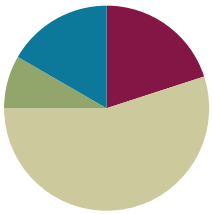
Lesson 12

Objective: Recognize lines of symmetry for given two-dimensional figures; identify line-symmetric figures and draw lines of symmetry.

Suggested Lesson Structure

Fluency Practice	(12 minutes)
Application Problem	(5 minutes)
Concept Development	(33 minutes)
Student Debrief	(10 minutes)
Total Time	**(60 minutes)**



Fluency Practice (12 minutes)

- Add and Subtract **4.NBT.4** (4 minutes)
- Find the Quotient and Remainder **4.NBT.6** (4 minutes)
- Find the Unknown Angle **4.MD.7** (4 minutes)

Add and Subtract (4 minutes)

Materials: (S) Personal white boards

Notes: This concept reviews adding and subtracting using the standard algorithm.

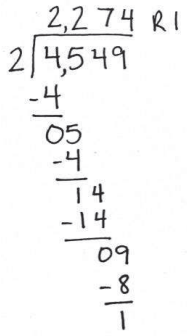
T: (Write 756 thousands 498 ones.) On your boards, write this number in standard form.
S: (Write 756,498.)
T: (Write 175 thousands 645 ones.) Add this number to 756,498 using the standard algorithm.
S: (Write 756,498 + 175,645 = 932,143 using the standard algorithm.)

Repeat the process for 482,949 + 375,678.

T: (Write 800 thousands.) On your boards, write this number in standard form.
S: (Write 800,000.)
T: (Write 648 thousands 745 ones.) Subtract this number from 800,000 using the standard algorithm.
S: (Write 800,000 – 648,745 = 151,255 using the standard algorithm.)

Repeat the process for 754,912 – 154,189.

Find the Quotient and Remainder (4 minutes)



Materials: (S) Personal white boards

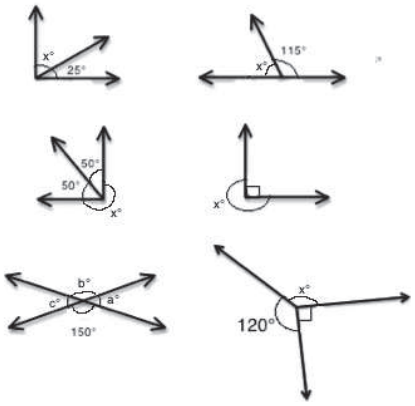
Note: This fluency reviews G4–M3–Lesson 28's Concept Development.

T: (Write 4549 ÷ 2.) On your boards, find the quotient and remainder.

S: (Write the quotient and remainder on the right.)

Continue with the following possible sequence: 6761 ÷ 5, 1665 ÷ 4, and 1335 ÷ 4.

Find the Unknown Angle (4 minutes)



Materials: (S) Personal white boards

Note: This fluency reviews G4–M4–Lesson 10.

T: (Project first unknown angle problem. Run finger over the larger angle.) This is a right angle. On your boards, write a number sentence to find the measure of $\angle x$.

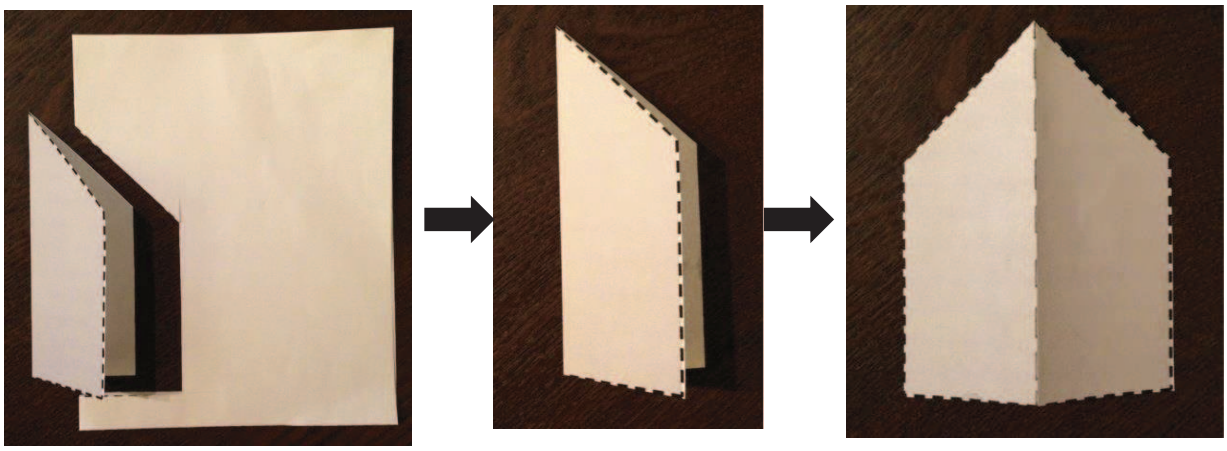
S: (Write 90 - 25 = x. Below it, write $x°$ = 65°.)

