485). Students should have experiences comparing examples and non-examples of shapes in addition to interacting with shapes in a variety of sizes and orientations, materials, and colors to help students avoid common misconceptions involving prototypical shapes (Clements & Sarma, 2000; Hourigan & Leavy, 2015; Van de Walle, et al., 2014). The following example displays prototypical shapes that should be limited as well as a variety of sizes and orientations that could be encouraged.

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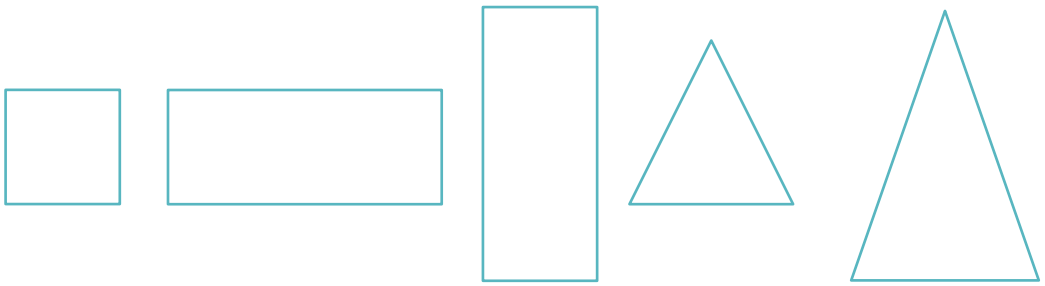
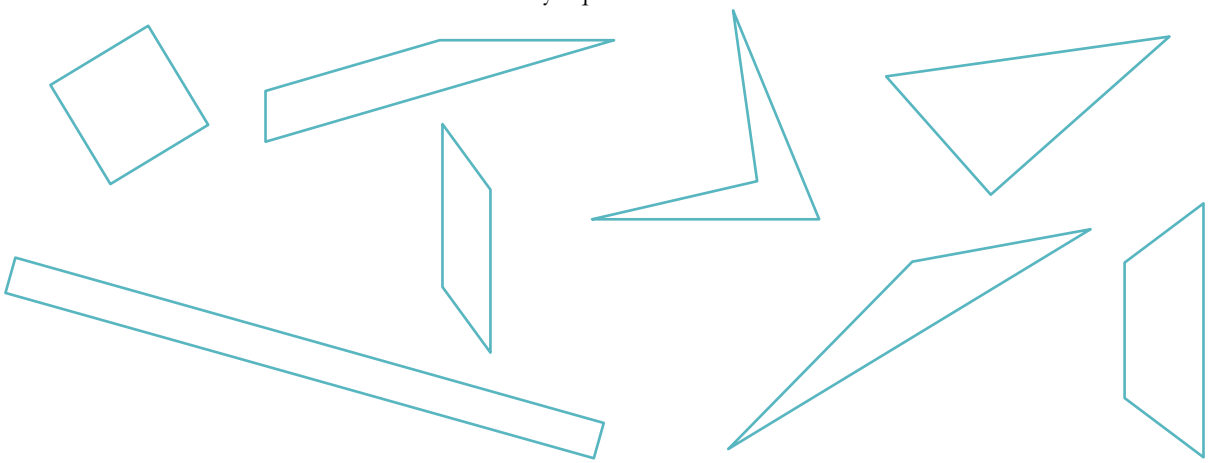
AN EXAMPLE

Prototypical shapes that should be limited (Clements & Sarma, 2000; Van de Walle, et al., 2014):



Expand students' experiences to include shapes in a variety of sizes and orientations. In addition, students should experience quadrilaterals other than squares and rectangles, as well as triangles that are not only equilateral or scalene.



In addition to experiences with example and non-examples as well as a wide variety of shape sizes and orientations, students should be encouraged to discuss different shapes and the shape's attributes (Van de Walle, et al., 2014). While students may not need to know the vocabulary of geometric terms such as "right angle" or "90-degree angle", students can still describe attributes with descriptions like "corner angles", and students should be encouraged to describe and compare the attributes of different shapes both orally and through writing. Van de Walle and colleagues (2014) also state that students should be challenged with a variety of geometric tasks that include concrete materials, drawings, and even computer models.

LEARNING MAP INFORMATION

The learning map section for this sequence of activities reflects that students will proceed through three levels of geometric thinking, beginning with the pre-recognition level and Level 0 with recognizing shapes such as squares, rectangles, circles, and triangles. Then students proceed to Level 1 with nodes such as, DESCRIBE THE

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ATTRIBUTES OF SHAPES, RECOGNIZE THE DEFINING ATTRIBUTES OF A SHAPE, REPRESENT SHAPES GIVEN DEFINING ATTRIBUTES, and COMPARE AND CONTRAST THE PROPERTIES OF 2 OR MORE SHAPES.

INSTRUCTIONAL ACTIVITIES

The activities in this unit are designed to move students through the beginning levels of geometric thinking by engaging students with hands-on, concrete experiences, drawing and analyzing images of shapes, and writing to describe attributes, similarities, and differences of shapes. In the first lesson, students will explore artwork or their surroundings in a shape hunt (Hourigan & Leavy, 2015; Van de Walle, et al., 2014). In the second lesson, students will analyze examples and non-examples of shapes as well as identify matching shapes using attributes to explain why the shapes match (Van de Walle, et al., 2014). In the final lesson, students will identify a "rule" for a specific set of shapes based on examples and non-examples; students will create shapes by drawing, manipulating concrete materials, and utilizing computer activities; and students will play a game similar to the card game Go Fish (Hourigan & Leavy, 2015; Van de Walle, 2014).

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REFERENCES

Clements, D., & Battista, M. (1992). Geometry and spatial reasoning. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning: A project of the National Coucnil of Teachers of Mathematics* (pp. 420-464). New York, NY: Macmillan Publishing Co., Inc.

Clements, D., & Sarma, J. (2000). Young children's ideas about geometric shapes. *Teaching children mathematics 6*(8), 482-488.

Hourigan, M., & Leavy, A. (2015). What's a real 2D shape?: Designing appropriate geometric instruction. *Australian primary mathematics classroom, 20*(1), 24-29.

Van de Walle, J., Lovin, L., Karp, K., Bay-Williams, J. (2014). *Teaching student-centered mathematics: Developmentally appropriate instruction for grades Pre-K-2* (2nd ed.). Upper Saddle River, NJ: Pearson Education Inc.

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RECOGNIZING AND CREATING SHAPES

OVERVIEW OF INSTRUCTIONAL ACTIVITIES

Lesson	Learning Goal	Nodes Addressed
Lesson 1	Students will identify, name, and describe the attributes of circles, triangles, quadrilaterals, pentagons, and hexagons. In addition, students will focus on the attributes and non-attributes of shapes.	▶ RECOGNIZE *RECTANGLE* ▶ RECOGNIZE *SQUARE* ▶ RECOGNIZE *CIRCLE* ▶ RECOGNIZE *TRIANGLE* ▶ RECOGNIZE *HEXAGONS* ▶ RECOGNIZE *PENTAGON* ▶ DESCRIBE THE ATTRIBUTES OF SHAPES ▶ RECOGNIZE THE NON-DEFINING ATTRIBUTES OF A SHAPE
Lesson 2	Students will identify examples and non-examples of circles, triangles, quadrilaterals, pentagons, and hexagons. In addition, students will focus on the attributes and non-attributes of shapes.	▶ DESCRIBE THE ATTRIBUTES OF SHAPES ▶ RECOGNIZE THE NON-DEFINING ATTRIBUTES OF A SHAPE ▶ RECOGNIZE THE DEFINING ATTRIBUTES OF A SHAPE ▶ RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES ▶ ANALYZE SHAPES TO IDENTIFY COMMON ATTRIBUTES
Lesson 3	Students will create and draw circles, triangles, quadrilaterals, pentagons, and hexagons when given shape names as well as when given attributes.	▶ ANALYZE SHAPES TO IDENTIFY COMMON ATTRIBUTES ▶ COMPARE AND CONTRAST THE PROPERTIES OF 2 OR MORE SHAPES ▶ REPRESENT SHAPES GIVEN DEFINING ATTRIBUTES ▶ REPRESENT SHAPES GIVEN ATTRIBUTE VALUES ▶ DESCRIBE THE ATTRIBUTES OF SHAPES ▶ RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES

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RECOGNIZING AND CREATING SHAPES

INSTRUCTIONAL ACTIVITY

Lesson 1

LEARNING GOAL

Students will identify, name, and describe the attributes of circles, triangles, quadrilaterals, pentagons, and hexagons. In addition, students will focus on the attributes and non-attributes of shapes.

PRIMARY ACTIVITY

Students will search for targeted shapes in artwork and their surroundings.

OTHER VOCABULARY

Students will need to know the meaning of the following terms:

- Circle
- Triangle
- Quadrilateral
- Rectangle
- Square
- Pentagon
- Hexagon
- Attributes
- Non-attributes

MATERIALS

- INSTRUCTIONAL ACTIVITY STUDENT HANDOUT
- INSTRUCTIONAL ACTIVITY SUPPLEMENT or at least three images or representations of each shape.
- Images of artwork that contain each shape (optional)
- Tablets or dry erase boards and markers – optional (Recommend one tablet for every two students or one dry erase board for each student.)

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IMPLEMENTATION

Before implementing the lesson, **prepare** or **gather** at least three examples of each shape. **Ensure** that each set of shapes contains shapes of different colors and sizes and that shapes are shown in different orientations.

- Circle
- Triangle – Be sure to include triangles other than equilateral, such as right, obtuse, isosceles, and scalene.
- Quadrilateral – Be sure to include rectangles, squares, and irregular quadrilaterals.
- Pentagon – Be sure to include both regular and irregular pentagons.
- Hexagon – Be sure to include both regular and irregular hexagons.

The INSTRUCTIONAL ACTIVITY SUPPLEMENT contains images of shapes if needed.

Begin the lesson by showing students the shapes one shape set at a time. For example, show students all the circles together.

> **Display** the shapes and **ask** students to share—either with the whole group or with a partner—what they notice about the shapes. After students share, **tell** students the shape name and **explicitly** point out the attributes of each shape. Bring student attention to the non-attributes such as size, orientation, and color.
>
> **Require** students to find shapes with images/artwork or by finding them in the classroom/school by
>
> - showing images on a projector or interactive white board. Use images of the school or a website with artwork such as Museum of Modern Art's Kids page: https://www.moma.org/audio/playlist/2#tour-stop-342
>   - Distribute dry-erase boards and markers or pencil and paper.
>   - Require students to write or draw each shape they see in an image.
>   - Discuss the shapes in each image before moving to the next image. Require students to share the attributes of the shape they found.
> - requiring students to find shapes throughout the classroom or even the school and playground.
>   - Distribute tablets or paper and pencil to students in groups of two.
>   - Provide students with a designated amount of time to find shapes in the classroom or designated area.
>   - Students should draw or take a picture of shapes they find in the designated space.
>   - At the end of the designated time, discuss the shapes students found. Require students to share their shapes either to the whole class or with another partner group.

Use the following guiding questions to elicit student understanding.

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GUIDING QUESTIONS

Elicit student thinking:

- What shapes do you see?

Determine if the student can RECOGNIZE (RECTANGLE, SQUARE, CIRCLE, TRIANGLE, HEXAGONS, PENTAGON):

- [Point to a shape the student recorded.] What shape is this?
- Do you see any (name of shape) in this (image/space)? If so, where?

Determine if the student can DESCRIBE THE ATTRIBUTES OF SHAPES:

- [Point to a shape the student recorded.] How do you know this is a (name of shape)?
- What does a (name of shape) look like?

Determine if the student can RECOGNIZE THE NON-DEFINING ATTRIBUTES OF A SHAPE:

- [Point to a shape the student recorded.] Would this be the same shape if it was a different color? Why or why not?
- [Show the same shape in two different sizes.] Are these the same shape? How do you know?
- [Show the same shape in two different colors.] Are these the same shape? How do you know?
- [Show the same shape in two different orientations.] Are these the same shape? How do you know?

Distribute the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT.

Require students to complete independently or with a partner.

Use the following guiding questions to elicit student understanding.

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GUIDING QUESTIONS

Elicit student thinking:

- [Point to a question.] What do you notice about all of these shapes?

Determine if the student can RECOGNIZE (RECTANGLE, SQUARE, CIRCLE, TRIANGLE, HEXAGONS, PENTAGON):

- [Point to a question.] What shapes did you color here?
- [Point to a question.] Show me all of the (name of shape) in this question?

Determine if the student can RECOGNIZE THE DEFINING ATTRIBUTES OF A SHAPE:

- [Point to a question.] How do you know these shapes are (name of shape)?
- What does a (name of shape) look like?
- [Point to a shape the student did not color in.] Why is this shape not a (name of shape)?

Determine if the student can RECOGNIZE THE NON-DEFINING ATTRIBUTES OF A SHAPE:

- [Point to a shape the student colored on a question.] Would this be the same shape if it were a different size? Why or why not?
- [Turn the student paper so a shape is a different orientation.] Is this the same shape as before? How do you know?

Review student answers by selecting two or three students to share which shapes they colored in and why.

Discuss why the uncolored shapes were not colored in. Be sure to highlight the attributes of the given shapes to identify why the shapes should not be colored in.

Collect the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT to review for student understanding.

At the end of the activity, teachers should display one shape from each of the shape sets used at the beginning of the lesson. Students should respond with the name of the shape.

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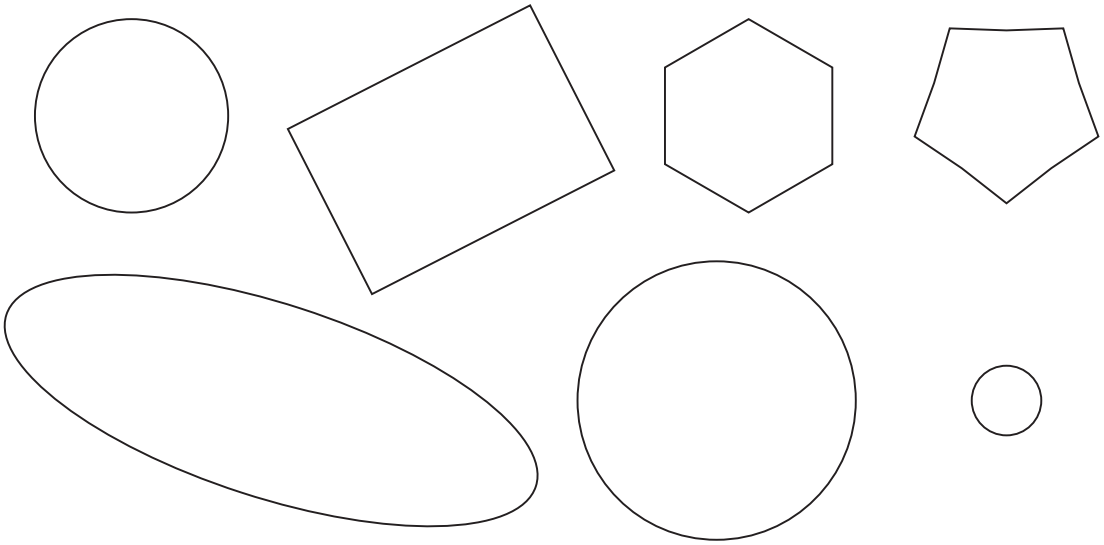
Name_____

