SYMMETRY

4.G.3

CONTENTS

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

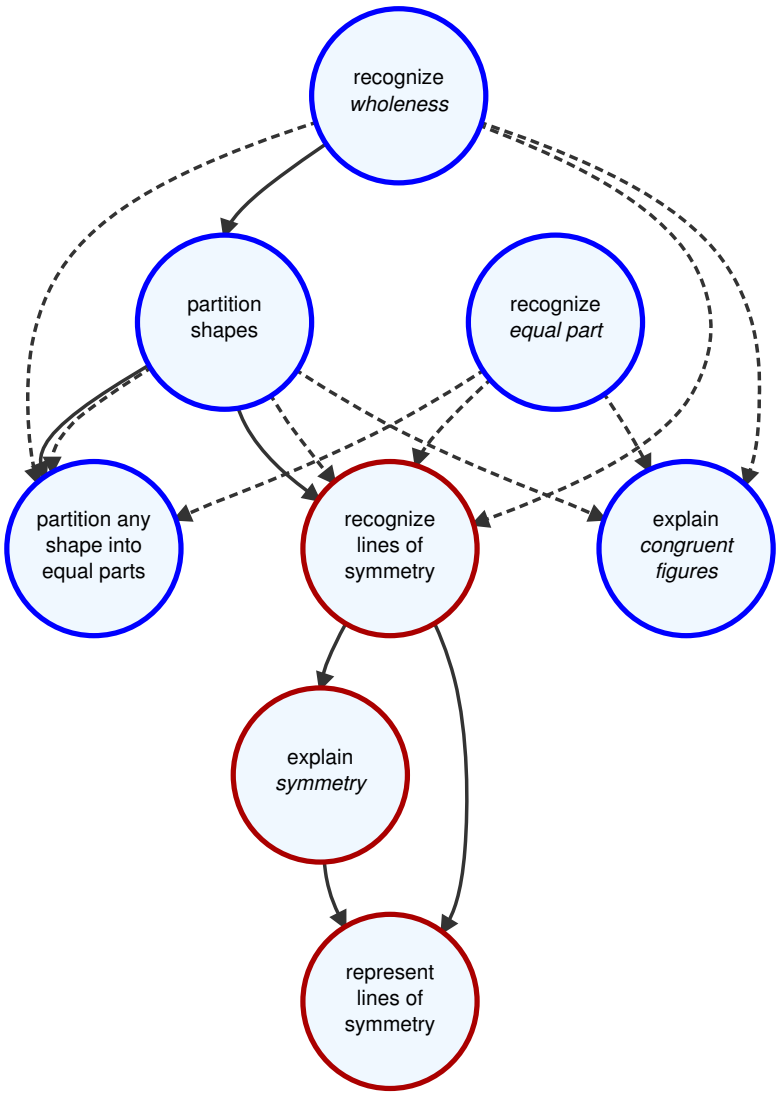
Enhanced Learning Maps developed these materials under a grant from the Department of Education, PR/ Award # S368A150013. Contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the Federal Government.

SYMMETRY

LEARNING MAP INFORMATION

STANDARDS

4.G.3 Recognize a line of symmetry for a two-dimensional (plane) 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.



**Learning map model of* 4.G.3

Node Name	Node Description
EXPLAIN *CONGRUENT FIGURES*	Make known your understanding that congruent figures have the same shape and size.
EXPLAIN *SYMMETRY*	Make known your understanding that symmetric figures can be divided into congruent parts, where each of the parts is a mirror image of the other.
PARTITION ANY SHAPE INTO EQUAL PARTS	Divide any shape into a specified number of equal parts. For example, when asked to partition a shape into sixths (or six equal parts), the student creates six equal-size parts.
PARTITION SHAPES	Divide or separate a shape into two or more shapes. For example, divide a rectangle into two triangles.
RECOGNIZE *EQUAL PART*	Identify or name equal parts of a whole. Know that equal parts of a whole do not need to have the same shape, but they must have the same area.
RECOGNIZE LINES OF SYMMETRY	Identify or name lines of symmetry.
RECOGNIZE *WHOLENESS*	Identify or name whole as something composed of the entire object.
REPRESENT LINES OF SYMMETRY	Through writing or an appropriate assistive technology, represent lines of symmetry.

SYMMETRY

TEACHER NOTES

This unit includes the following documents:

- Learning Map Information
- Instructional Activity (two lessons)
- Instructional Activity Student Handout (for Lessons 1 and 2)
- Instructional Activity Supplement (for Lessons 1 and 2)
- Student Activity
- Student Activity Solution Guide

In this unit, students will learn how to identify and represent lines of symmetry in two-dimensional objects.

RESEARCH

Symmetry concepts are built on students' prior experiences with two-dimensional shapes. In early grades, students should have experiences exploring how shapes can be decomposed into smaller, component shapes (Van de Walle, Karp, Lovin, & Bay-Williams, 2014). Building on these early partitioning experiences, students then can learn to equipartition shapes to create equal-size parts within a variety of shapes. These experiences provide a critical foundation for fraction understanding and support student understanding of the symmetries seen in various plane (two-dimensional) figures.