Continue with the remaining unknown angle problems.

Application Problem (5 minutes)

(Distribute Figure 1 from the activity template, pre-folded, to students or partners.)

Cut along the dotted line and unfold the figure. Notice how each side of the folded line matches. Then fold another way and see if the sides match. Discuss the attributes of the figure and your observations with your partner.



Note: This Application Problem leads into today's lesson on lines of symmetry.

Concept Development (33 minutes)

Materials: (T) Graph paper, copies of rectangles and squares, 1 parallelogram, 1 rhombus, 1 trapezoid, and 1 circle cutout, activity template (S) Graph paper, straightedge, scissors, activity template

Problem 1: Recognize folded symmetry.

T: What did you notice about the figure you cut out in the Application Problem?

S: It was a pentagon. → It had two right angles, two obtuse angles, and one acute angle. → When I cut it out, it was folded in half. → Both sides matched perfectly when folded in half. → When I folded it other ways, the sides did not match perfectly.

T: We can show the fold that cut the figure in half by using our straightedge and tracing that line.

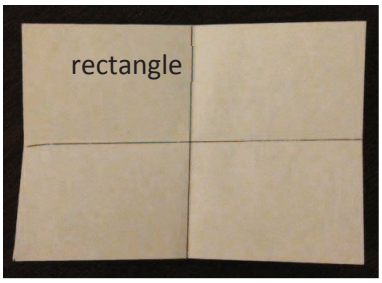
Model for students and allow time for students to trace the line created by the fold.

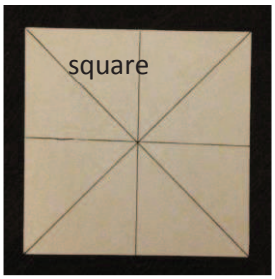
Distribute rectangles and squares, one per pair.

T: In your pair, one person fold the rectangle and the other the square as many ways as you can so that when it is folded, the shapes match. If you find a fold that creates two shapes that match, use a straightedge to record the line created by the fold.

Allow time for students to fold.

T: What did you notice when you folded these?





S: The square had more folds than the rectangle. → We folded the square four different ways and the sides matched perfectly each time. The rectangle only matched when folded two ways. → The rectangle folded into smaller rectangles, but the square folded into smaller rectangles and right triangles!

T: Why do you think the square had more folds with sides that matched than the rectangle?

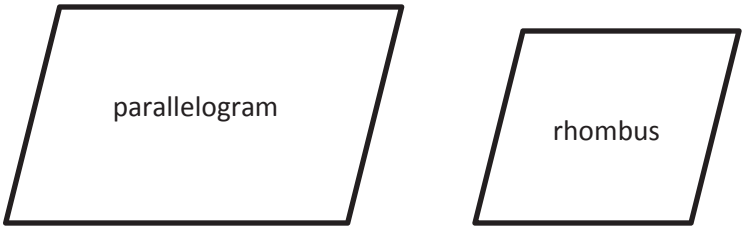
S: Because all the sides of the square are the same but not in the rectangle. → You could fold a square diagonally because all four sides are the same but you can't do that with the rectangle because two of its sides are longer.

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

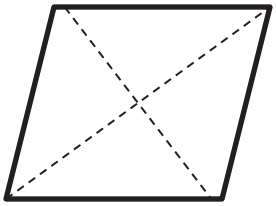
For students who may find folding paper challenging at first, offer the following:

- Model folding along lines of symmetry in a triangle.
- Provide step-by-step directions.
- Provide a pre-folded rectangle and square model which students can study and practice with before attempting their own.
- As a last resort, offer shapes that have fold lines to guide student folding. Then offer students a second opportunity to fold shapes independently.

Display the parallelogram and rhombus on the board and show cut-outs.



T: Here I have a parallelogram and a rhombus. I want to know how many times I can fold these so that the shapes created by the folds match.