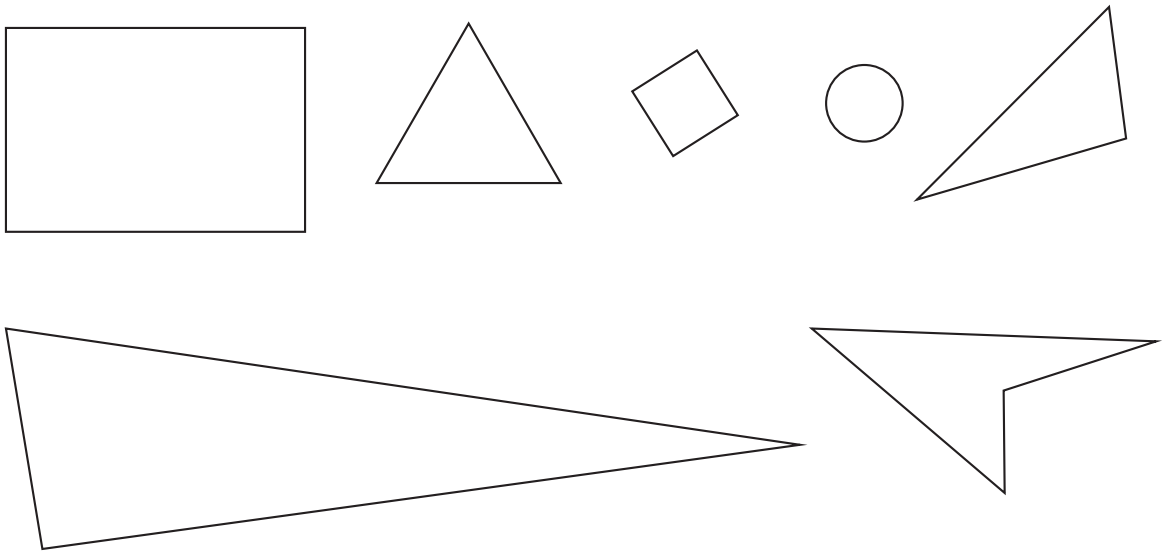
Recognizing and Creating Shapes

Lesson 1

1. Color in all the circles.



2. Color in all the triangles (shapes with 3 sides).



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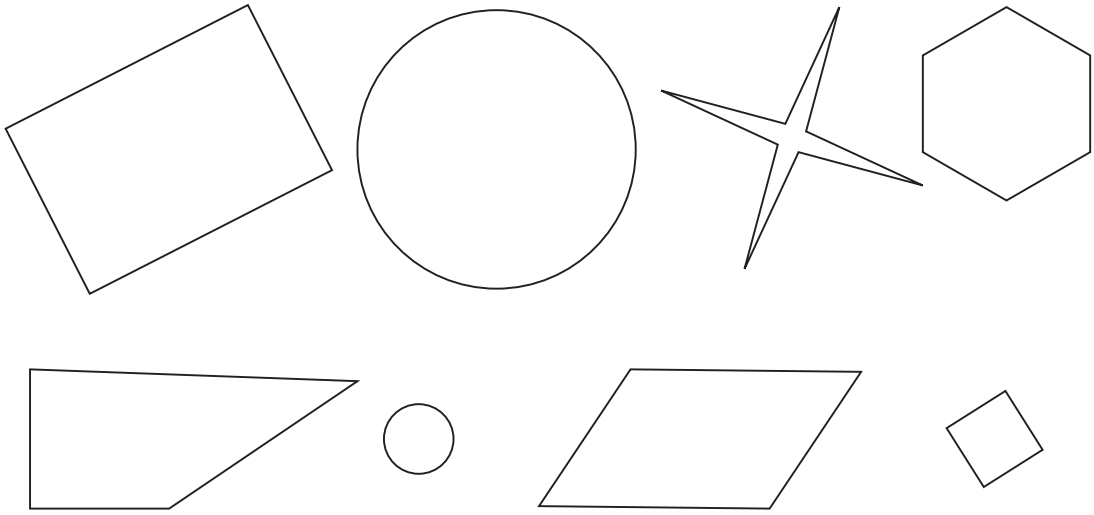
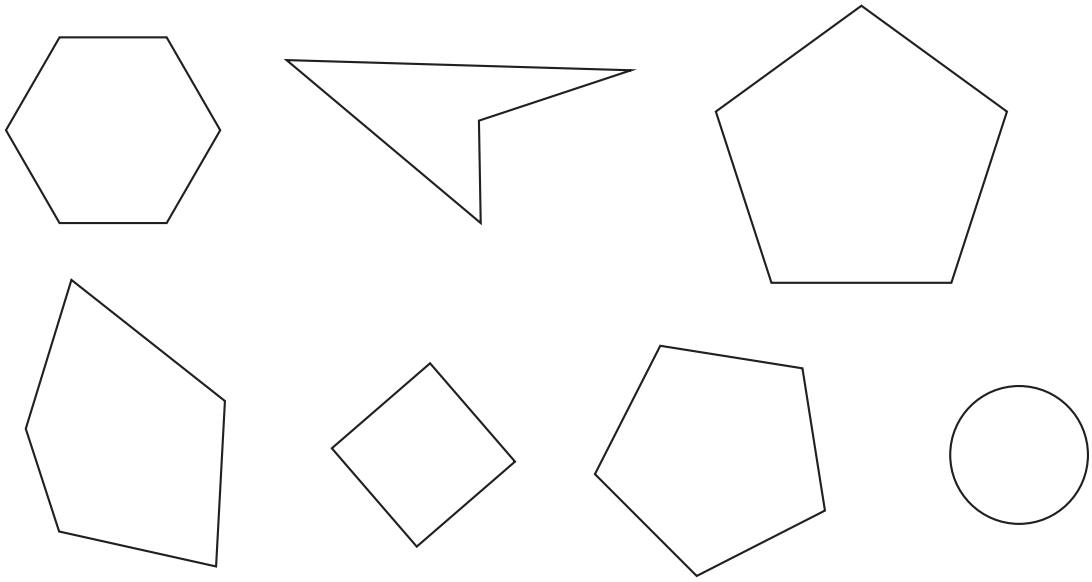
3. Color in all the quadrilaterals (shapes with 4 sides).



4. Color in all the pentagons (shapes with 5 sides).



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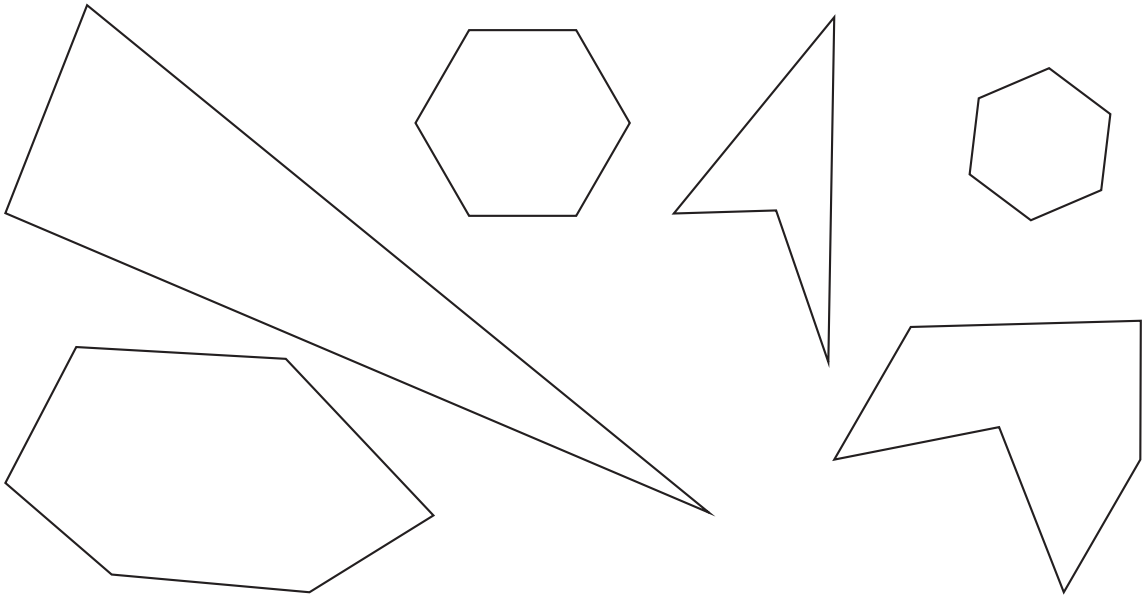
Name_____

5. Color in all the hexagons (shapes with 6 sides).



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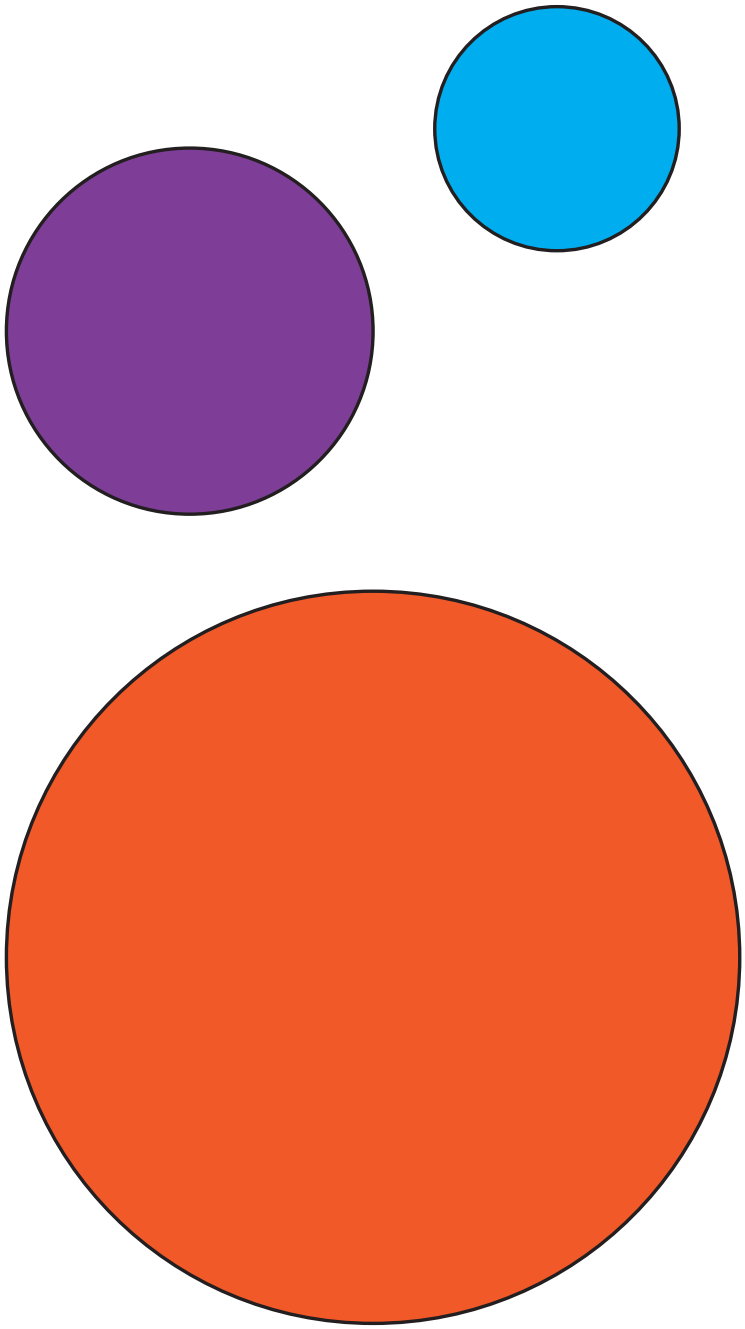
Circle



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Triangle

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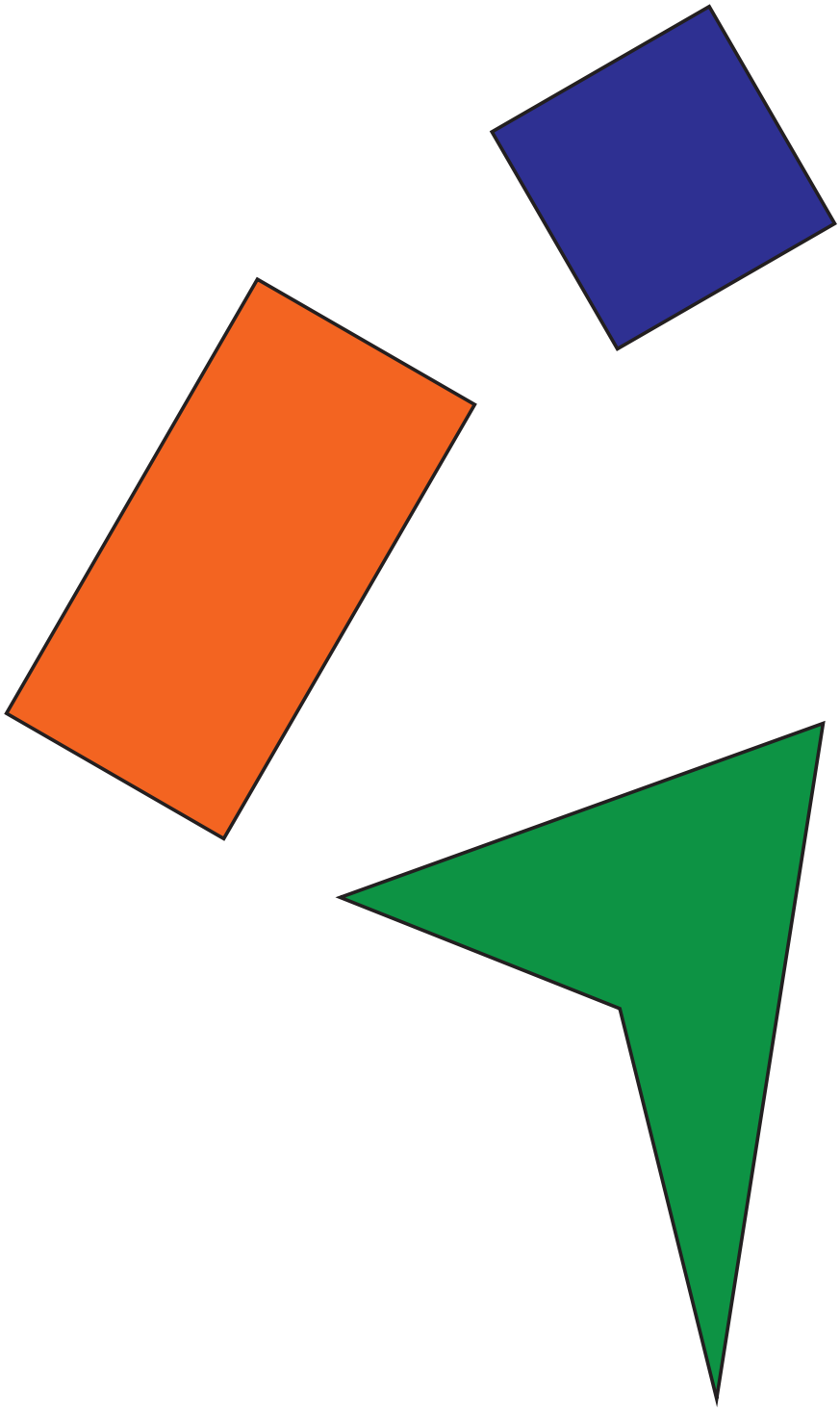
Quadrilateral



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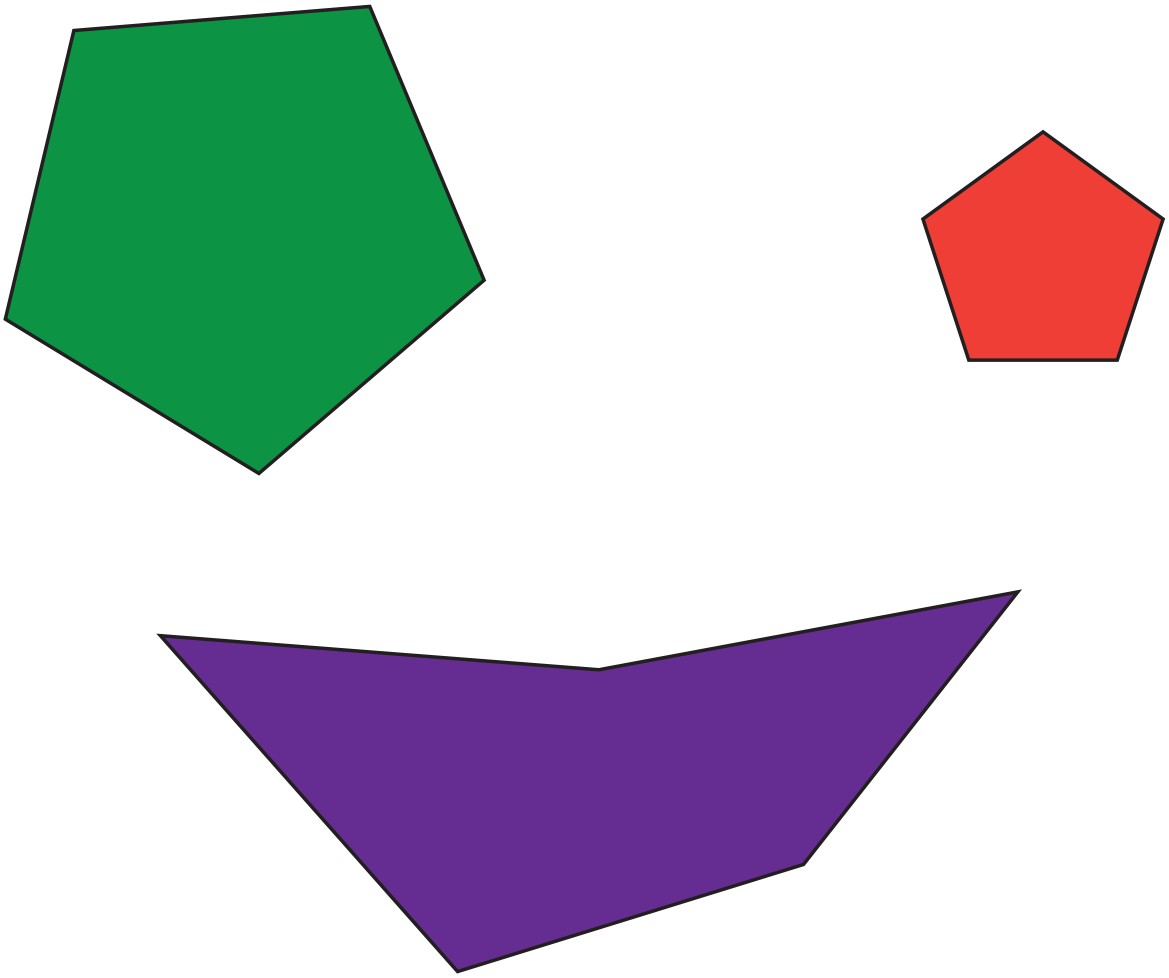
Pentagon