> It is important to note that the activities in this unit are about recognizing symmetry in existing objects. Students should focus on the corresponding parts of a figure and whether the given figure has line symmetry. In later grades, students will learn about reflections, where a pre-image and an image are created in symmetry.

The activities in this unit introduce students to symmetry through familiar, real-world examples. Many students will have an innate awareness of symmetry, and a class discussion is beneficial to elicit students' prior knowledge and any existing misconceptions (Cole, 2010). Students should be allowed to make conjectures about symmetry and test them (e.g., by cutting out shapes and folding along the hypothesized line of symmetry, or by tracing figures onto patty paper and folding along the hypothesized line of symmetry); therefore, an open-ended discussion about whether an object has symmetry is a useful way of introducing the topic (Cole, 2010; Schoffel & Breyfogle, 2005; Steele, 2000). Students can offer their opinion and discuss their thoughts on symmetry in a safe, exploratory environment.

Because students develop their understanding of symmetry from their interactions with the real world, lessons covering the topic should be rooted in real-world examples (Cole, 2010; Kurz, 2013; Moyer, 2001; Seidel, 1998). Many figures found in nature show symmetry, such as snowflakes, flowers, and butterflies. There are also many examples of symmetry in the buildings and structures that students encounter. Basing a

lesson on a familiar object permits students the opportunity to connect new information with existing knowledge while also displaying the relevance of the topic.

Because of the relative simplicity and likely familiarity of the concept of symmetry, this unit is an excellent opportunity to develop students' vocabulary (Cole, 2010). Students will have an instinctive understanding of symmetry but will likely not use highly developed vocabulary such as "congruent figures" (two or more figures that are the same size and the same shape) or "corresponding parts" (parts of two more figures that are in the same relative position in each of the figures). Through probing questions, teachers can elicit phrases students use to describe symmetry and start rephrasing their statements using more sophisticated and technical language, such as "corresponding" or "congruent" parts. Teachers are encouraged to engage students in dialogue and discussions with other students to practice using their growing vocabulary. Certain discussions, such as when students are expected to use precise vocabulary to explain their perspective regarding line symmetry or to establish agreement among one another regarding the line(s) of symmetry in a figure, address the mathematical practices of attending to precision and constructing viable arguments and critiquing the reasoning of others (National Council of Teachers of Mathematics, 2014).

Students should be required to create their own examples of symmetry (Cole, 2010; Hartweg, 2004; Kurz, Seidel, 1998). Giving students opportunities to be creative and produce their own examples of symmetry gives them ownership of their learning, as well as a product that they can refer back to. There are many ways for students to create their own symmetric figures, including three-dimensional building blocks, paint, and computer software (Hartweg, 2004; Seidel, 1998). Additionally, students could consider the symmetry in rhythmic patterns (music) or clapping patterns, which allows for accessibility for students with visual impairments. Symmetry can also exist in patterns or sequences of objects (e.g., star, star, box, box, star, star). Note that although colored designs may help many students identify symmetry, it is advised that frequent use of color is avoided due to accessibility concerns.

In order to appropriately teach symmetry, teachers must be familiar with mathematics content beyond the grade level they currently teach (Cole, 2010). Teachers should be aware that students will likely know about the corners, square corners, and sides of shapes, but in this unit, students have the opportunity to attach refined vocabulary to these known ideas, namely vertex and right angle.

INFORMAL VOCABULARY	REFINED VOCABULARY
point/corner	vertex
square corner	right angle
same size and same shape	congruent
matching parts	corresponding parts

In order to allow for developmentally appropriate lessons, teachers should also familiarize themselves with how symmetry is used in future mathematics, such as in relation to midpoints, regular polygons, graphs, patterns, number lines, sequences, and even and odd functions.

LEARNING MAP INFORMATION

The learning map section for this sequence of activities begins with a basic understanding of geometry and division of shapes. Students should be able to partition shapes prior to introducing symmetry. Their first introduction to symmetry should be with shapes shown with given lines of symmetry. Then students should gradually suggest lines of symmetry for different figures, beginning with shapes that are easily divided in half, such as rectangles or hexagons. Then students may be prepared to think about lines of symmetry for shapes that are less easily imagined divided in half, such as triangles or stars. During all activities students should be encouraged to explain in words what symmetry is, where they develop increasingly more sophisticated and accurate descriptions as they move through their various instructional experiences.

INSTRUCTIONAL ACTIVITIES

The first lesson allows students to interact with symmetry as it relates to simple figures and real-world images and examples. Students discuss where lines of symmetry exist and where they do not, while justifying their answers. The discussion centers on the definition of "symmetric", that the figures can be partitioned into two congruent parts that are mirror images of each other. Students then practice recognizing and representing lines of symmetry on a practice worksheet.

In the second lesson, students are given the opportunity to choose one or more activities in which they create a symmetric figure. Each activity has different criteria, and students can self-differentiate by choosing an activity at a level appropriate for them. After creating a symmetric figure, the students are required to describe their figures and make use of the new vocabulary from the lesson.