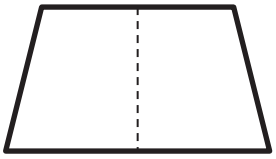


Invite students to come fold the cut-outs.

S: There are two folds in the rhombus that match but none in the parallelogram. → But a rectangle is a lot like a parallelogram and we found four lines of symmetry in a rectangle. → I guess it was the four right angles of the rectangle that made it work.

Display a trapezoid on the board and show cut-out.

T: Here is a trapezoid. Watch as I fold it and let me know when you see a fold that matches.



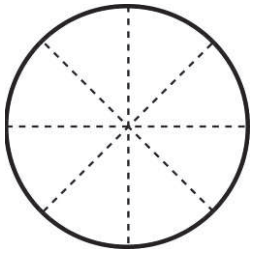
S: There is only one fold that matches in this trapezoid.

T: Just like the figure we cut out in the Application Problem, this trapezoid also has just one fold that matches. Will that be true for all trapezoids? Sketch some trapezoids on your boards and try to imagine their folds.

S: A trapezoid with a right angle doesn't have a fold. → A trapezoid that looks like our cut out, but the left side is slanted more, didn't have a fold.

T: It appears that the only trapezoid with a fold line that separates the shape in half is the trapezoid from our cutout, where when we fold it in half the corners match up.

Display a circle on the board and show cutout.



T: Here I have a circle. With your partner, discuss how many folds you think will match in a circle.

S: I think there will be four folds just like a square. → No, there are eight like in a pizza. → There are too many folds to count!

MP.3 T: Watch as I start making folds in my circle. Any way I make my fold, the sides match! Why is that?

S: Well a circle doesn't have sides, so I guess the round edges just let it fold a lot of different ways. → But I don't think we could fold an oval many different ways, and an oval doesn't have straight sides, just like circles. → The circle must be special that it has so many different folds.

T: A circle is a set of points that are the same distance from a center point. Measuring from the center point to the edge at any point on the circle will always measure the same length. On a square, when you measure from the center to a point on the side, you can get different lengths. (Demonstrate with a ruler.) This special attribute of a circle allows it to have an infinite number of lines of symmetry.

Problem 2: Identify lines of symmetry in familiar figures.

Display and distribute the images from the activity template.

T: With your partner, look at each image and determine whether there is a fold or folds that let the figure fold perfectly in half. If you find a fold that creates two shapes that match, use a straightedge to draw it.

T: Which images had one fold that matched?

S: The letter *A*, smiley face, heart, lobster, and butterfly.

T: Which images had more than one fold that matched?

S: The letter *H* and the star.

T: Watch as I use my straightedge to show the folds that create two shapes that match. Check to make sure you have the same lines drawn.

T: Does everyone see that? When we fold each of these images along the line, both halves match exactly. This line is called a **line of symmetry**.

T: Which images had no such folds?

S: The car, the hand, and the curved arrow.

T: We can say that these figures had no lines of symmetry. Discuss with your partner why these images don't have lines of symmetry.

S: If we fold the car in half, the front and the back of the car are different. One side has headlights, the other taillights. And the door doesn't match on both sides. If I folded it top to bottom, the top of the car doesn't have tires! → The hand can't fold left to right because all 5 fingers are different. The thumb and pinkie don't match. Top to bottom, the fingertips meet the wrist. Those aren't the same. → The arrow doesn't even work if we folded it diagonally because one end is flat and the other has the arrow.

Problem 3: Draw lines of symmetry.

Display Figure 2.