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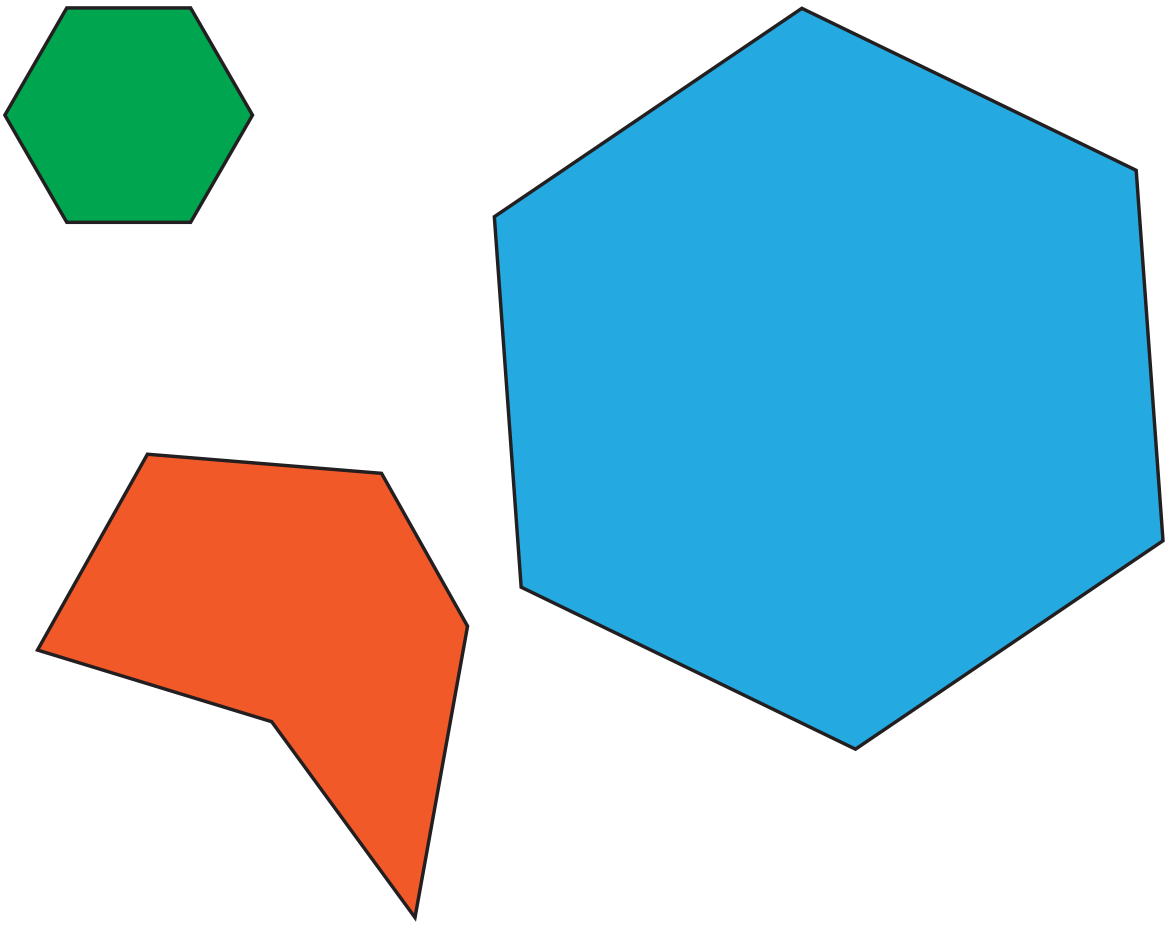
Hexagon



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RECOGNIZING AND CREATING SHAPES

INSTRUCTIONAL ACTIVITY

Lesson 2

LEARNING GOAL

Students will identify examples and non-examples of circles, triangles, quadrilaterals, pentagons, and hexagons. In addition, students will focus on the attributes and non-attributes of shapes.

PRIMARY ACTIVITY

Students will identify examples and non-examples of shapes and defend their response by stating the shape's attributes. Students will also play a game in which they will match shapes and use attributes to explain why the chosen shapes match.

OTHER VOCABULARY

Students will need to know the meaning of the following terms:

- Cube
- Circle
- Triangle
- Quadrilateral
- Rectangle
- Square
- Pentagon
- Hexagon
- Attributes
- Non-attributes
- Non-example
- Corner
- Side
- Face
- Edge

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MATERIALS

- INSTRUCTIONAL ACTIVITY STUDENT HANDOUT
- INSTRUCTIONAL ACTIVITY SUPPLEMENT (Recommend one copy of the Student Set for every one to two students.)
- A cube
- Base-ten ones cubes (Recommend one cube for every student.)

IMPLEMENTATION

Begin the lesson by distributing one Student Set of the INSTRUCTIONAL ACTIVITY SUPPLEMENT to each student or every two students.

> **Display** one card from the Teacher Set of the INSTRUCTIONAL ACTIVITY SUPPLEMENT.
>
> **Direct** students to hold up or display the card from their set with a shape that matches the displayed shape.
>
> **Select** one or two students or pairs to share why their chosen card/shape matches the displayed shape. **Encourage** students to use the attributes as opposed to just the shape name. **Ask** students if non-attributes (e.g., color, size, or orientation) helped them determine what shape matched the displayed shape.

Use the following guiding questions to elicit student understanding.

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GUIDING QUESTIONS

Elicit student thinking:

- [Referencing the displayed shape] What do you notice about this shape?
- Have you seen a shape like this before?

Determine if the student can DESCRIBE THE ATTRIBUTES OF SHAPES:

- [Referencing the displayed shape] How do you know this is a (name of shape)?
- What does a (name of shape) look like?

Determine if the student can RECOGNIZE THE NON-DEFINING ATTRIBUTES OF A SHAPE:

- Does it matter if your shape is a different color than the displayed shape? Why or why not?
- Does it matter if your shape is a different size than the displayed shape? Why or why not?
- Does it matter if your shape is turned in a different way than the displayed shape? Why or why not?

Require students to put their shape cards to the side (they will need them later in the lesson).

Hold up the shape cards or draw a shape somewhere all students can easily see it. **Discuss** the following attributes of shapes with the shape cards.

- Right angles – students do not need to know this term but the idea; teachers can talk about how it looks like the corner of a page or a square corner
- Curved lines
- Number of sides/angles (corners)
- Side length

Explain that shapes must be closed. **Draw** or show non-examples of shapes next to examples of shapes. Point out that the shapes are closed: all the sides meet one other side at an angle (corner).

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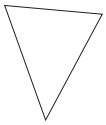
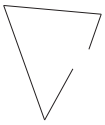
Example



Non-example



Non-example

Distribute the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT.

Explain that students should circle or color in the example of the shape. Then, students need to write why the shape they circled is the example and why the non-example is the non-example.

Use the following guiding questions to elicit student understanding.

GUIDING QUESTIONS

Elicit student thinking:

- [Point to a question.] What do you notice about these shapes?
- [Point to a question.] How are these two shapes the same?
- [Point to a question.] How are these two shapes different?

Determine if the student can DESCRIBE THE ATTRIBUTES OF SHAPES:

- [Point to a shape the student circled as the example.] How do you know this is the example of the (name of shape)?
- [Point to a shape the student did not circle, the non-example.] Why is this not the example? How is it different from the example?
- What are the attributes (or parts) of a (name of shape)?

Review student answers by asking students to show with their hands/fingers or a dry-erase board which image they thought was the example. **Select** one or two students to explain why the example is the example and why the non-example is the non-example.

Collect the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT to analyze for student understanding.

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Explain that shapes are defined by their attributes. **Provide** a couple examples by showing the shape and telling the students what the defining attributes are.

Defining Attributes – Square

- Closed
- Four sides
- All sides the same length
- Four square corners

Emphasize that some shapes share attributes. For example, a rectangle is also closed, has four sides, and four square corners.

Display a cube. **Ask** students what they notice about the figure. On poster paper, a dry-erase board, or an interactive white board that has been pre-divided into two columns, write the word "cube" at the top of the first column, and underneath it write what the students notice about the figure.

Display or **draw** a square. **Ask** students what they notice about the shape. On the same poster paper, dry-erase board, or interactive white board, write the word "square" at the top of the second column, and underneath it write what the students notice about the shape.

Lead a discussion comparing and contrasting the cube and square lists.

Distribute a single base-ten block or small cube to each student, and tell students to get their shape card with the square on it. **Tell** students to explore the cube and square by feeling each shape. **Explain** that the cube is three-dimensional, which means we can touch it and feel it, and then explain that the square is two-dimensional, which means we cannot touch it or feel it; the paper is what we are touching and feeling.

Refine the list of what students noticed about the cube to reflect the attributes of a cube. **Require** students to touch or point to each attribute for the cube.

Arrange students into groups of two or three. **Tell** students to retrieve one set of their shape cards. **Distribute** the Attribute Cards from the INSTRUCTIONAL ACTIVITY SUPPLEMENT.

Require the students to stack the Attribute Cards face down.

Tell students the directions for the activity.

- Choose one Attribute Card and read the attribute.
- Group all of the shapes (Shape Cards) that have that attribute.
- Repeat until there are no more Attribute Cards.

Use the following guiding questions to support student understanding.

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GUIDING QUESTIONS

Elicit student thinking:

- [Point to a shape card.] What do you notice about this shape?
- [Point to an attribute card.] Tell me about a time you have seen this attribute in a shape.

Determine if the student can RECOGNIZE THE DEFINING ATTRIBUTES OF A SHAPE:

- [Point to a shape card.] How do you know this shape has the attribute on the attribute card?
- [Point to a shape card.] What are the attributes of this shape? How do you know?

Determine if the student can RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES:

- What shapes have (an attribute)? How do you know?
- [Point to an attribute card.] What shapes have this attribute? How do you know?

Determine if the student can ANALYZE SHAPES TO IDENTIFY COMMON ATTRIBUTES:

- [Point to a group of shape cards]. How are these shapes the same? How do you know?
- [Point to a group of shape cards.] Is the attribute on the attribute card the only one these shapes have in common? How do you know?
- [Point to an attribute card.] What shapes have this attribute? How do you know?

Require each group to share one Attribute Card and the Shape Cards that match it. **Collect** all sets of Attribute and Shape cards.

At the end of the activity, teachers should display two or three attribute cards one at a time and ask students to share with a partner what shapes have that attribute.

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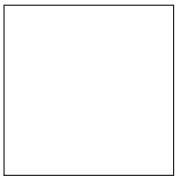
Name_____

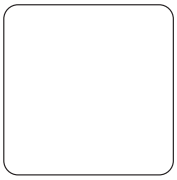
Recognizing and Creating Shapes

Lesson 2

Circle the **example**. Write why that shape is an example. Write why the other shape is not an example.

1. Square





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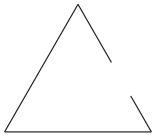
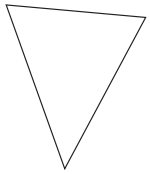
2. Triangle





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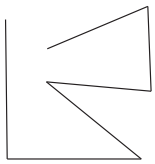
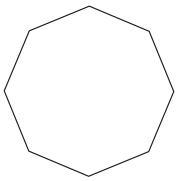
3. Hexagon (shape with 6 sides)





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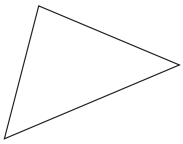
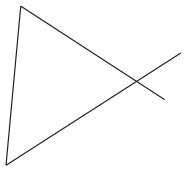
4. Triangle





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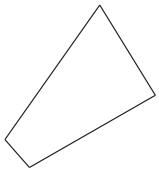
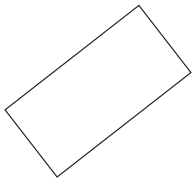
5. Rectangle





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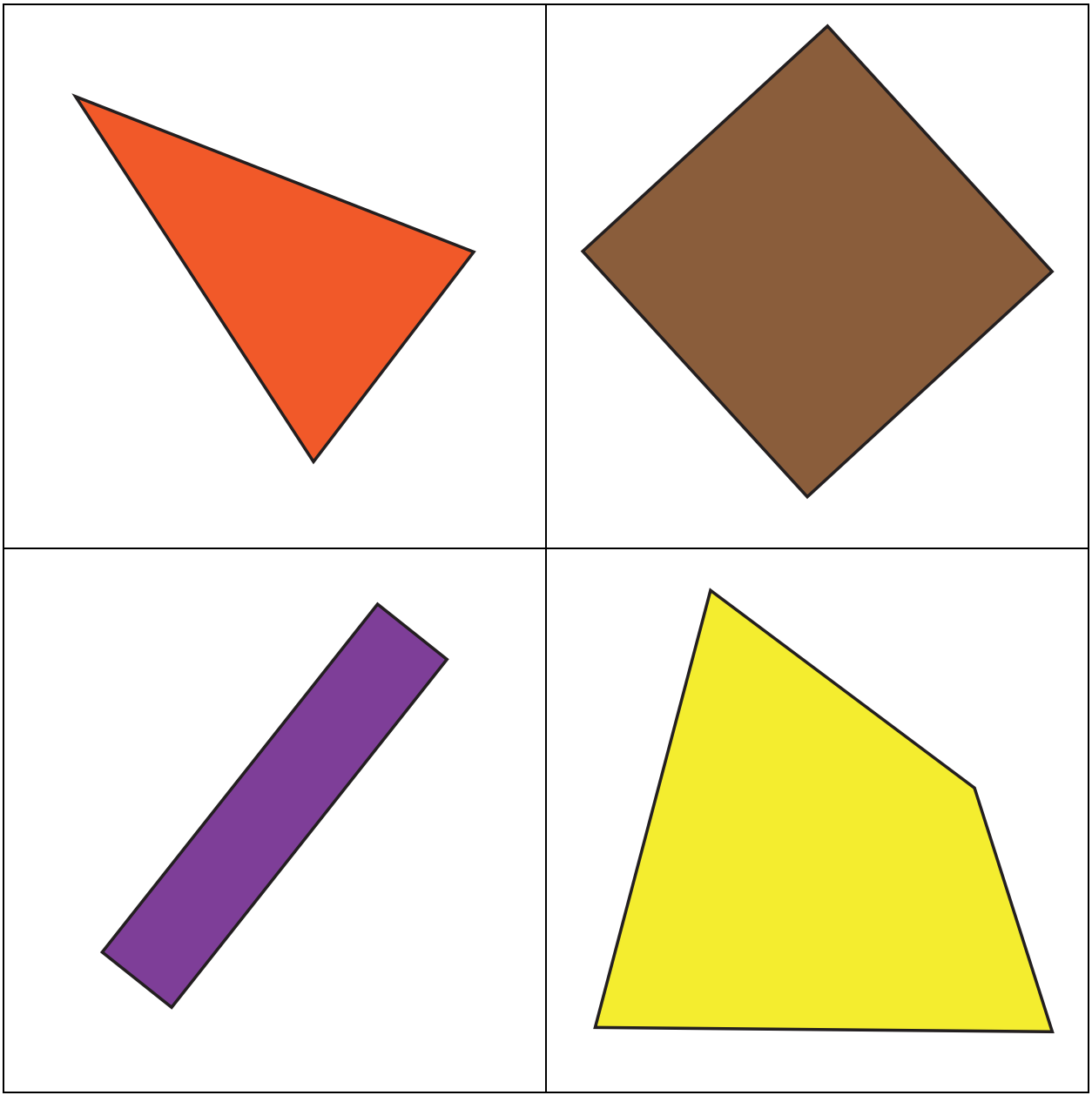
Teacher Shape Cards



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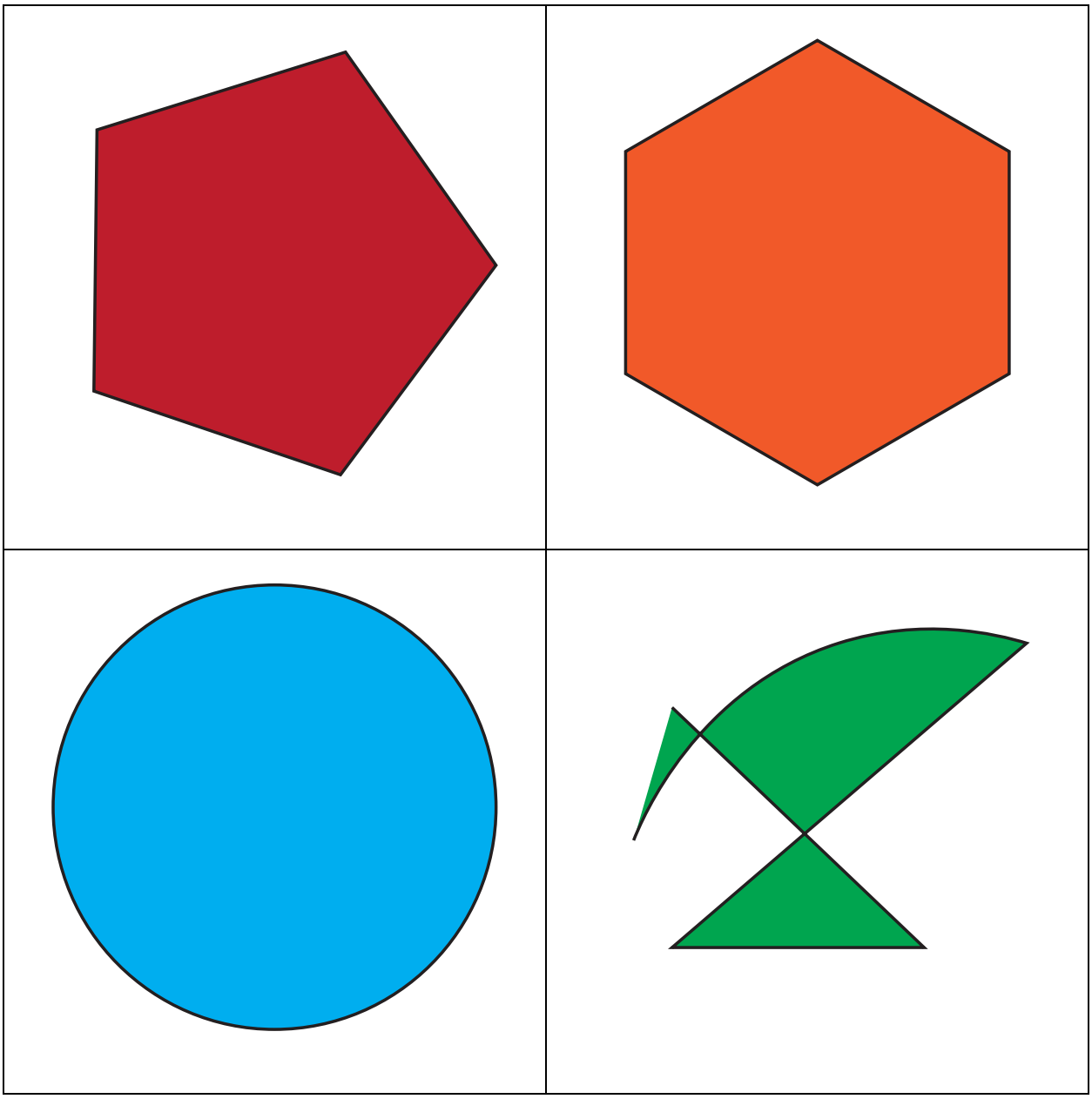