REFERENCES

Cole, S. (2010). Symmetry gave me four legs! *Teaching Children Mathematics, 17*(4), 212-217.

Hartweg, K. (2004). Responses to the Picasso masterpiece problem. *Teaching Children Mathematics, 10*(6), 295-301.

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Steele, D. (2000). Enthusiastic voices from young mathematicians. *Teaching Children Mathematics, 6*(7), 464-468.

Van de Walle, J. A., Karp, K. S., Lovin, L. A. H., & Bay-Williams, J. M. (2014). *Teaching Student-centered Mathematics: Developmentally Appropriate Instruction for Grades 3-5* (Vol. 1). Pearson Higher Ed.

SYMMETRY

INSTRUCTIONAL ACTIVITY

Lesson 1

LEARNING GOAL

Students will draw lines of symmetry and identify whether a line drawn in a figure is a line of symmetry.

PRIMARY ACTIVITY

Students will be introduced to symmetry and lines of symmetry with simple figures and a real-world example, then extend their understanding of symmetry to additional examples.

OTHER VOCABULARY

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

- Congruent
- Corresponding
- Line of Symmetry
- Horizontal
- Vertical
- Diagonal
- Reflection
- Symmetric
- Asymmetric

MATERIALS

- Picture of a symmetric two-dimensional object (A butterfly is provided as an option in the INSTRUCTIONAL ACTIVITY SUPPLEMENT.)
- INSTRUCTIONAL ACTIVITY STUDENT HANDOUT
- Patty paper or tracing paper

IMPLEMENTATION

Begin the lesson by identifying a line of symmetry in a variety of basic shapes.

Draw a few simple figures (e.g., an isosceles triangle, a rectangle, and a heart) and mark one line of symmetry per figure.

Explain that you have drawn one line of symmetry in each figure and that the line of symmetry separates the figure into two parts that are mirror images of each other.

Provide students with patty paper and ask them to draw a new shape (e.g., a hexagon) and draw in a line of symmetry.

Ask students to fold the patty paper in order to check whether their line of symmetry was accurate and that the two parts are mirror images of each other.

Refocus students' attention to the shapes displayed for the whole class.

Ask students if any additional lines of symmetry can be drawn for each figure.

Ask scaffolded questions to establish and draw all lines of symmetry in each figure.

Require students to draw any additional lines of symmetry in the figure they have on their patty paper.

Provide students with additional practice with increasingly complex shapes (e.g., a star, a tree, a house) on patty paper as needed.

Next, show students a picture of an object they are familiar with that is symmetric, such as a local monument or park. If nothing local fits that description, then a picture of a butterfly is provided in the INSTRUCTIONAL ACTIVITY SUPPLEMENT.

Display the image for the whole class to see, and **distribute** the image to students to informally draw lines of symmetry during the whole class discussion.

Ask students if they can draw a line of symmetry that separates the image into two equal parts. **Allow** some time for students to try this.

If students struggle to draw this line, **refer** back to or **provide** a simple image (e.g., a heart or a rectangle) and ask the student if they can draw a line that separates the simpler image into two equal parts.

Remind students that an image has symmetry if it can be divided into two parts that are mirror images of each other. At this time, **introduce** the vocabulary *congruent parts* to describe each of the parts that is a mirror image of the other.

Encourage students to use vocabulary such as *corresponding parts* (parts of two more figures that are in the same relative position in each of the figures) and *congruent figures* (two or more figures that are the same size and the same shape) as they discuss symmetry.

Ask students whether they see symmetry in the chosen image.

Require students to explain their reasoning, and **lead** them to a consensus that the image does have symmetry.

After deciding that the image has symmetry, **distinguish** between horizontal and vertical lines of symmetry by **discussing** which line of symmetry could be drawn on the image. If students have difficulty remembering the difference between horizontal and vertical, have them practice by showing the direction with their arms. **Direct** students to make their arms horizontal, then have them switch to vertical.

Model drawing the line(s) of symmetry on the image you are studying.

Use the following guiding questions to facilitate a class discussion.

GUIDING QUESTIONS

Elicit student thinking:

- Can you describe this image?
- What aspects of this image stand out to you?
- How could you divide (partition) this image?

Determine if the student can RECOGNIZE LINES OF SYMMETRY:

- [Point to or draw a line through a figure.] Is this a line of a symmetry for the figure?

Determine if the student is ready to EXPLAIN *SYMMETRY*:

- How do you know there is symmetry?
- What is a line of symmetry?
- What would have to change about the image for it to have a diagonal line of symmetry?

Determine if the student can REPRESENT LINES OF SYMMETRY:

- Do you see symmetry in this image? If so, where? If not, what would have to change for there to be symmetry?
- Is there a vertical line of symmetry in this figure? If so, where would it be drawn?
- Is there a horizontal line of symmetry in this figure? If so, where would it be drawn?

Determine if the student can EXPLAIN *CONGRUENT FIGURES*:

- What does it mean for two shapes to be congruent?
- [Point to the parts of the figure on either side of the line of symmetry.] Are these two parts congruent to each other? How do you know?