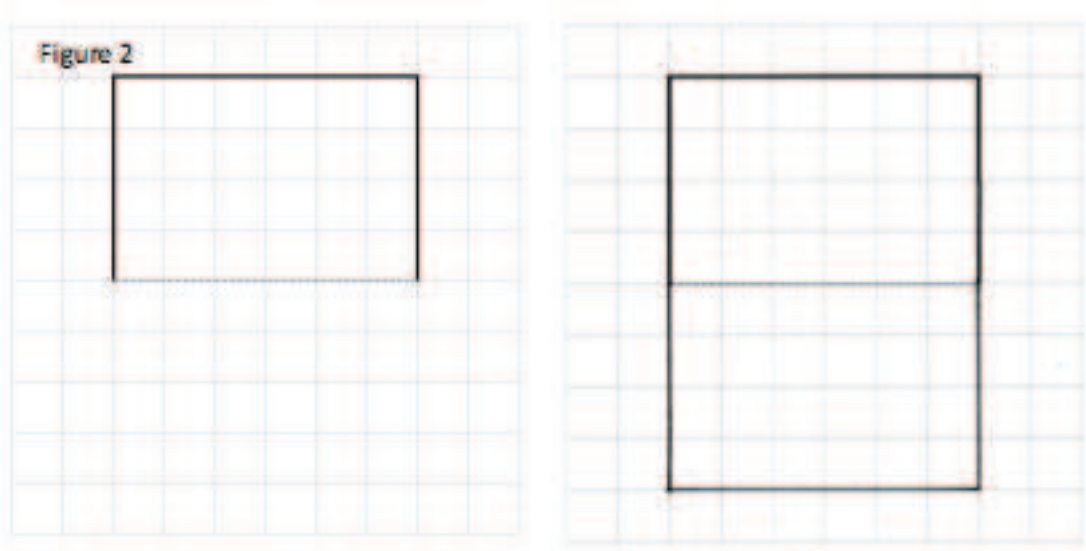
T: This figure is incomplete. The dashed line is the line of symmetry. In order to complete the figure, we need to make a mirror image of the figure that is already drawn. Use the grid to complete the figure. Discuss with your partner how to complete the figure so that it is symmetrical.

S: I can count the number of squares to help me draw. → We can use a straightedge to make sure the lines are straight. → It's 4 units wide, so we need to double that, and make it 8 units wide. → It's 6 units long, but we can just connect the vertical lines.

T: Complete Figure 2.

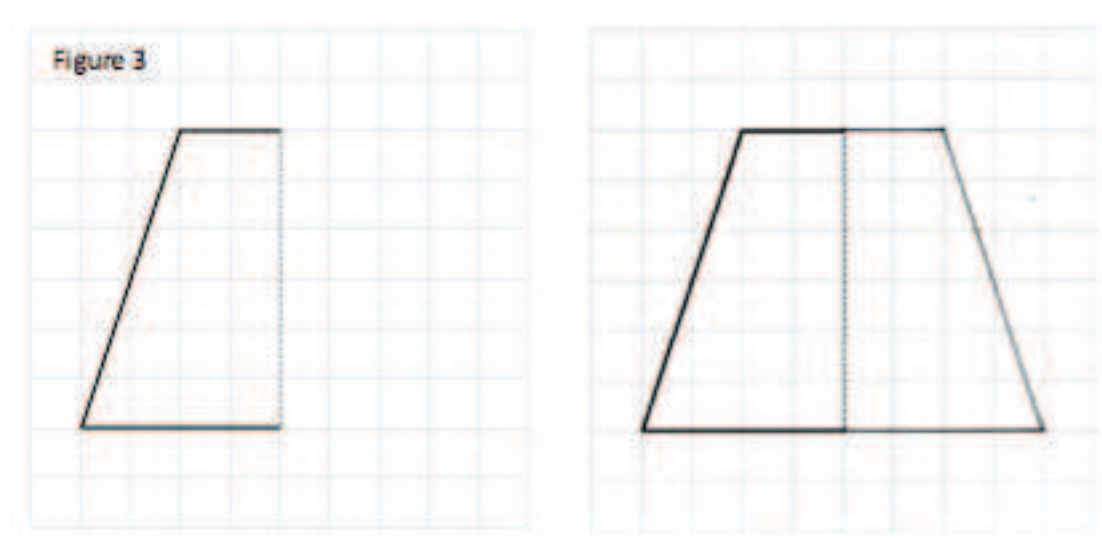
NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Challenge students working above grade level to draw an incomplete image on grid paper. After drawing the incomplete image, students can exchange papers and can challenge a partner to complete the image using the line of symmetry as a point of reference in order to create a mirror image.