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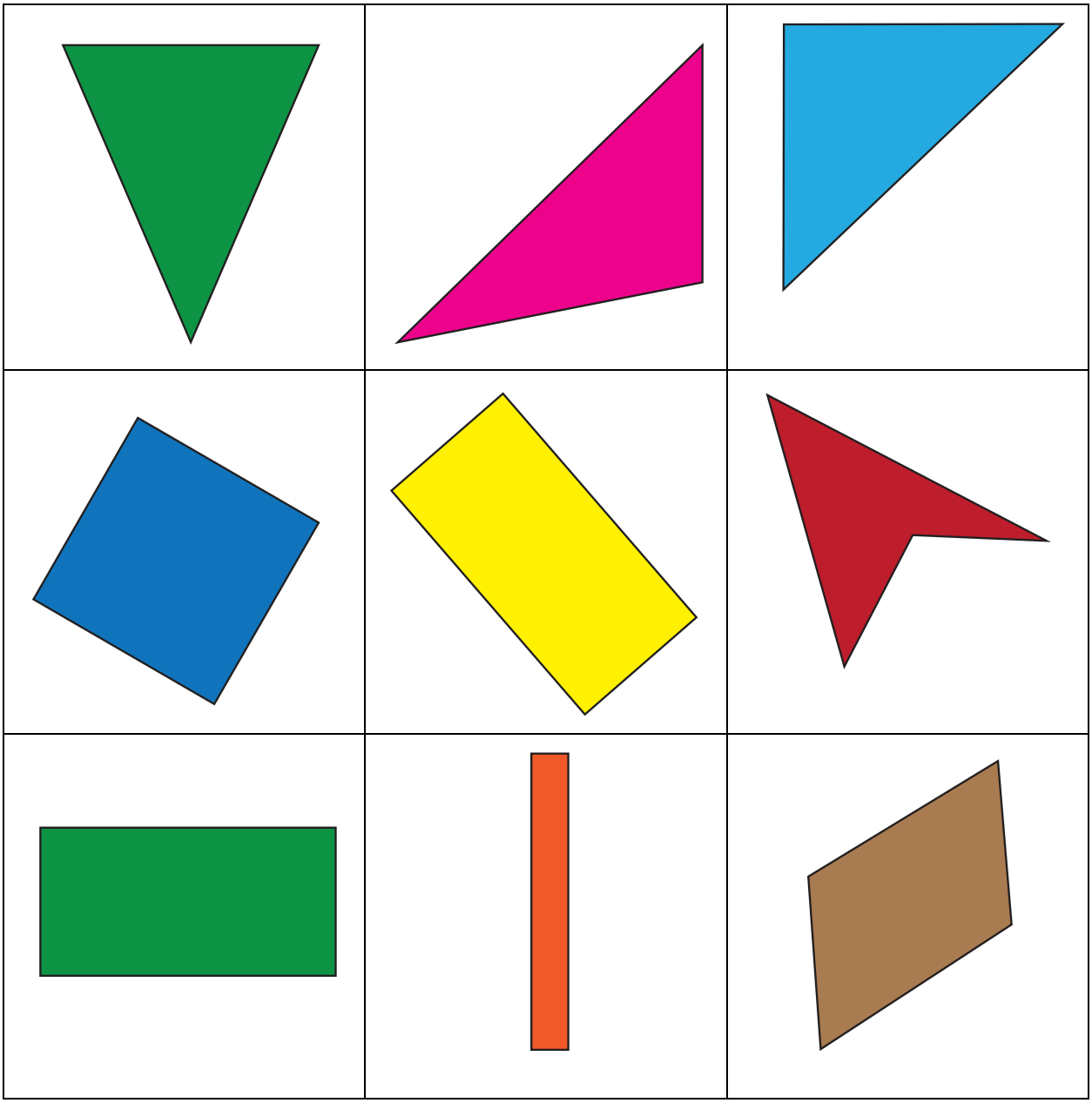
Student Shape Cards



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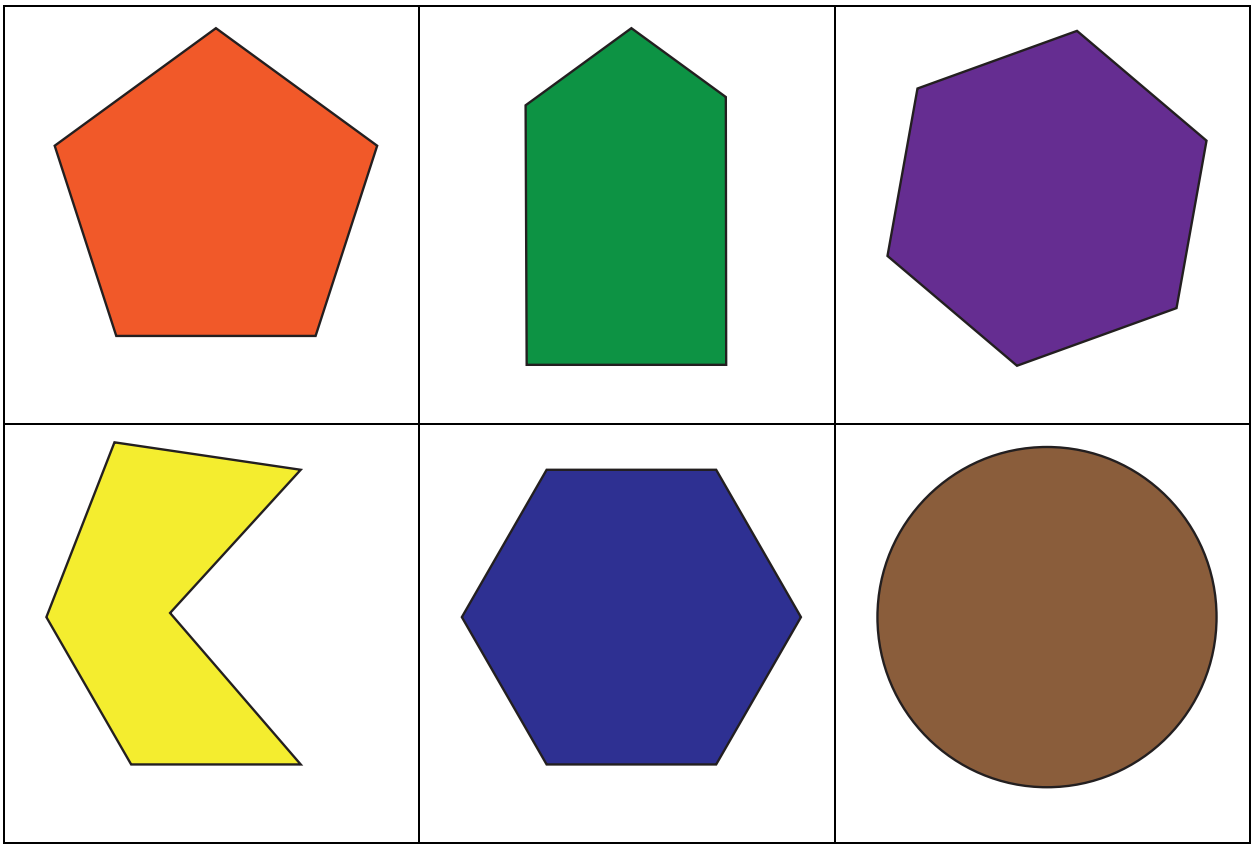

Attribute Cards

Curved sides

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3 sides
4 sides
5 sides
6 sides

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Square corners
All sides the same length
2 sides the same length
No sides the same length

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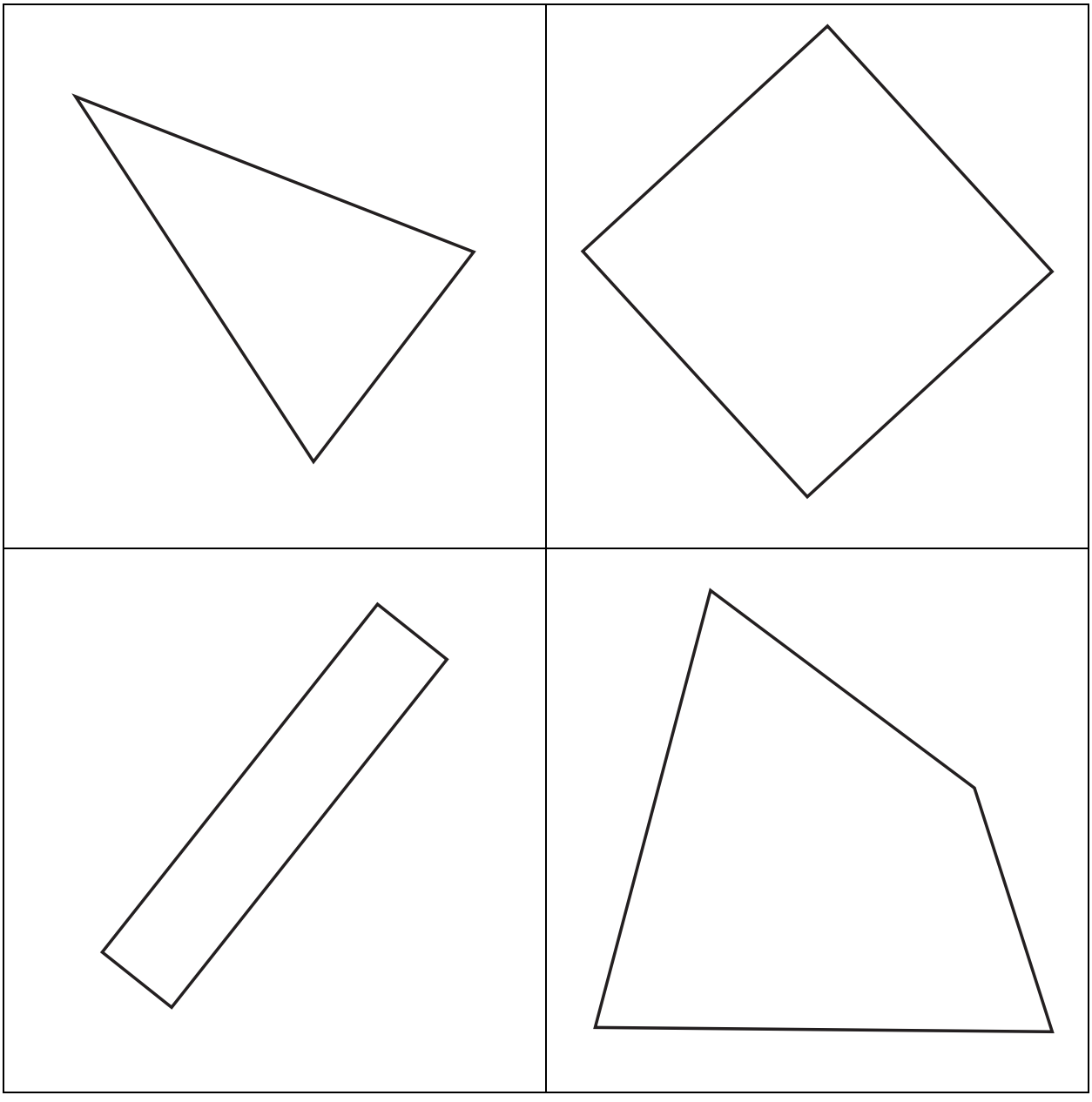
Teacher Shape Cards



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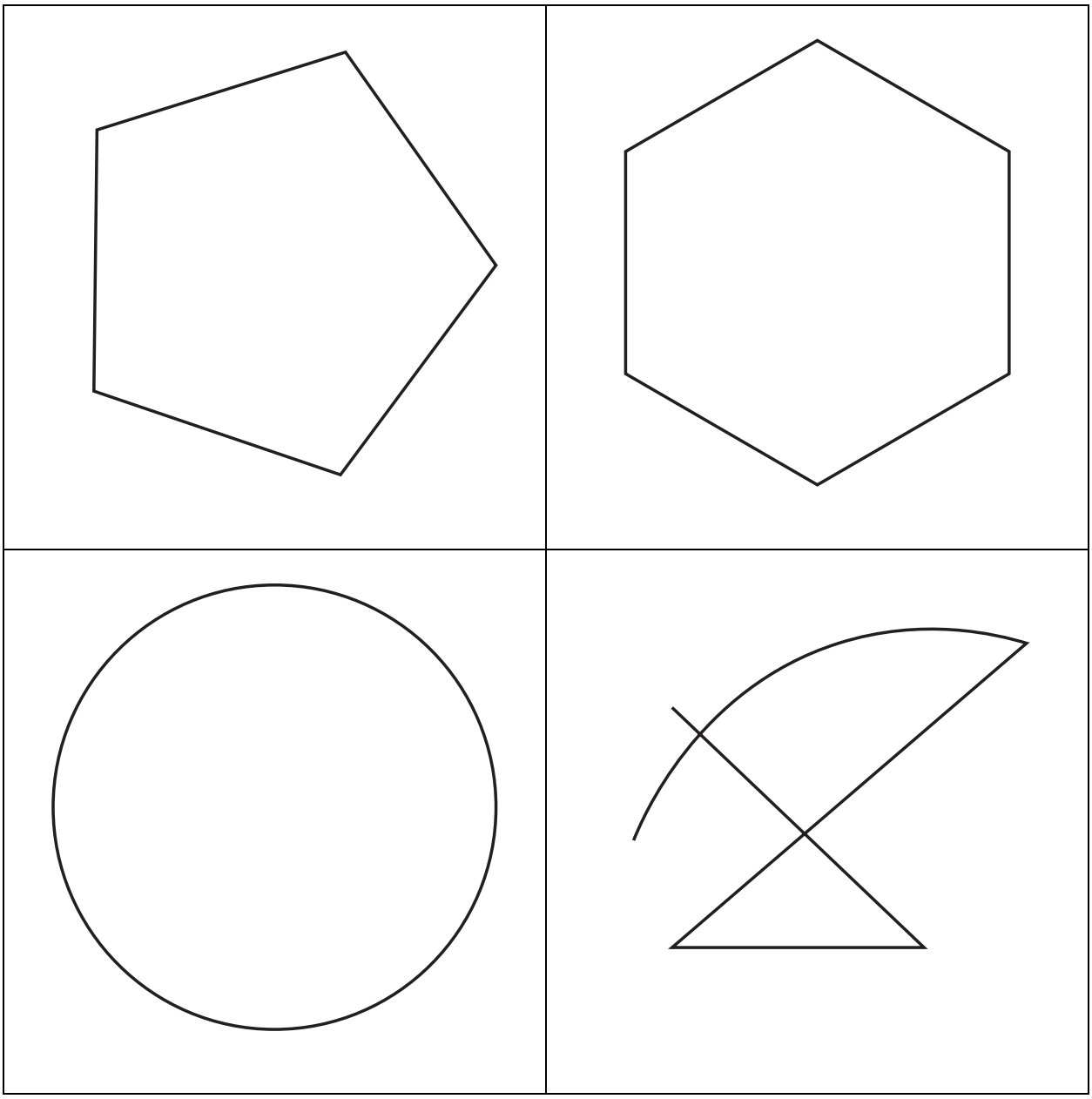

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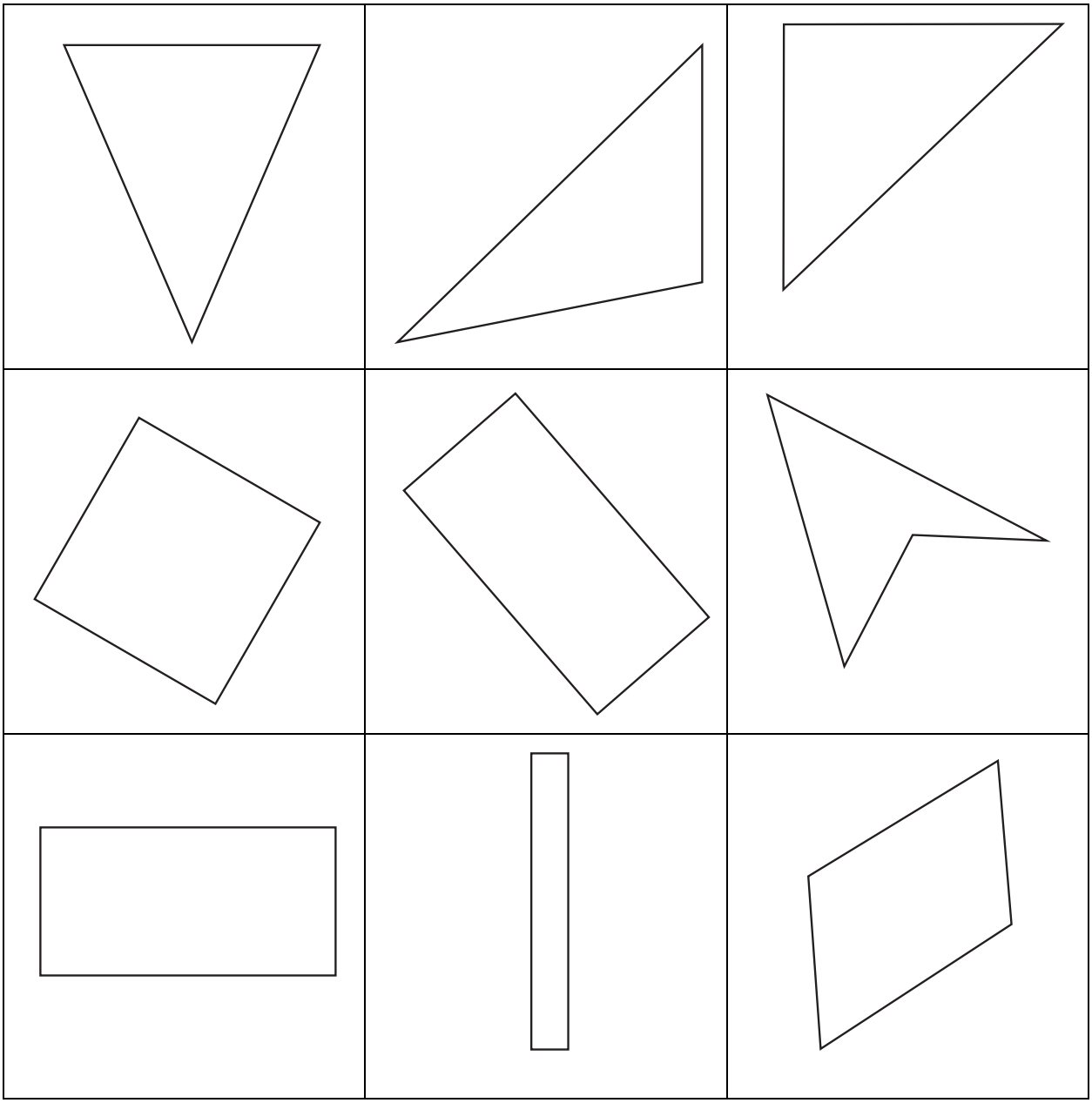
Student Shape Cards