Next, discuss the parts of the image in order to develop new vocabulary.

Ask students targeted questions to develop what they notice about the mirror images.

Discuss how a symmetric image has congruent corresponding parts by pointing out pieces of the image and having students point to their corresponding parts. For example, in the butterfly image, point to a spot on one wing and require students to locate the corresponding spot on the other wing.

Ask students what they notice about each corresponding part in the image and its distance from the line of symmetry. Students should notice that corresponding parts are equidistant from the line of symmetry.

The following guiding questions refer to the butterfly image in the INSTRUCTIONAL ACTIVITY SUPPLEMENT but can be adapted to any image.

GUIDING QUESTIONS

Elicit student thinking:

- What do you know about the left wing and the right wing of the butterfly?
- What are the corresponding parts of the image?

Determine if the student can EXPLAIN *SYMMETRY*:

- What do you know about the two antennae?
- Which parts of the butterfly are congruent?
- What is the corresponding part to this [point to a part of the butterfly]?
- How do you know that the two wings are congruent?
- How does the part of the butterfly on one side of the line of symmetry relate to the part of the butterfly on the other side of the line of symmetry?

Determine if the student can REPRESENT LINES OF SYMMETRY:

- Do you see symmetry in the butterfly? If so, where? If not, what would have to change for there to be symmetry?
- Is there a vertical line of symmetry in the butterfly image? If so, where would it be drawn?
- Is there a horizontal line of symmetry in the butterfly image? If so, where would it be drawn?

Allow students to practice their new knowledge by completing the questions provided in the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT.

While students work, **circulate** around the room and **ask** guiding questions. **Include** questions that elicit evidence of student understanding of mirror images.

Discuss with students, as they work through the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT, how a symmetric image has congruent corresponding parts by pointing out pieces of the image and having students point to their corresponding parts and describe the size of each part of the image.

For students who finish quickly, provide additional images with diagonal lines of symmetry, or a circle with infinite lines of symmetry.

For students who are struggling, provide patty paper (or tracing paper) and **demonstrate** how to copy images on the paper and fold it over to check for lines of symmetry.

GUIDING QUESTIONS

Elicit student thinking:

- How do you know you have identified all lines of symmetry in the image?
- What does the phrase "mirror image" mean to you?

Determine if the student can RECOGNIZE LINES OF SYMMETRY:

- [Point to or draw a line through a figure.] Is this a line of symmetry for this image?

Determine if the student can EXPLAIN *SYMMETRY*:

- What strategies did you use to find objects with vertical lines of symmetry in the classroom?
- If an object has a vertical line of symmetry, does it automatically have a horizontal line of symmetry?
- What do you know about all lines of symmetry?
- What must be true about the image on both sides of the line of symmetry?
- [Point to or draw a line through a figure.] Why is (or isn't) this a line of symmetry?

Determine if the student can REPRESENT LINES OF SYMMETRY:

- Where can you draw a line of symmetry in this image?

Determine if the student can EXPLAIN *CONGRUENT FIGURES*:

- What does it mean for two shapes to be congruent?
- [Point to parts of a figure on either side of the line of symmetry.] Are these two parts congruent to each other? How do you know?

Students should be required to share their responses to the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT with a partner. If they have any disagreements about the correct lines of symmetry, they should work to reach an agreement through a discussion with each other (and other peers if necessary) and adjust their answers accordingly.

At the end of the activity, have each pair of students write down the most interesting image they identified for each of the last three questions (vertical, horizontal, and no lines of symmetry) in the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT on poster paper or the front whiteboard.

Name_____

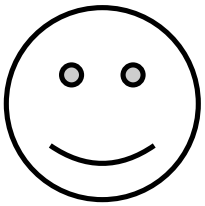
SYMMETRY

Lesson 1

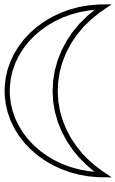
1. Draw in the line(s) of symmetry on the following figures.

a.

b.

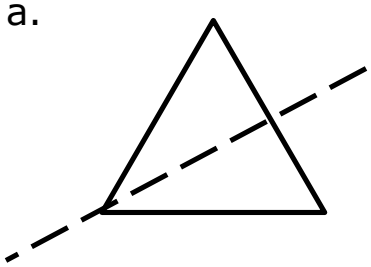


c.

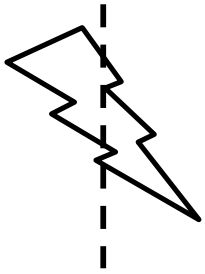


2. Are the given lines of symmetry correct? Explain why or why not.

a.



b.