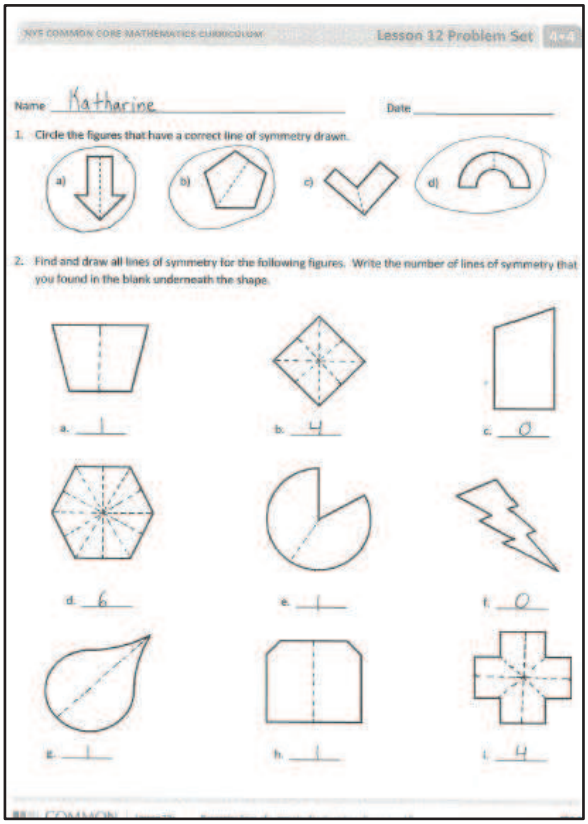
T: With your partner, complete Figure 3.

S: I will draw the horizontal lines first because they are connected to the figure. I don't know where to start drawing the slanted line. → I counted two squares for the top segment, and four squares for the bottom segment. Then I just connected them with a slanted segment. But I counted it to make sure it went up six and over two so that it matched the left side.



Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.


NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 12 Problem Set 4•4

Name Katharine Date

1. Circle the figures that have a correct line of symmetry drawn.

a) b) c) d)

2. Find and draw all lines of symmetry for the following figures. Write the number of lines of symmetry that you found in the blank underneath the shape.

a. 1 b. 4 c. 0

d. 6 e. 1 f. 0

g. 1 h. 1 i. 4

Student Debrief (10 minutes)

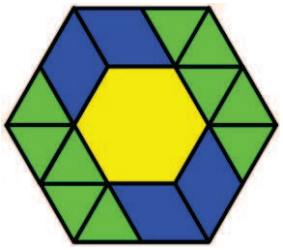
Lesson Objective: Recognize lines of symmetry for given two-dimensional figures: identify line-symmetric figures and draw lines of symmetry.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.

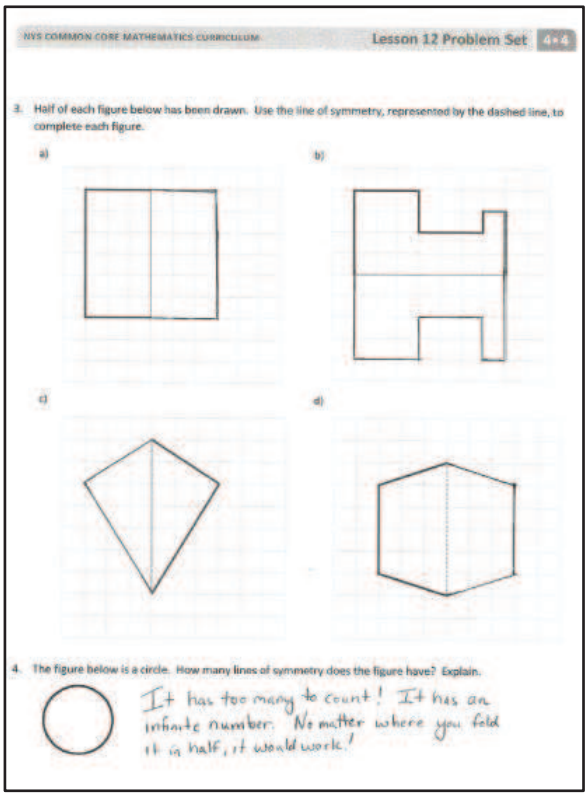
You may choose to use any combination of the questions below to lead the discussion.

- Which figures in Problem 2 were most difficult to see lines of symmetry in? Why are some easier and others more difficult?
- In Problem 3, what method did you use to complete each figure? How would you complete the figure if there were no graph paper?
- In Problem 4, why does a circle have an infinite number of **lines of symmetry**?
- Identify objects around the classroom or in nature that have lines of symmetry.
- In what ways are our bodies symmetrical and in what ways are they not symmetrical?
- How can you be sure objects have lines of symmetry?
- How can lines of symmetry help to solve problems quicker? Consider this shape to the right. How would finding a line of symmetry allow you to more quickly count the number of green triangles in the figure?



Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students' understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.



NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 12 Problem Set 4•4

3. Half of each figure below has been drawn. Use the line of symmetry, represented by the dashed line, to complete each figure.

a)

b)

c)

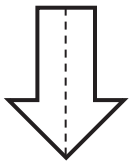
d)

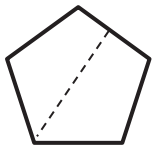
4. The figure below is a circle. How many lines of symmetry does the figure have? Explain.