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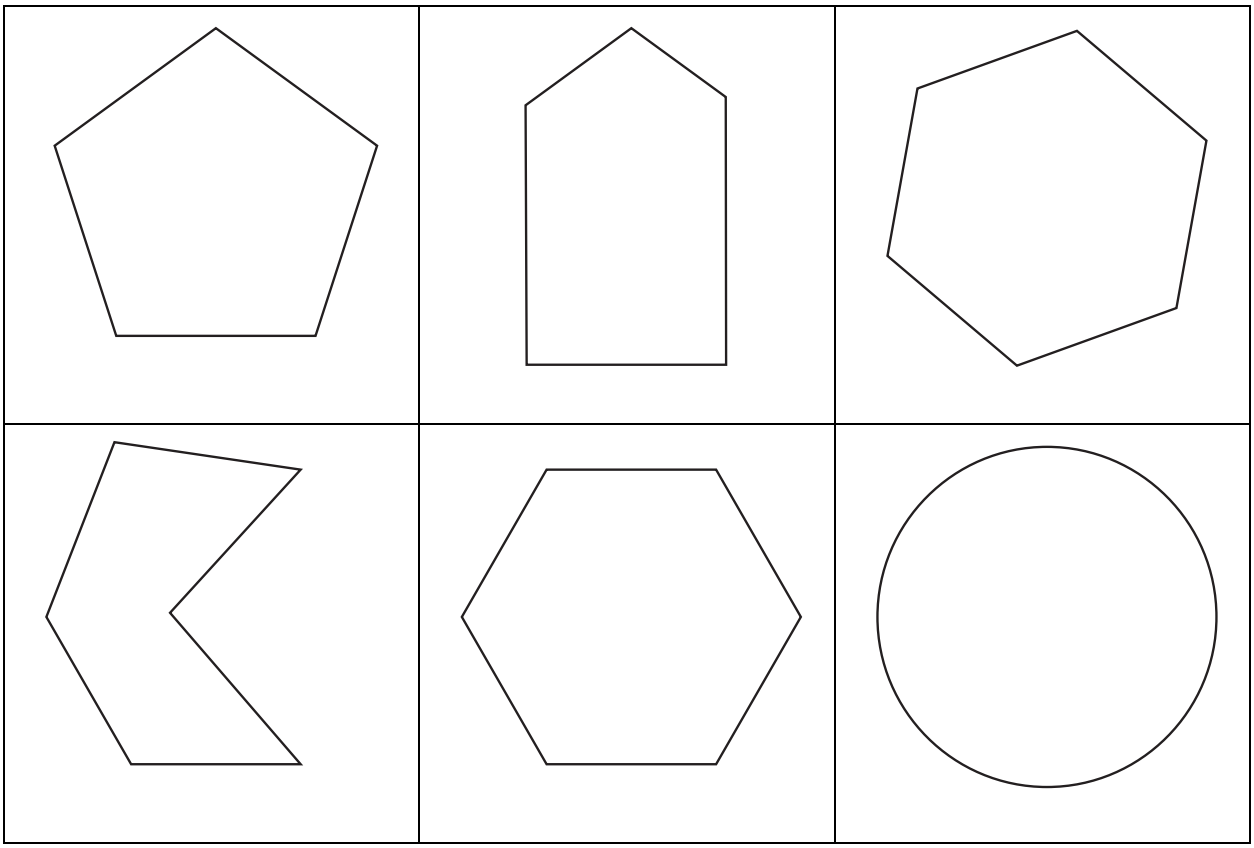

Attribute Cards

Curved sides

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3 sides
4 sides
5 sides
6 sides

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Square corners
All sides the same length
2 sides the same length
No sides the same length

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RECOGNIZING AND CREATING SHAPES

INSTRUCTIONAL ACTIVITY

Lesson 3

LEARNING GOAL

Students will create and draw circles, triangles, quadrilaterals, pentagons, and hexagons when given shape names as well as when given attributes.

PRIMARY ACTIVITY

Students begin by identifying shapes in a mystery set that have specific attributes based on a group of examples and non-examples. Then, students will create shapes using a variety of mediums such as drawing, geoboards, technology, and straight things (e.g., pretzel sticks, coffee stirs, or straws). Students will finish by playing a game of Guess My Shape, which is similar to the game Twenty Questions.

OTHER VOCABULARY

Students will need to know the meaning of the following terms:

- Cube
- Circle
- Triangle
- Quadrilateral
- Rectangle
- Square
- Pentagon
- Hexagon
- Attributes
- Non-attributes
- Corner
- Side
- Face
- Edge

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MATERIALS

- INSTRUCTIONAL ACTIVITY STUDENT HANDOUT
- INSTRUCTIONAL ACTIVITY SUPPLEMENT A
- INSTRUCTIONAL ACTIVITY SUPPLEMENT B (Recommend one set for every two students.)
- Technology: tablets or laptops (Recommend enough for a small group–about one-fourth of the class–to use during stations.)
- Sticks: popsicle sticks, coffee stirrers, or pretzel sticks, etc. (Recommend about 30 sticks, enough for a small group–about one-fourth of the class–to use during stations.)
- Geoboards and rubber bands (Recommend enough for a small group–about one-fourth of the class–to use during stations.)

IMPLEMENTATION

Begin the lesson by displaying the set of example shapes from page 1 of the INSTRUCTIONAL ACTIVITY SUPPLEMENT A.

Ask students what the shapes have in common (how they are the same). Students may share with the whole group or with a partner.

Display the set of non-example shapes on the INSTRUCTIONAL ACTIVITY SUPPLEMENT A so that the students can still see the example shapes.

Ask students how the non-example shapes are different from the example shapes. Students may share with the whole group or with a partner.

Display the mystery set of shapes on the INSTRUCTIONAL ACTIVITY SUPPLEMENT A so that students can still see the example and non-example sets.

Ask students which shapes they think belong with the example set and why. Students may share with the whole group or with a partner. (The shapes in the mystery set that should be identified are all of the rectangles.)

As students consider the examples, non-examples, and mystery set, use the following guiding questions to elicit student understanding.

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GUIDING QUESTIONS

Elicit student thinking:

- What do you notice about these shape?
- Have you seen a shape like this before?

Determine if the student can ANALYZE SHAPES TO IDENTIFY COMMON ATTRIBUTES:

- How are these shapes the same? How do you know?
- How are these shapes different? How do you know?

Determine if the student can COMPARE AND CONTRAST THE PROPERTIES OF 2 OR MORE SHAPES:

- [Point to the example set.] What attribute(s) do these shapes share? How do you know?
- [Point to a non-example.] How do you know this shape does not have the attribute(s) that the example shapes share?
- [In response to a student choice from the mystery set] How is that shape the same as the shapes in the example set?
- [In response to a student choice from the mystery set] How do you know that shape shares the same attribute(s) as the example set?

Repeat the process with pages 2 and 3 (if needed) of the INSTRUCTIONAL ACTIVITY SUPPLEMENT A. (The shapes on page 2 that should be identified are all of the hexagons. The shapes on page 3 that should be identified are all of the acute triangles.)

Review the following attributes and shapes by **requiring** students to draw them with their finger in the air, on the carpet, or on their desktop.

- Square corner (right angle)
- Shape with four sides
- Parallel lines or a shape with parallel sides
- Triangle
- Circle
- Shape with three angles
- Shape with five sides
- Square
- Shape with three points (vertices)
- Shape with six sides
- Rectangle

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Set up "stations" for students to rotate through drawing shapes in different methods. There are cards with station directions from stations 1 and 3 in the INSTRUCTIONAL ACTIVITY SUPPLEMENT A.

- Station 1: Use the Geoboard Cards from INSTRUCTIONAL ACTIVITY SUPPLEMENT A, geoboards, and rubber bands to have students create the shapes on the cards. If you do not have access to geoboards, there is an online interactive geoboard available at the University of Cambridge's NRICH website: https://nrich.maths.org/virtualgeoboard
- Station 2: Technology – Using a technology device available to your students, select one or more websites/programs to have students create shapes. The following websites/programs are examples:
  - Shape Tool on NCTM's Illuminations: https://illuminations.nctm.org/Activity.aspx?id=3587
  - Making Triangles or Making Rectangles on NCTM's Illuminations: https://illuminations.nctm.org/Lesson.aspx?id=4013 or https://illuminations.nctm.org/Lesson.aspx?id=3991
  - Kid Pix (15 day free trial): https://www.mackiev.com/kidpix/index.html
  - Doodle Dawg: Sketch, Draw, Color (App): https://www.getjar.com/categories/entertainment-apps/more/doodledawg-free-459520
  - Gocco Doodle (App): http://goccoplay.com/
- Station 3: Use materials like coffee stirrers, popsicle sticks, pretzel sticks, etc. to create shapes given on the Stick Cards from the INSTRUCTIONAL ACTIVITY SUPPLEMENT A.
- Station 4: Draw shapes with crayons, colored pencils, markers, or pencils on the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT.

As students work at the stations, use the following guiding questions to elicit student understanding.

GUIDING QUESTIONS

Elicit student thinking:

- What do you notice about this shape?
- When have you had to create shapes before?
- Tell me about another time that you drew shapes.
- Which shape is the easiest to create? Why?
- Which shape is the hardest to create? Why?

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Determine if the student can REPRESENT SHAPES GIVEN DEFINING ATTRIBUTES:

- [Point to a shape the student created.] How do you know this is an example of (attribute)?
- Show me a different example of a shape with (attribute).
- Show me a shape that has (attribute).

Determine if the student can REPRESENT SHAPES GIVEN ATTRIBUTE VALUES:

- [Point to a shape the student created.] How do you know this is an example of a shape with (number of sides/angles)?
- Show me a different example of a shape with (number of sides/angles).
- Show me a shape that has (number of sides/angles).

Lead a whole class discussion by asking students which station they liked the best and why, which attributes/shapes were most difficult to create, and which shapes/attributes were easiest to create. Students can share with a partner before sharing with the whole group.

Arrange students into groups of two and distribute one set of the "Guess My Shape" cards from the INSTRUCTIONAL ACTIVITY SUPPLEMENT B.

Tell students the directions for the game Guess My Shape, which is similar to the game Twenty Questions.

- One students selects a shape card and does not let the second student see the card. The second student takes a shape tracker. (The shape tracker in the INSTRUCTIONAL ACTIVITY SUPPLEMENT B can be printed multiple times and students use a fresh copy each time, or it can be printed and laminated or placed in a plastic sleeve for repeated use.)
- The second student asks the first student "yes" and "no" questions about their shape, focusing on using attributes.
- As the second student asks questions, they will mark off shapes on the shape tracker that do not have the attributes they asked the first player about.
- At any time, the second player can ask, "Is your shape a (name of shape)?"
- The two students keep playing until the second player finds the shape that matches the first player's card.
- Students switch roles and play again.

As the students play the game, use the following guiding questions to elicit and support student understanding.

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GUIDING QUESTIONS

Elicit student thinking:

- [Point to a card with a shape on it.] What do you notice about this shape?
- Have you played a game like this before? Explain.
- Do you think this game is (will be) easy or hard to play? Why?

Determine if the student can DESCRIBE THE ATTRIBUTES OF SHAPES:

- [Point to a shape on the shape tracker.] What attributes does this shape have that you could ask a "yes" or "no" question about?
- [Point to a shape on the shape tracker.] What could you ask about this shape?
- [Point to a shape on the shape tracker.] How would you describe this shape?
- Is color an attribute of a shape? Why or why not?
- Is size an attribute of a shape? Why or why not?
- [Point to a shape card.] Why did you say yes (or no) to that question?

Determine if the student can RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES:

- What shapes have (an attribute)? How do you know?
- [Point to a shape on the shape tracker.] What other shapes on the shape tracker have this attribute? How do you know?
- Did you mark off all of the shapes that have (or does not have) (an attribute)? How do you know?

Require each group to return the Guess My Shape game cards. **Collect** each Instructional Activity Student Handout and analyze to determine student understanding.

At the end of the activity, teachers should provide each student with a notecard with the name of a shape written on it. Each student should draw the shape on one side of the notecard and write *why* it is that shape on the other side of the notecard.

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Name_____

Recognizing and Creating Shapes

Lesson 3

1. Draw a triangle.

2. Draw a shape with four sides.

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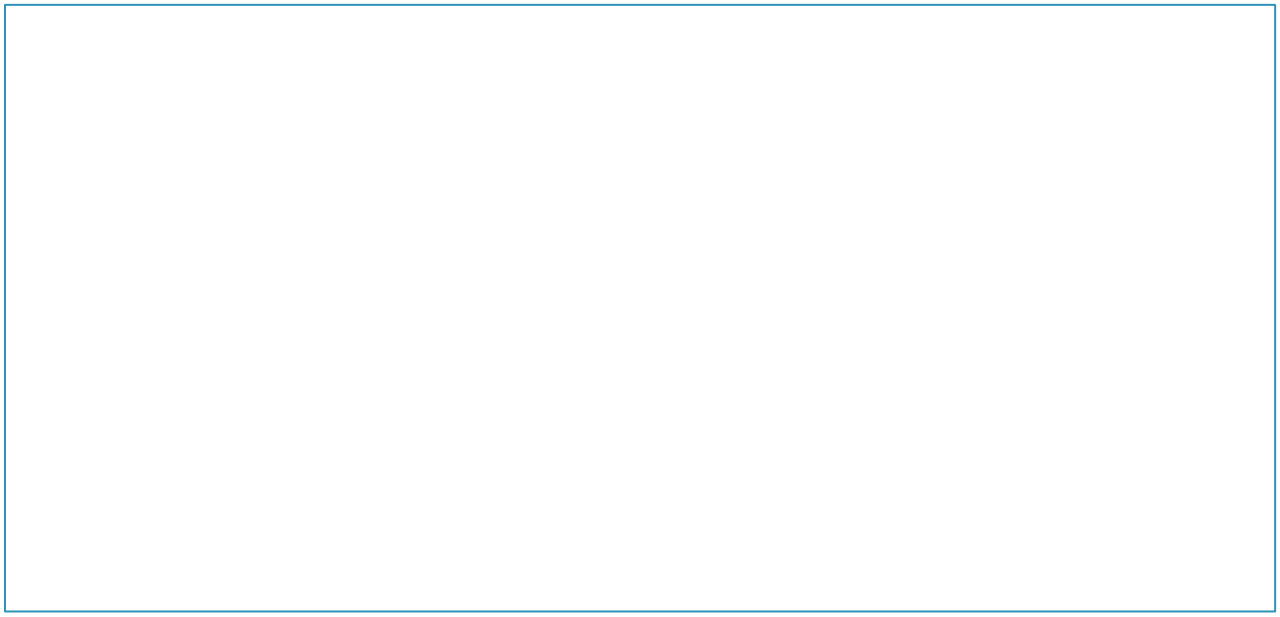
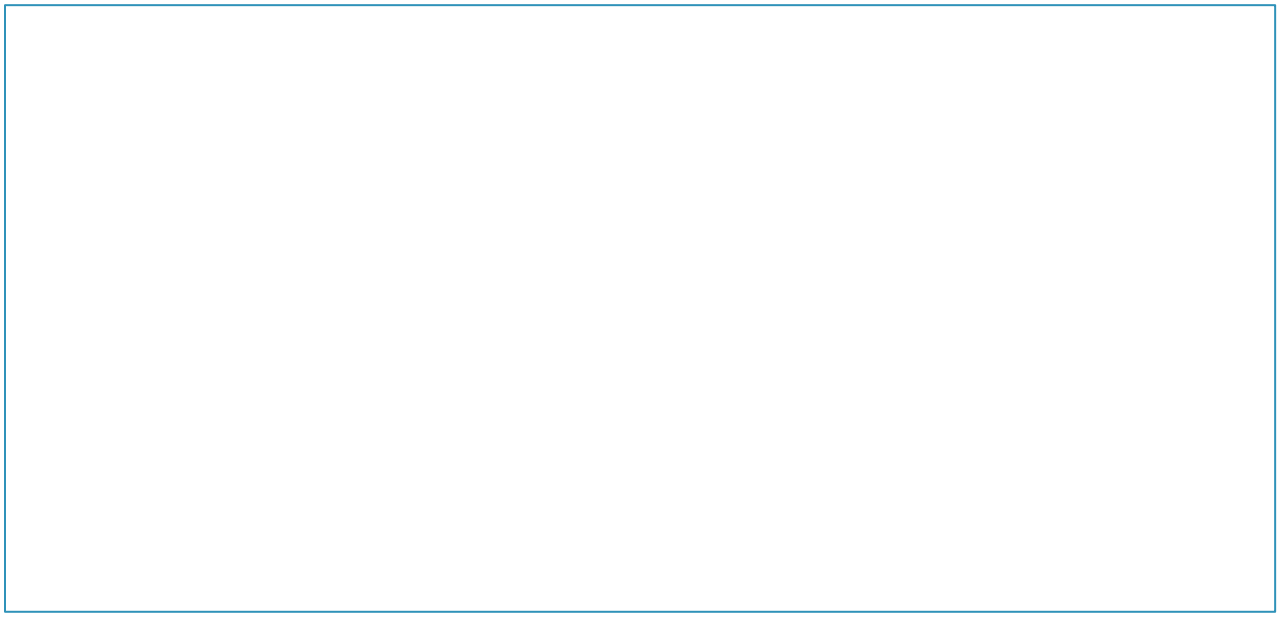
3. Draw a shape that has four sides and four corner angles.