Name_____

3. Name five objects in the classroom that have a vertical line of symmetry.

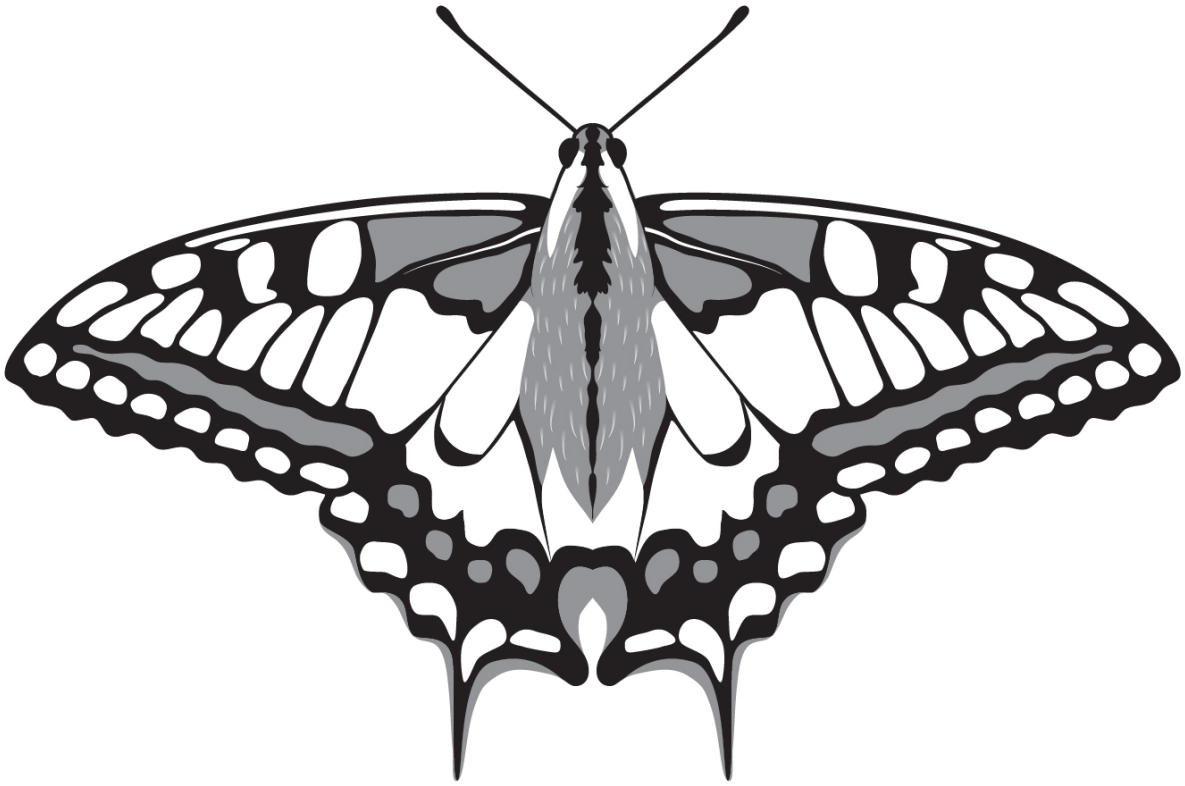
4. Name five objects in the classroom that have a horizontal line of symmetry.

5. Name five objects in the classroom that have no symmetry.

SYMMETRY

INSTRUCTIONAL ACTIVITY SUPPLEMENT

Lesson 1



SYMMETRY

INSTRUCTIONAL ACTIVITY

Lesson 2

LEARNING GOAL

Students will create symmetric images based on specific criteria.

PRIMARY ACTIVITY

Students choose from a menu of options to create a symmetric image through various media.

OTHER VOCABULARY

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

- Line of symmetry
- Reflection
- Horizontal line of symmetry
- Vertical line of symmetry
- Diagonal line of symmetry
- Congruent
- Corresponding

MATERIALS

- Computers with Microsoft Office and/or Paint (or other image-creating software)
- Computer paper
- Scissors
- Paint
- Construction paper
- INSTRUCTIONAL ACTIVITY STUDENT HANDOUT
- INSTRUCTIONAL ACTIVITY SUPPLEMENT (optional)

IMPLEMENTATION

Recall from LESSON 1 that students have volunteered their favorite or most interesting objects from the classroom that have symmetry.

Begin by reviewing these objects and further clarifying whether or not they have symmetry, and how to identify that they have symmetry.

Go through the list and make sure all students can see the object. It might also be beneficial to pass the object around when possible.

Decide which objects promote further learning and **discuss** these as a class.

GUIDING QUESTIONS

Determine if the student can EXPLAIN *SYMMETRY*:

- How do you know this object has a vertical line of symmetry?
- How do you know this object has a horizontal line of symmetry?
- If the object doesn't have symmetry, what would we have to change to make it have symmetry?

Tell the students that they will be creating their own objects and images that have symmetry based on specific criteria.

NOTE: A menu of choices is provided in the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT. One choice requires students to have a copy of the INSTRUCTIONAL ACTIVITY SUPPLEMENT. At teacher discretion and depending on available resources, students may choose one or two options, or the whole class can do the same option. The options have been tiered by difficulty to allow for differentiation.

Ask the following guiding questions as students work through one or more of the options in the INSTRUCTIONAL ACTIVITY STUDENT HANDOUT.

GUIDING QUESTIONS

Elicit student thinking:

- What are the equal (or congruent) parts of this shape?
- Where did you create symmetry?
- How did you make sure there were only [specify amount] lines of symmetry?
- What was the hardest part of this task? Do you have advice for other students who choose this task?