What is the name of the shape you drew?

_____

4. Draw a shape that has five sides.



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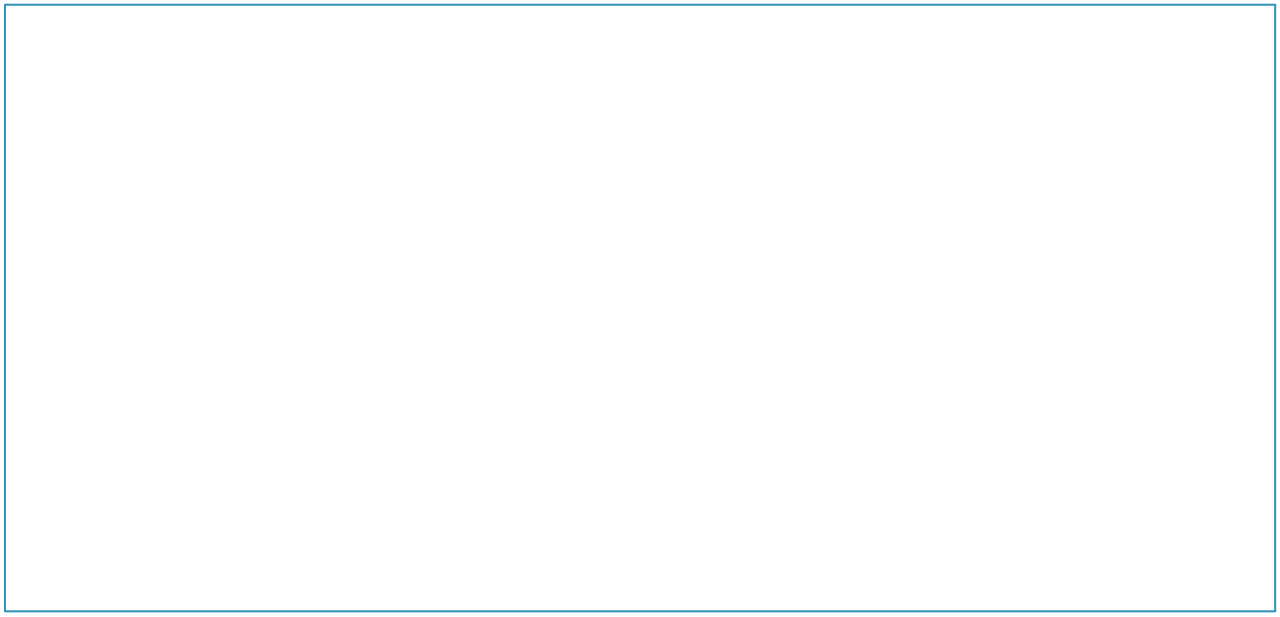
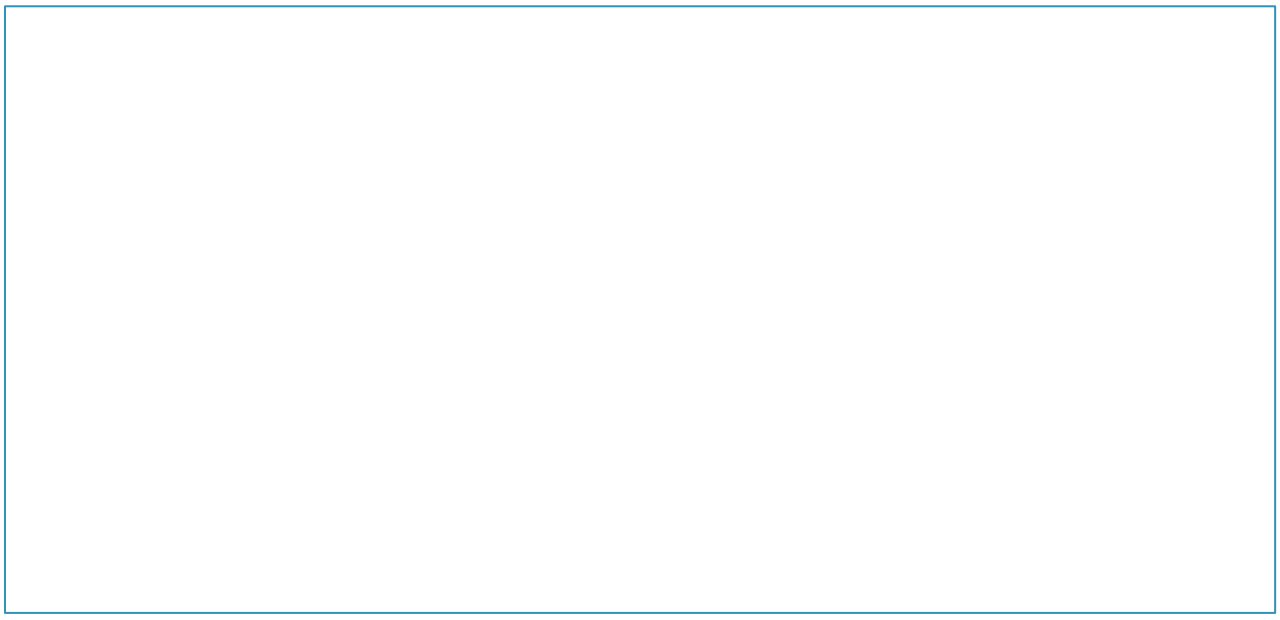
Name_____

5. Draw a shape that has six sides.



6. Draw a square.



How do you know this is a square?

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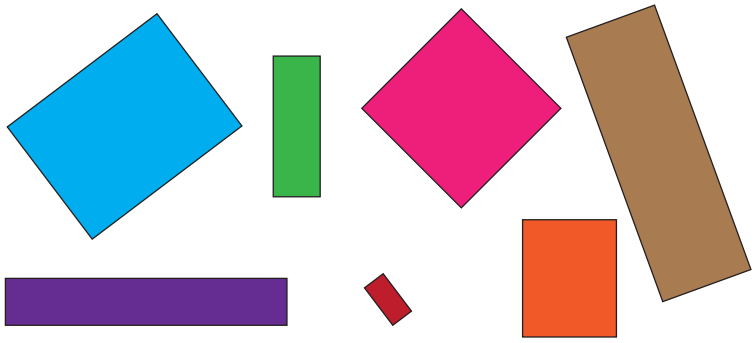
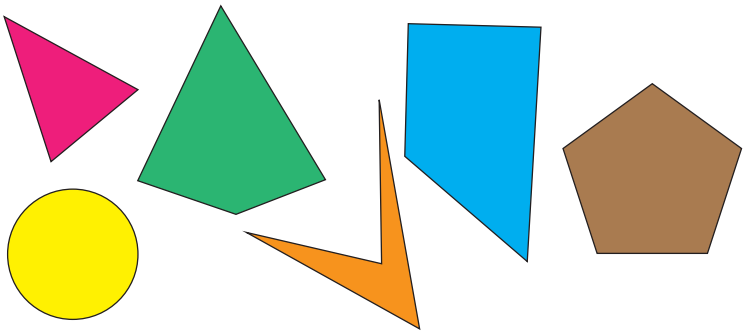
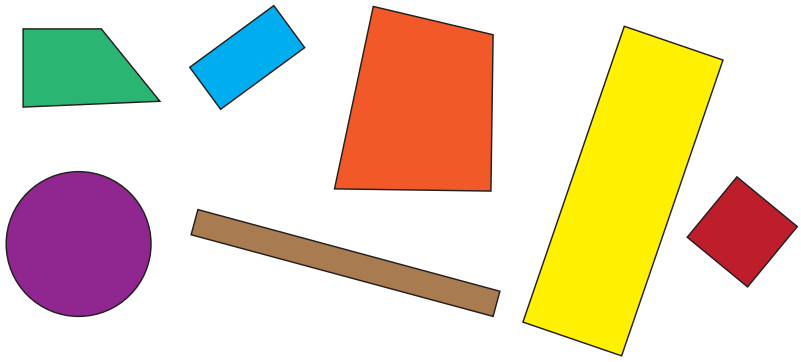
Example Set



Non-Example Set



Mystery Set



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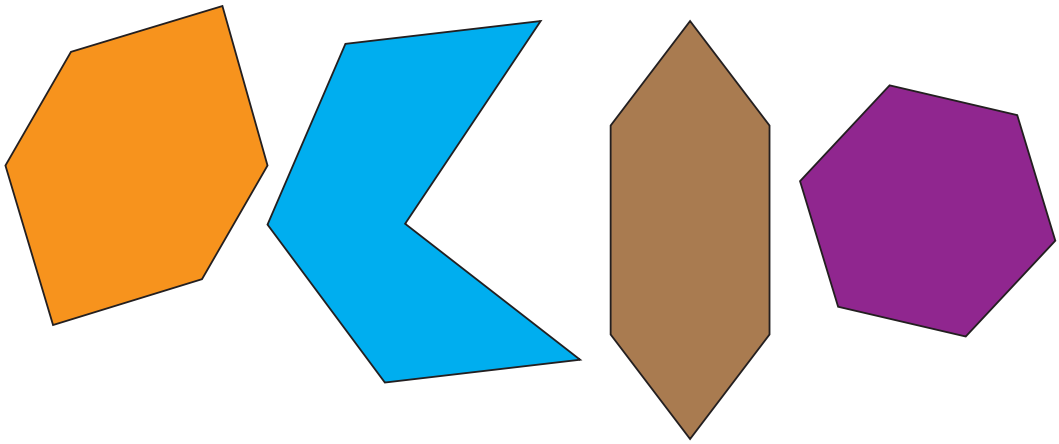
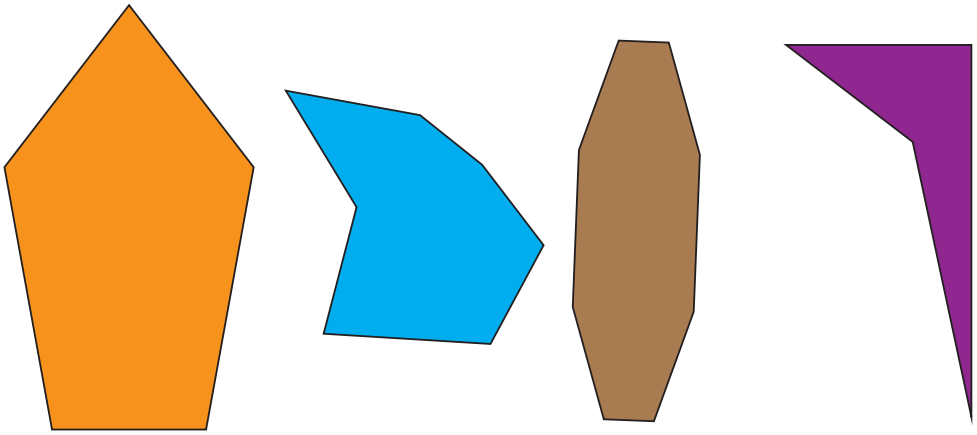
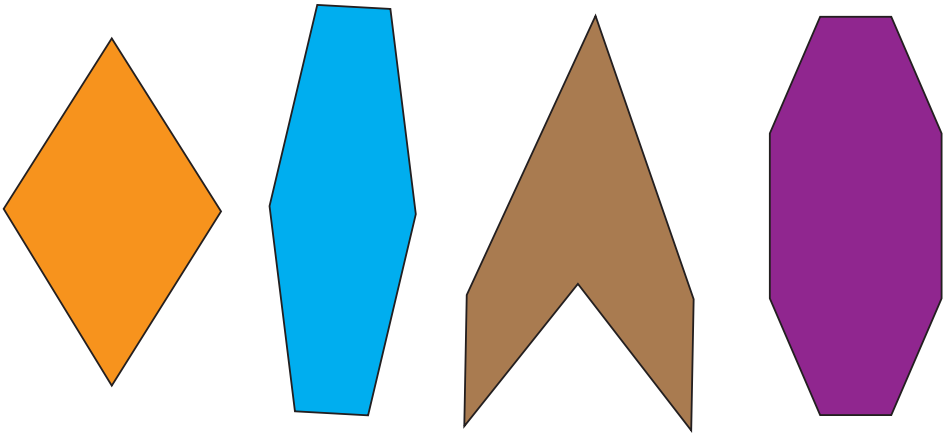
Example Set



Non-Example Set



Mystery Set



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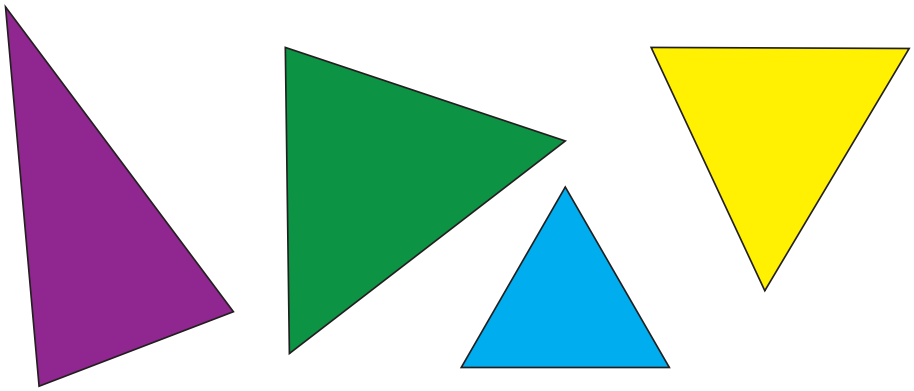
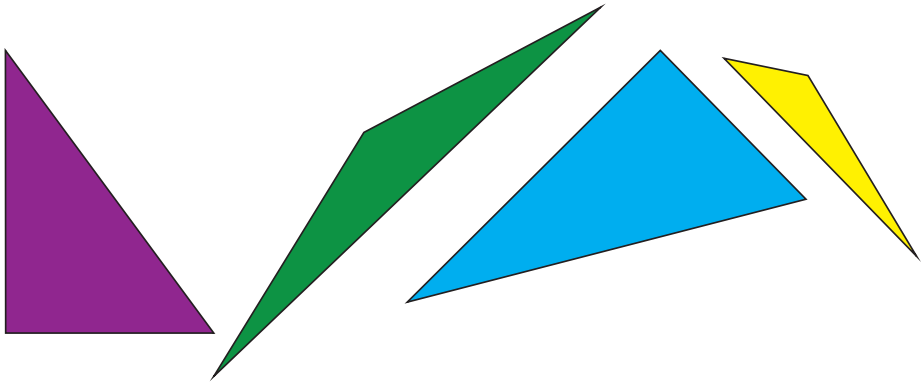
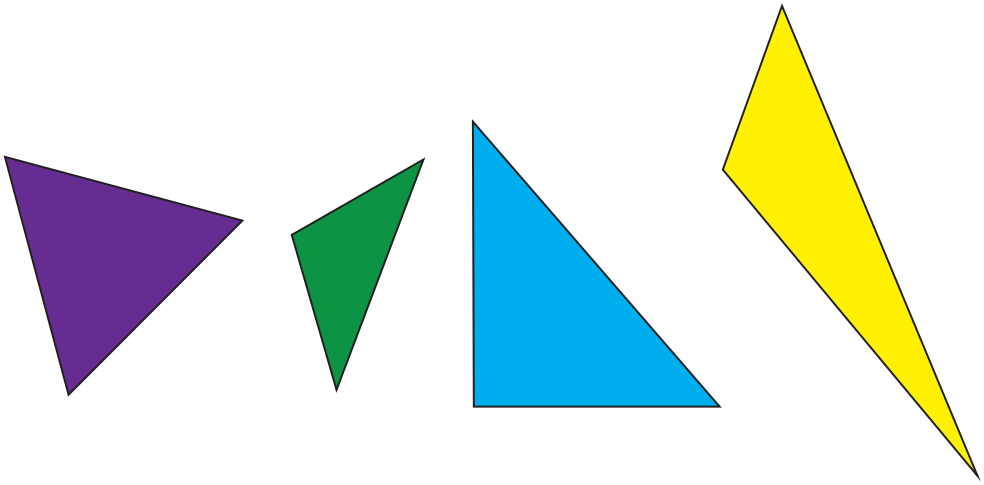
Example Set



Non-Example Set



Mystery Set



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STATION 1

Use the rubber bands and geoboard to make the shapes you see on the cards.

STATION 3

Use the sticks to make the shapes you see on the cards.

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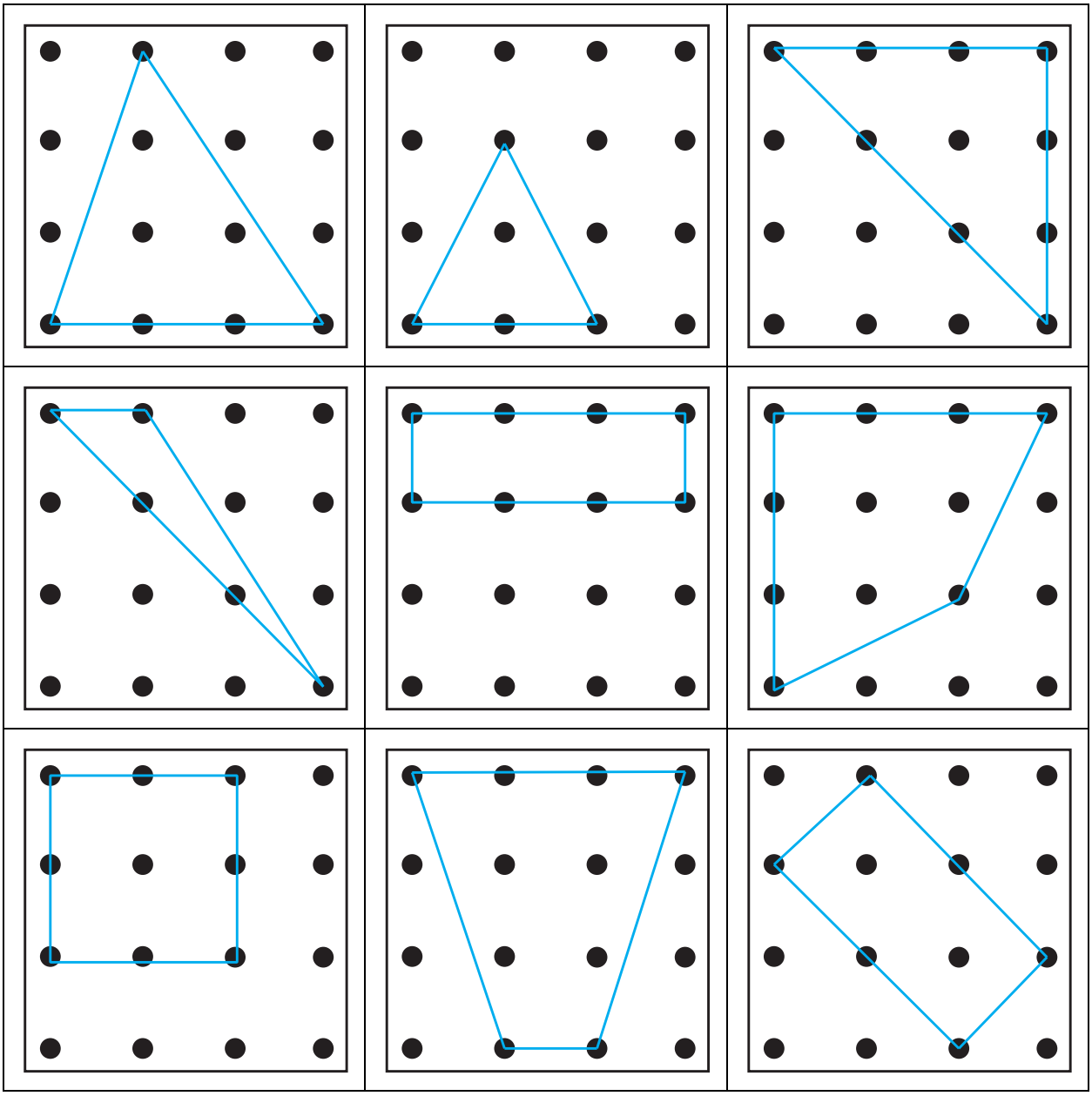
Geoboard Cards



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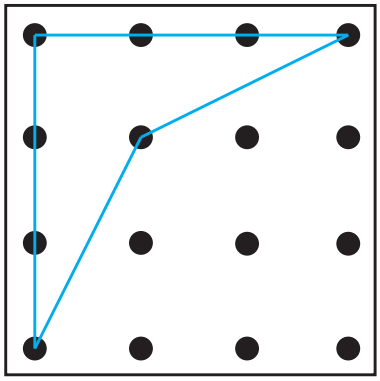	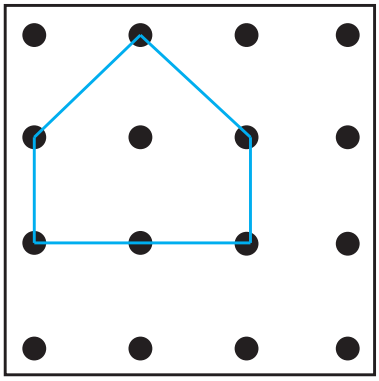	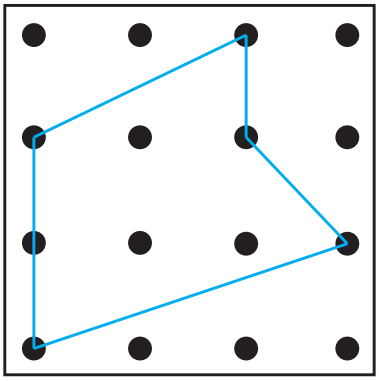
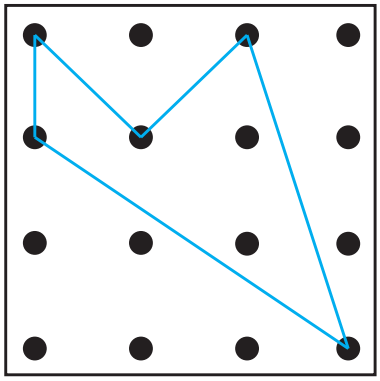	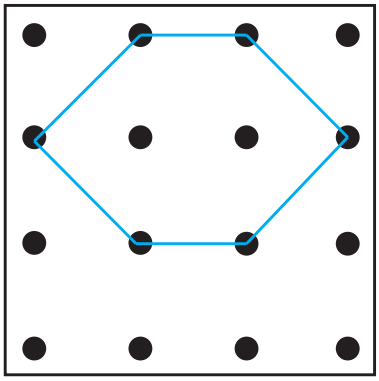	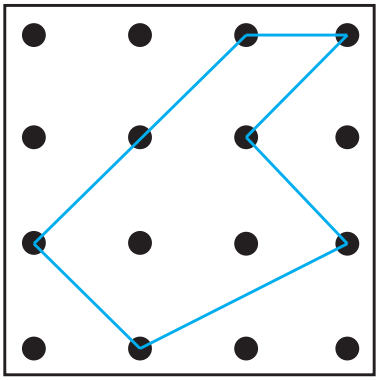
Make a shape with four sides	Make a square	Make a triangle
Make a hexagon	Make a pentagon	Make a rectangle

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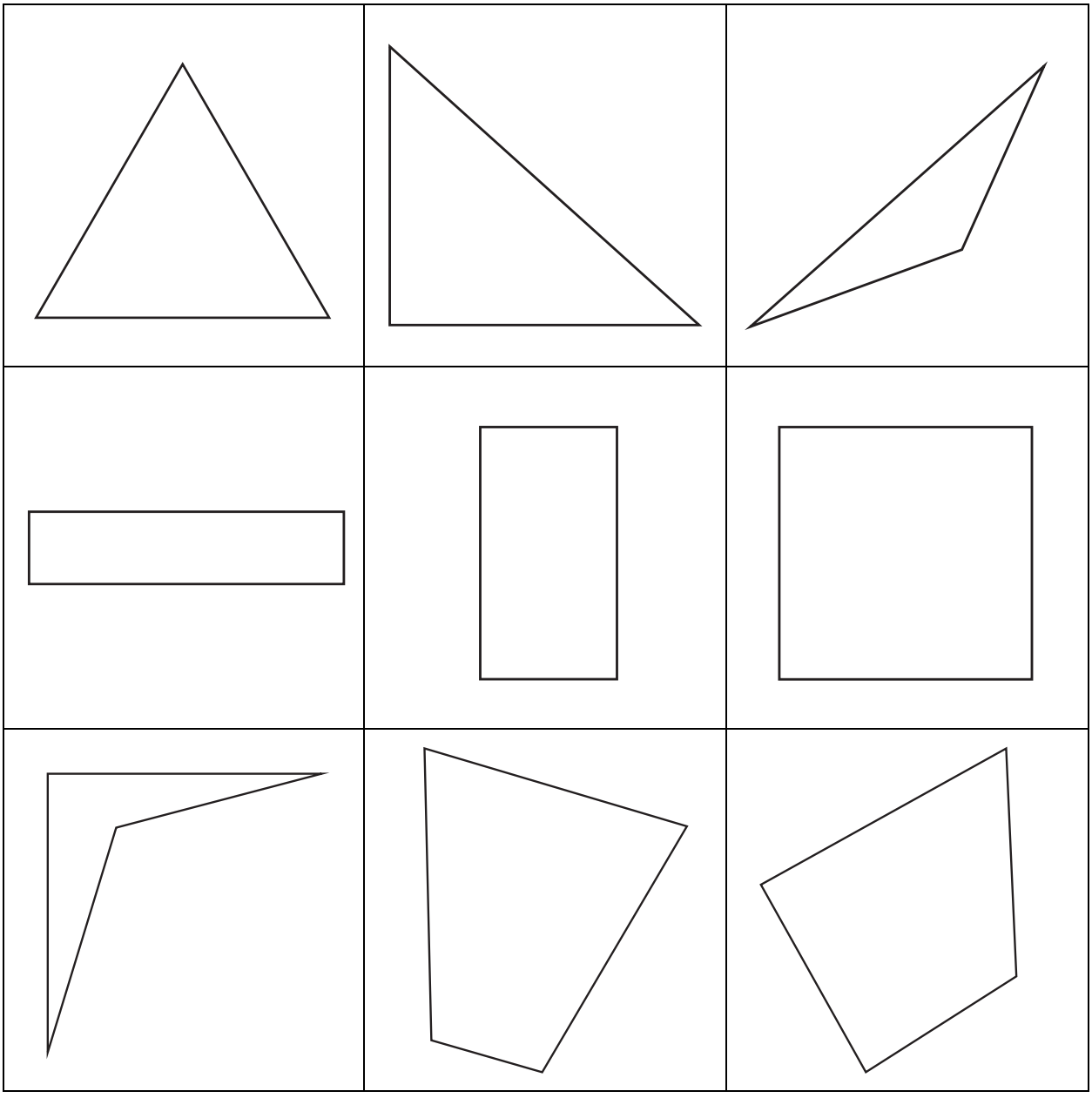
Stick Cards



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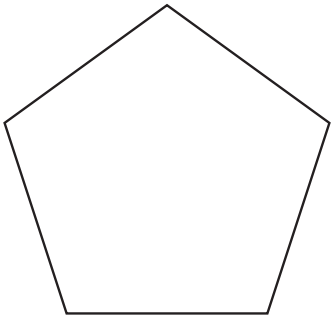	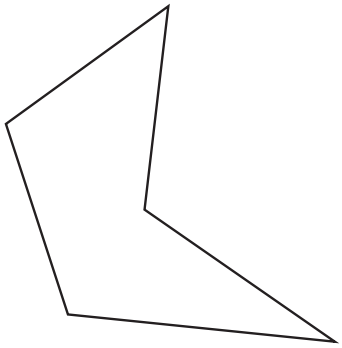	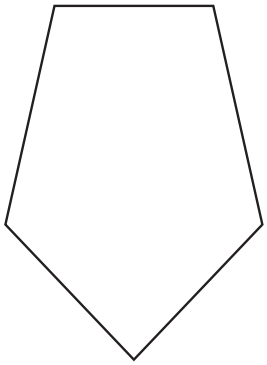
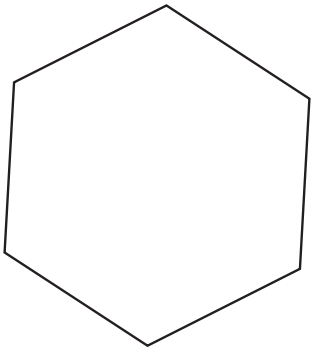	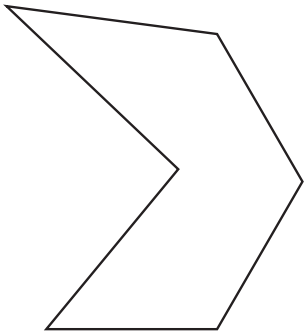	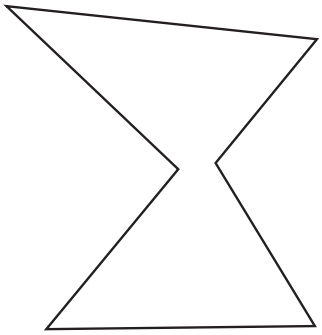
Make a shape with four sides	Make a square	Make a triangle
Make a hexagon	Make a pentagon	Make a rectangle

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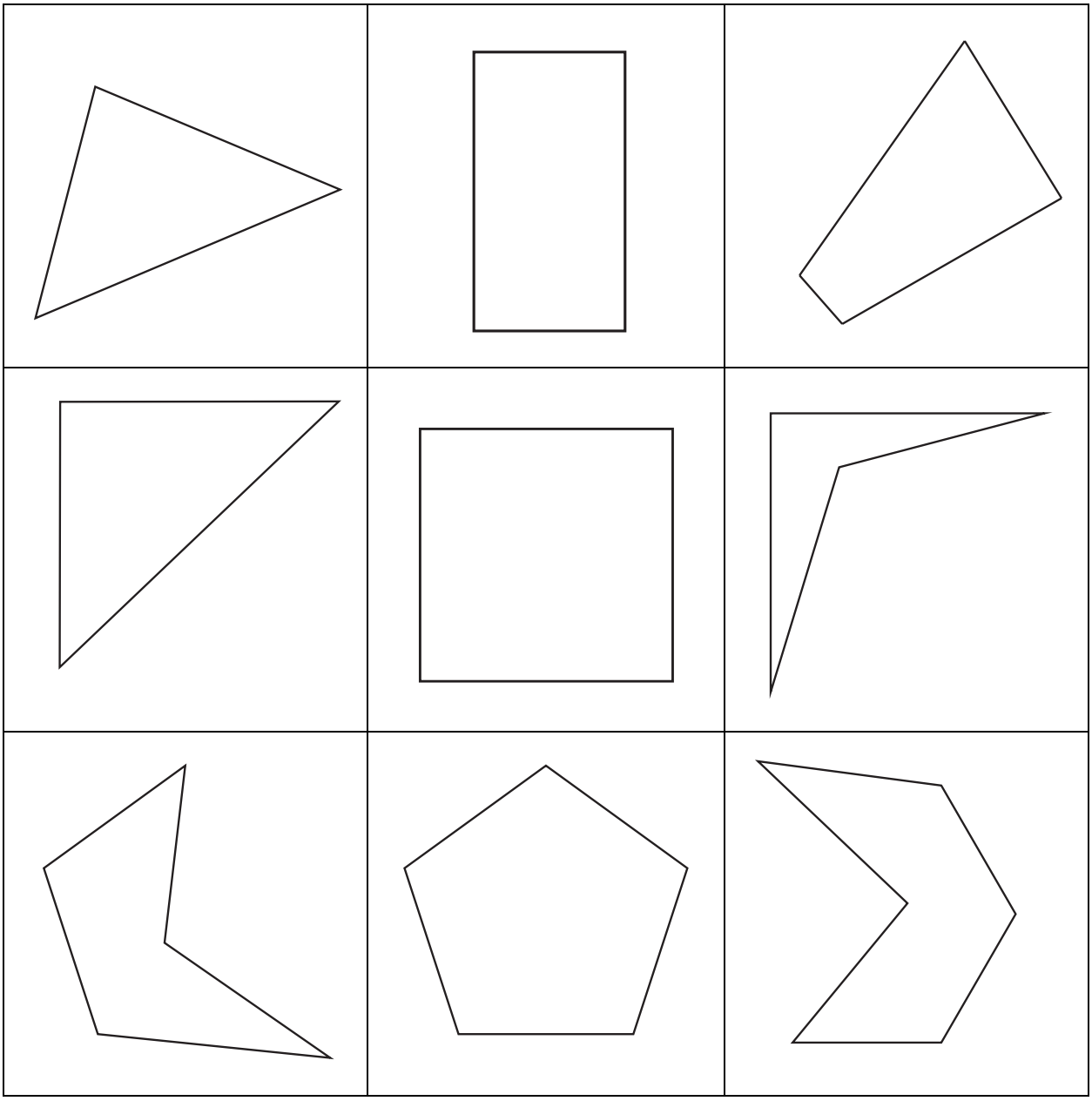
Guess My Shape cards



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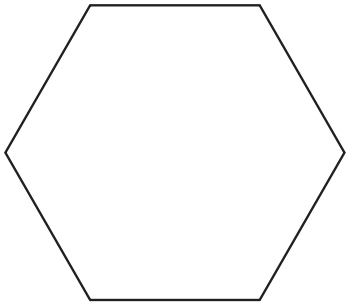	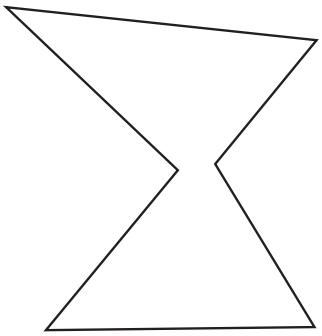	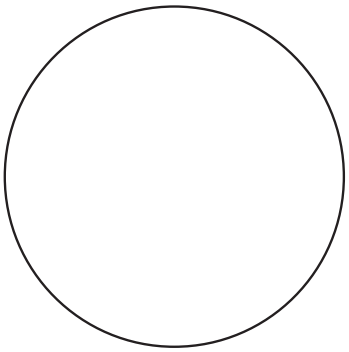
A rectangle	A square	A triangle with 1 corner angle
A triangle with 3 angles the same size	A pentagon (5 sides)	A hexagon (6 sides)
A quadrilateral (4 sides) with only 2 corner angles	A quadrilateral (4 sides)	A triangle (3 sides)

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Name: _____

SHAPE TRACKER

Does your shape have…

1 corner angle?	2 corner angles?	3 corner angles?	4 corner angles?	1 angle that is larger than a corner angle?
all of the angles on the outside of the shape?	an angle on the inside of the shape?	2 sides the same length?	3 sides the same length?	4 sides the same length?
3 sides?	4 sides?	5 sides?	6 sides?	no straight sides?