Determine if the student can REPRESENT LINES OF SYMMETRY:

- Where is the line (or lines) of symmetry in the image you are working on?
- Can you draw a line of symmetry in this image? Where would the line of symmetry be?

Students should be required to give a brief presentation of their creation.

At the end of the activity, display students' work in order to have their examples of symmetry available for reference throughout the year.

Name_____

SYMMETRY

Lesson 2

Level 1	Draw three shapes on patty paper that have a horizontal line of symmetry.	Fill out the other half of the design on the Instructional Activity Supplement.	Design a Lego building with a vertical line of symmetry.
Level 2	Use a computer software to create a picture that has the following objects: 1. A shape with no lines of symmetry 2. A shape with 4 lines of symmetry 3. A shape with exactly 2 lines of symmetry	Paint a design on paper that, when folded over, will create a design with one line of symmetry.	Draw or use cut out shapes to create a quilt pattern on paper. There should be many lines of symmetry in your quilt.
Level 3	Design a snowflake by folding up and cutting a piece of computer paper. Tell how many lines of symmetry your snowflake has. Connect this information with the number of folds you made in the computer paper.	Paint a design on paper that when folded over will create a design with exactly two lines of symmetry.	Take a picture of a celebrity's face and see if their face is perfectly symmetric using computer software (e.g., www.symmeter.com on Windows) or using a ruler. Justify your reasoning.

For any option that you choose, write a story that goes along with your symmetric creation that uses each of the following words at least once:

- Congruent
- Symmetric
- Corresponding
- Line of symmetry

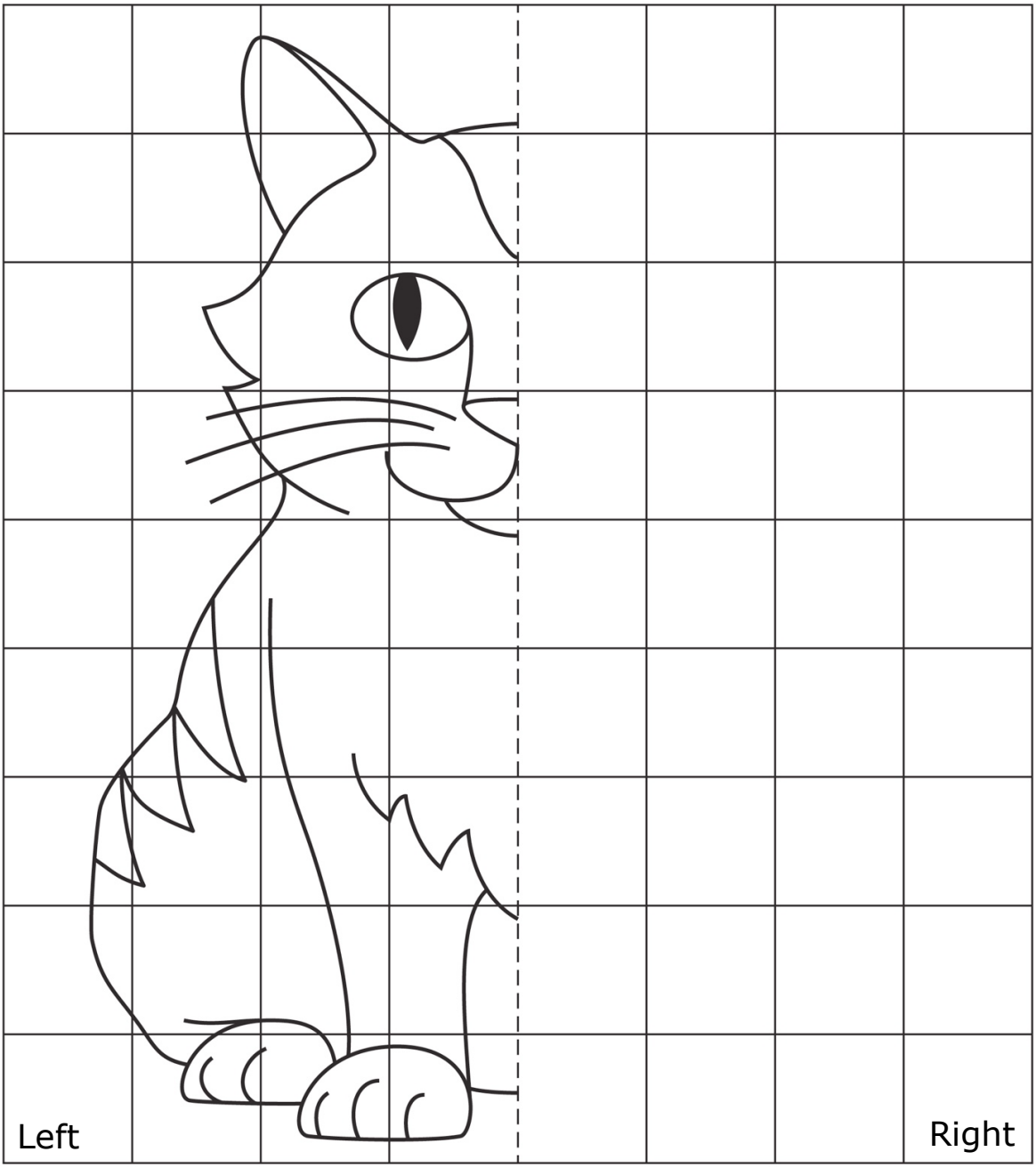
Name_____

SYMMETRY

INSTRUCTIONAL ACTIVITY SUPPLEMENT

Lesson 2

Using the grid to guide you, draw a mirror image of the cat's left side on the blank (right) side of the line of symmetry.