Is your shape…

a triangle?	a quadrilateral?	a square?	a rectangle?	a pentagon?
a hexagon?	a circle?	not a shape?		

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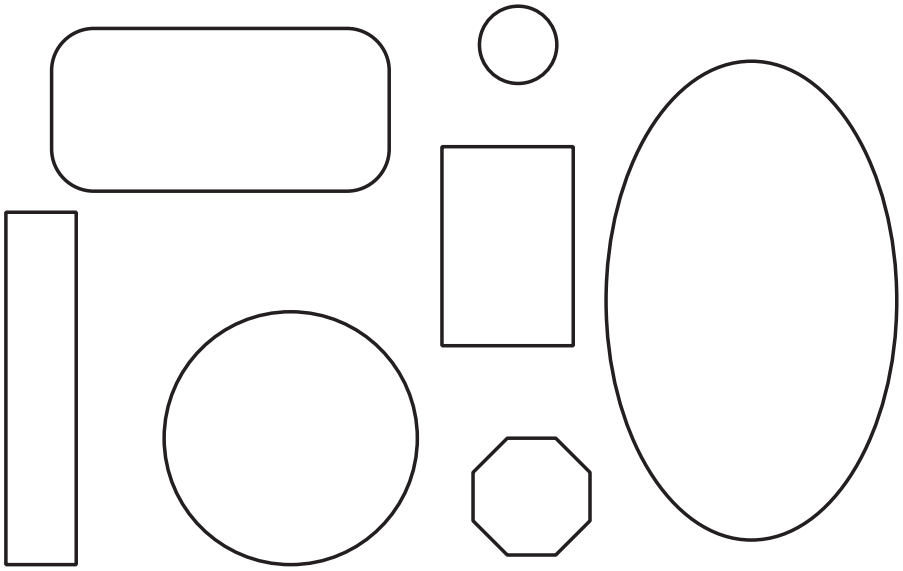
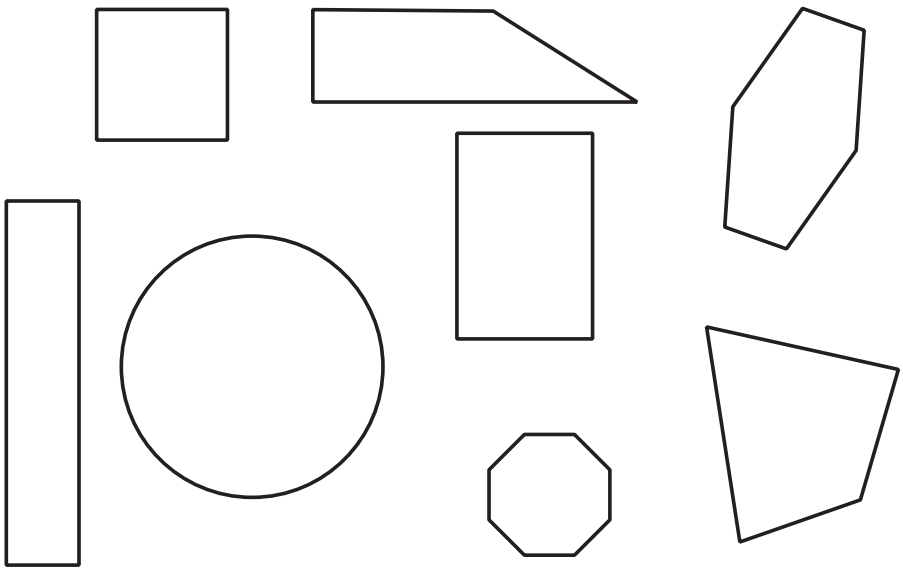
Name_____

Recognizing and Creating Shapes

1. Circle or color in all of the circles.



2. Circle or color in all of the rectangles.



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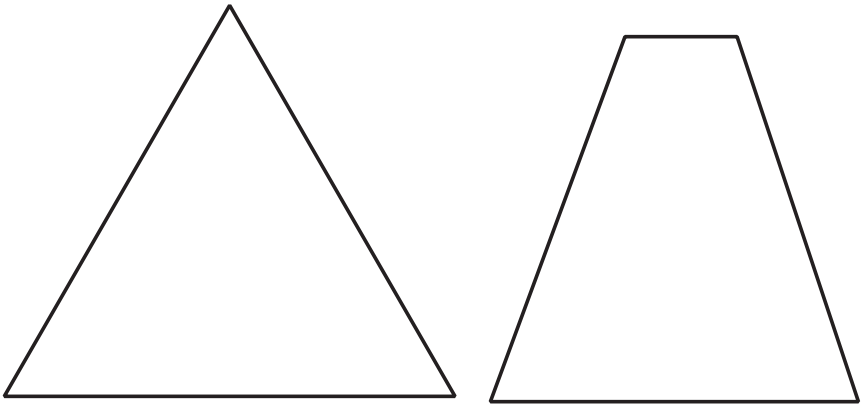
Name_____

3. Circle the triangle. Explain why it is a triangle and why the other shape is not a triangle.



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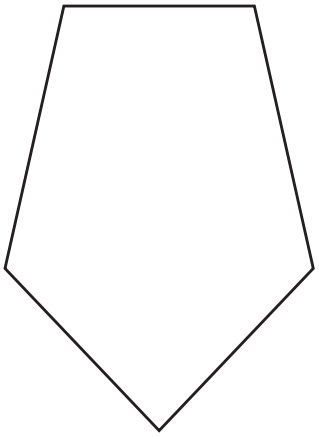
Name_____

4. For each picture of a shape, circle the name of the shape, and explain how you know that is the name of the shape.

4.a.



square

rectangle

triangle

pentagon

hexagon

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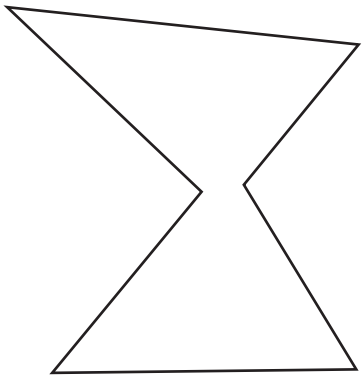
Name_____

4.a.



square

rectangle

triangle

pentagon

hexagon

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Name_____

5. Name and draw each of the shapes.

5.a. A shape that has four sides, four corner angles, and all sides of the same length

Shape name: _____

Drawing:

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Name_____

5.b. A shape that has three sides, three angles, and two sides of the same length

Shape name: _____

Drawing:

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Name_____

5.c. A shape that has six sides and six angles

Shape name: _____

Drawing:

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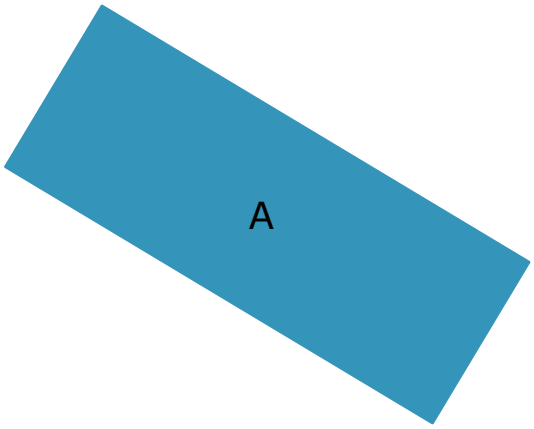
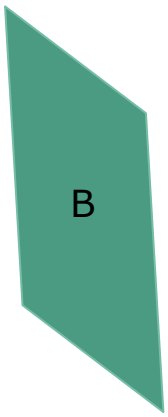
Name_____

6. Write how the two shapes are the same and how they are different.





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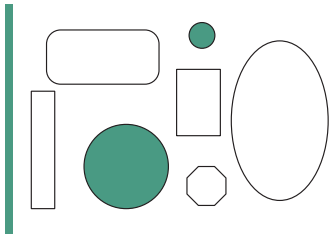
RECOGNIZING AND CREATING SHAPES

STUDENT ACTIVITY SOLUTION GUIDE

1. Circle or color in all of the circles.

CORRECT ANSWER

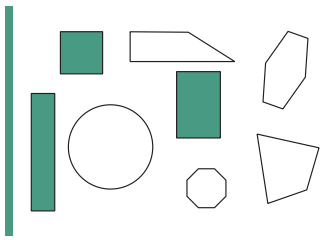


ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student circles or colors in all of the shapes.	does not recognize what a circle looks like	RECOGNIZE *CIRCLE* and RECOGNIZE *RECTANGLE*
The students circles or colors in the two circles and the oval.	recognizes that a circle has no straight sides but does not distinguish between an oval and a circle	RECOGNIZE *CIRCLE*
The student circles or colors in all of the rectangles.	confuses a rectangle with a circle	RECOGNIZE *CIRCLE* and RECOGNIZE *RECTANGLE*

2. Circle or color in all of the rectangles.

CORRECT ANSWER



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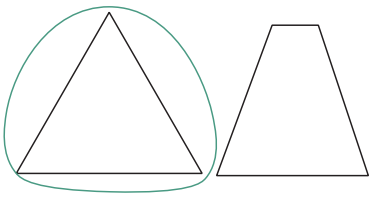
ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student circles or colors in all of the shapes.	does not recognize what a rectangle looks like	RECOGNIZE *RECTANGLE*, RECOGNIZE *HEXAGON*, and RECOGNIZE *CIRCLE*
The student circles or colors in all of the rectangles but does not include the square.	does not understand that a square can also be classified as a rectangle	RECOGNIZE THE DEFINING ATTRIBUTES OF A SHAPE
The student circles or colors in all of the quadrilaterals.	does not understand that a rectangle is a four-sided shape with four right angles, misinterprets a rectangle for any four-sided shape	RECOGNIZE THE DEFINING ATTRIBUTES OF A SHAPE

3. Circle the triangle. Explain why it is a triangle and why the other shape is not a triangle.

CORRECT ANSWER

Check student responses for accuracy. The following is an example of a possible student response.



The shape I circled is a triangle because it has three sides and three angles. The other shape has four sides and four angles, so it cannot be a triangle, because it is a four-sided shape.

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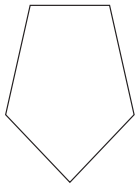
ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student circles the quadrilateral and provides an inaccurate response or no response.	does not recognize the different between a triangle and a quadrilateral	RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES, DESCRIBE THE ATTRIBUTES OF SHAPES, and RECOGNIZE *TRIANGLE*
The student does not circle either shape or circles both shapes and writes that the shapes are the same (e.g., they are both triangles because…, neither one are triangles because…).	does not recognize that one shape has three sides and the other shape has four sides	RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES, DESCRIBE THE ATTRIBUTES OF SHAPES, and RECOGNIZE *TRIANGLE*
The student circles the triangle but does not provide a written explanation or the written explanation is inaccurate.	does not understand how to describe the attributes of a shape	DESCRIBE THE ATTRIBUTES OF SHAPES

4. Circle the name of the shape shown. Explain how you know that is the name of the shape.

4.a.



square
rectangle
triangle
pentagon
hexagon

CORRECT ANSWER

Check student responses for accuracy. The following is an example of a possible student response.

pentagon

The shape is a pentagon because it is a closed shape that has five sides and five angles.

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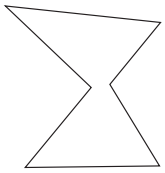
ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student cirlces *pentagon* but does not provide an explanation.	is unable to describe the attributes of a pentagon	DESCRIBE THE ATTRIBUTES OF SHAPES
The student circles any shape other than *pentagon* and does or does not provide an explanation.	does not recognize the shape as a pentagon and is unable to accurately describe the attributes of a pentagon	RECOGNIZE *PENTAGON* and/or RECOGNIZE *SQUARE*, RECOGNIZE *RECTANGLE*, RECOGNIZE *TRIANGLE*, RECOGNIZE *HEXAGONS*, and DESCRIBE THE ATTRIBUTES OF SHAPES

4.b. 

square
rectangle
triangle
pentagon
hexagon

CORRECT ANSWER

Check student responses for accuracy. The following is an example of a possible student response.

hexagon

The shape is a hexagon because it is a closed shape that has six sides and six angles.

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ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student cirlces *hexagon* but does not provide an explanation.	is unable to describe the attributes of a hexagon	DESCRIBE THE ATTRIBUTES OF SHAPES
The student circles any shape other than *hexagon* and does or does not provide an explanation.	does not recognize the shape as a hexagon and is unable to accurately describe the attributes of a hexagon	RECOGNIZE *HEXAGONS* and/or RECOGNIZE *SQUARE*, RECOGNIZE *RECTANGLE*, RECOGNIZE *TRIANGLE*, RECOGNIZE *PENTAGON*, and DESCRIBE THE ATTRIBUTES OF SHAPES

5. Name and draw each of the shapes described.

5.a. A shape that has four sides, four corner angles, and all sides of the same length

CORRECT ANSWER

Shape name: square

Drawing:

ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student draws a shape other than a square but writes *square* for the name of the shape.	recognizes that the attributes represent a square but does not draw a square	REPRESENT SHAPES GIVEN DEFINING ATTRIBUTES
The student draws a square but does not write *square* as the name of the shape.	does not understand that the attributes or drawing represent a square	RECOGNIZE *SQUARE* and RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES
The student draws a shape other than a square and does not write *square* as the name of the shape.	does not recognize the attributes as a square, cannot draw a shape with the given attributes	REPRESENT SHAPES GIVEN DEFINING ATTRIBUTES and RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES

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5.b. A shape that has three sides, three angles, and two sides of the same length

CORRECT ANSWER

Shape name: triangle

Drawing:

The following is an example of a student drawing. Check student work for accuracy.

ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student draws a triangle that does not have two sides of the same length and writes *triangle* for the name of the shape.	recognizes that the attribute *three sides* represents a triangle but does not draw a triangle with two sides of same length	REPRESENT SHAPES GIVEN ATTRIBUTE VALUES
The student draws a shape other than a triangle but writes *triangle* for the name of the shape.	recognizes that the attributes represent a triangle but does not draw a triangle	REPRESENT SHAPES GIVEN DEFINING ATTRIBUTES
The student draws a triangle but does not write *triangle* as the name of the shape.	does not understand that the attributes or drawing represent a triangle	RECOGNIZE *TRIANGLE* and RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES
The student draws a shape other than a triangle and does not write *triangle* as the name of the shape.	does not recognize the attributes as a triangle, cannot draw a shape with the given attributes	REPRESENT SHAPES GIVEN DEFINING ATTRIBUTES and RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES

5.c. A shape that has six sides and six angles

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CORRECT ANSWER

Shape name: hexagon

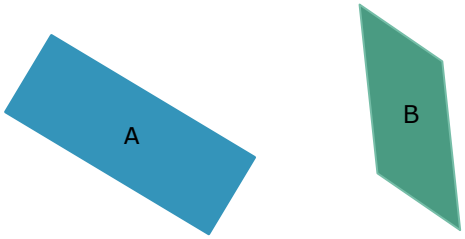
Drawing:

The following is an example of a student drawing. Check student work for accuracy.

ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student draws a shape other than a hexagon but writes *hexagon* for the name of the shape.	recognizes that the attributes represent a hexagon but does not draw a hexagon	REPRESENT SHAPES GIVEN DEFINING ATTRIBUTES
The student draws a hexagon but does not write *hexagon* as the name of the shape.	does not understand that the attributes or drawing represent a hexagon	RECOGNIZE *HEXAGONS* and RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES
The student draws a shape other than a hexagon and does not write *hexagon* as the name of the shape.	does not recognize the attributes as a hexagon, cannot draw a shape with the given attributes	REPRESENT SHAPES GIVEN DEFINING ATTRIBUTES and RECOGNIZE SHAPES WITH SPECIFIED ATTRIBUTES

6. Describe how the two shapes shown are the same and how they are different.



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CORRECT ANSWER

Check student work for accuracy. The following is an example of a student response.

The two shapes both have four sides and four angles. Shape A has four corner angles, and shape B does not have four corner angles. Shape A and shape B both have two sets of sides that run side by side. Both shapes have two sides that are the same length and two other sides that are the same length but a different length than the first two sides.

ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student only write how the shapes are the same or only how the shapes are different.	does not recognize the similarities or the differences between the two shapes	ANALYZE SHAPES TO IDENTIFY COMMON ATTRIBUTES and/or COMPARE AND CONTRAST THE PROPERTIES OF 2 OR MORE SHAPES
The student identifies the size, color, or orientation of the shapes' attributes that are different.	does not understand that size, color, and orientation of shapes are not defining attributes	RECOGNIZE THE NON-DEFINING ATTRIBUTES OF A SHAPE and/or RECOGNIZE THE DEFINING ATTRIBUTES OF A SHAPE

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