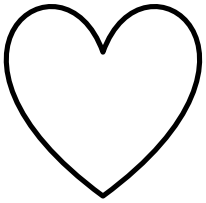
Line of Symmetry

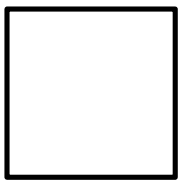
Name_____

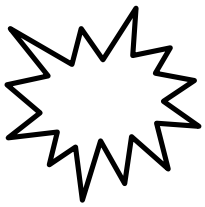
Symmetry Student Activity

Lessons 1 – 2

1. Draw all lines of symmetry for each image. If the image does not have any lines of symmetry, write "none".

1.a. 

1.b. 

1.c. 

2. Draw an image that fits the following criteria:

2.a. Has exactly one line of symmetry

2.b. Has no lines of symmetry

3. What do we call the matching parts of a symmetric image? (Choose the best answer.)

   a. Horizontal

   b. Line of Symmetry

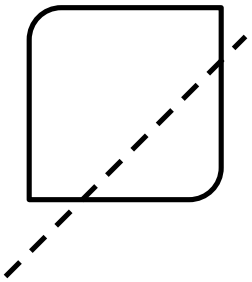
   c. Corresponding

4. What does it mean for two shapes to be congruent?

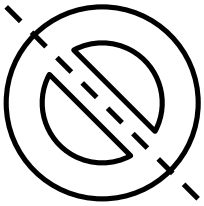
Name_____

5. Tell whether the given lines of symmetry are correct. Explain why or why not.

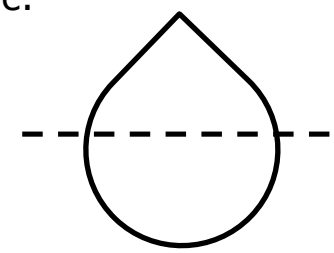
5.a.



5.b.



5.c.

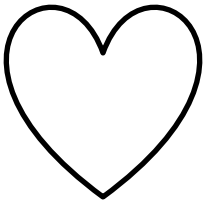


SYMMETRY

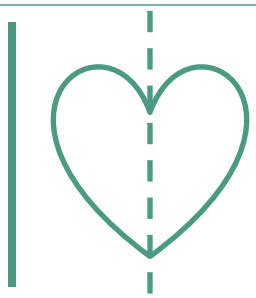
STUDENT ACTIVITY SOLUTION GUIDE

Lessons 1 – 2

1. Draw all lines of symmetry for each image. If the image does not have any lines of symmetry, write "none".

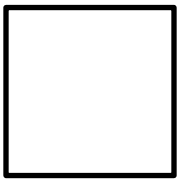
1.a. 

CORRECT ANSWER

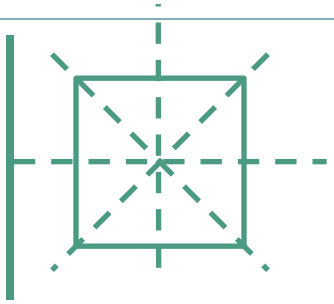


ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
Student draws in a horizontal line through the heart.	thinks that all shapes have a horizontal line of symmetry	PARTITION ANY SHAPE INTO EQUAL PARTS and REPRESENT LINES OF SYMMETRY
Student draws in a line of symmetry through the top hump part of the heart in an attempt to split it in half.	doesn't look at the figure as a whole and tries to split the smaller parts of the figure	PARTITION ANY SHAPE INTO EQUAL PARTS and REPRESENT LINES OF SYMMETRY

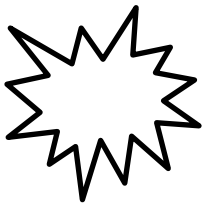
1.b. 

CORRECT ANSWER

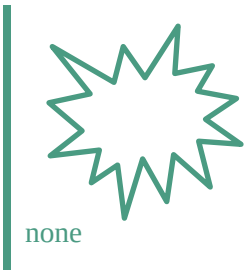


ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
Student leaves out the diagonal lines of symmetry.	doesn't understand that there can be more than one line of symmetry	REPRESENT LINES OF SYMMETRY
Student only draws in one of the lines of symmetry (likely the vertical one).	doesn't understand that there can be more than one line of symmetry	REPRESENT LINES OF SYMMETRY

1.c. 

CORRECT ANSWER



ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

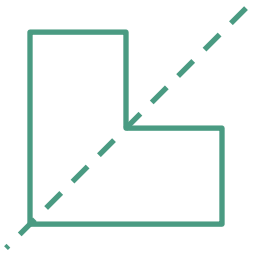
Example Error	Misconception	Missing Knowledge
Student draws in a vertical line.	believes that a figure always has a vertical line of symmetry	REPRESENT LINES OF SYMMETRY
Student draws in a horizontal line.	believes that a figure always has a vertical line of symmetry	REPRESENT LINES OF SYMMETRY
Student draws a line dividing one component of the image in half (i.e. one of the spikes on the image) but does not divide the entire image into two equal pieces.	believes that dividing one part of the figure in half will divide the entire figure in half	REPRESENT LINES OF SYMMETRY

2. Draw an image that fits the following criteria:

2.a. Has exactly one line of symmetry

CORRECT ANSWER

Answers may vary. One option would be:



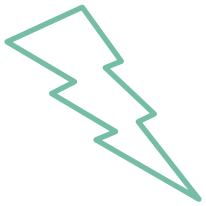
ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
Student draws a square or other figure with several lines of symmetry.	doesn't account for the multiple lines of symmetry	REPRESENT LINES OF SYMMETRY
Student draws a figure with no lines of symmetry.	tries to draw a figure with one line of symmetry but makes the figure too intricate and no lines of symmetry exist	REPRESENT LINES OF SYMMETRY

2.b. Has no lines of symmetry

CORRECT ANSWER

Answers may vary. One option would be:



ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The student draws a figure with lines of symmetry.	fails to recognize the symmetry of a figure	RECOGNIZE LINES OF SYMMETRY

3. What do we call the matching parts of a symmetric image? (Choose the best answer.)
   a. Horizontal
   b. Line of Symmetry
   c. Corresponding

CORRECT ANSWER

c. Corresponding

ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
Line of Symmetry	sees a familiar phrase relevant to the topic but doesn't understand the definition of it	EXPLAIN *SYMMETRY*
Horizontal	chooses a word that they are familiar with but which does not fit the definition	EXPLAIN *SYMMETRY*

4. What does it mean for two shapes to be congruent?

CORRECT ANSWER

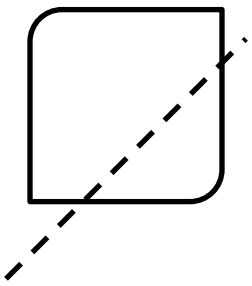
> Two shapes are congruent if they have the same shape and size. If one image can be placed on top of another image and it matches, then the two images are congruent.

ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
Two shapes are congruent if they are the same.	doesn't use the terminology of the unit, i.e. "mirror image", "corresponding"; only offers a simplistic explanation	EXPLAIN *CONGRUENT FIGURES*
Two shapes are congruent if they have lines of symmetry.	tries to explain congruence within each shape independently; does not focus on how the shapes must look in comparison to each other	EXPLAIN *CONGRUENT FIGURES*
NOTE: Although student understanding of congruent figures is not required until later grades, it is recommended that the term "congruent" is introduced during discussions about symmetry.		

5. Tell whether the given lines of symmetry are correct. Explain why or why not.

5.a.



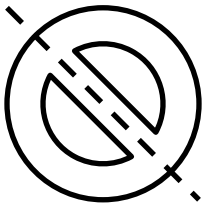
CORRECT ANSWER

> The given line is not a line of symmetry, because the line divides the figure into non-congruent parts.

ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The given line is not a line of symmetry.	only recognizes the lack of symmetry but doesn't have the ability to explain why there is no symmetry	EXPLAIN *SYMMETRY*
The given line is a line of symmetry.	sees that the figure has a diagonal line of symmetry but confuses it with the shown line	EXPLAIN *SYMMETRY*

5.b.



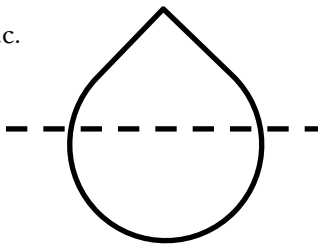
CORRECT ANSWER

> The given line is a line of symmetry, because the line divides the figure into parts that are congruent and mirror images of each other.

ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The given line is not a line of symmetry because it is diagonal.	believes that the lines of symmetry can only be horizontal or vertical	EXPLAIN *SYMMETRY*
The given line is a line of symmetry.	doesn't give an explanation to show that they know the definition and reasoning of symmetry	EXPLAIN *SYMMETRY*

5.c.



CORRECT ANSWER

> The given line is not a line of symmetry, because the top and bottom of the figure are not mirror images of each other. The top and the bottom of the figure are not congruent.

ERRORS, MISCONCEPTIONS, AND MISSING KNOWLEDGE

Example Error	Misconception	Missing Knowledge
The given line is not a line of symmetry.	doesn't justify the answer, but can recognize that the given line is not a line of symmetry	RECOGNIZE LINES OF SYMMETRY
The given line is a line of symmetry because it goes through the middle of the figure.	believes that the line of symmetry always goes through the middle of the image, or that the line through the middle always spits the image into congruent mirror images	REPRESENT LINES OF SYMMETRY