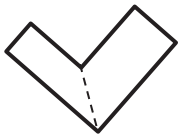
It has too many to count! It has an infinite number. No matter where you fold it in half, it would work!

Name _____ Date _____ + _____

1. Circle the figures that have a correct line of symmetry drawn.

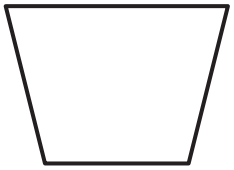
a. 

b. 

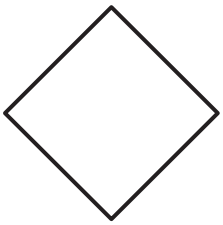
c. 

d. 

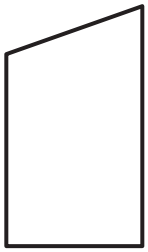
2. Find and draw all lines of symmetry for the following figures. Write the number of lines of symmetry that you found in the blank underneath the shape.



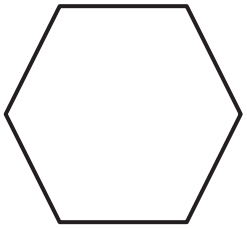
a. _____



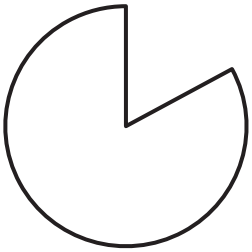
b. _____



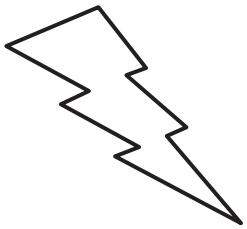
c. _____



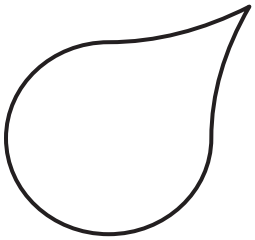
d. _____



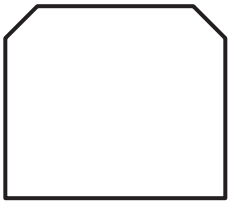
e. _____



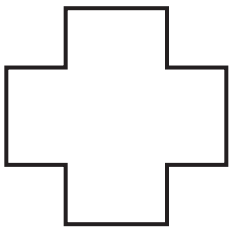
f. _____



g. _____



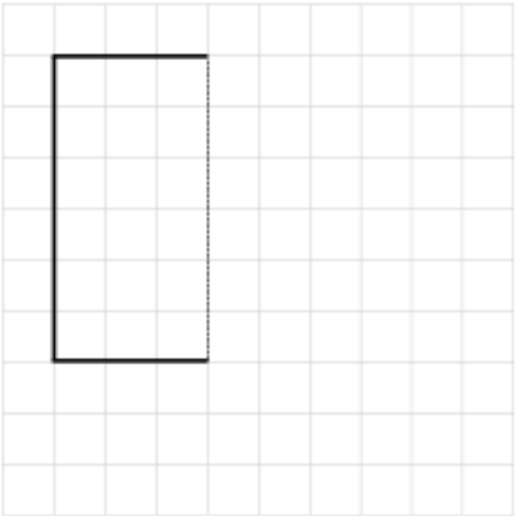
h. _____



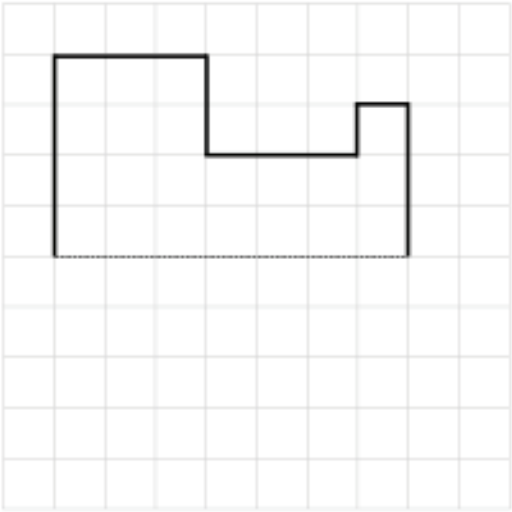
i. _____

3. Half of each figure below has been drawn. Use the line of symmetry, represented by the dashed line, to complete each figure.

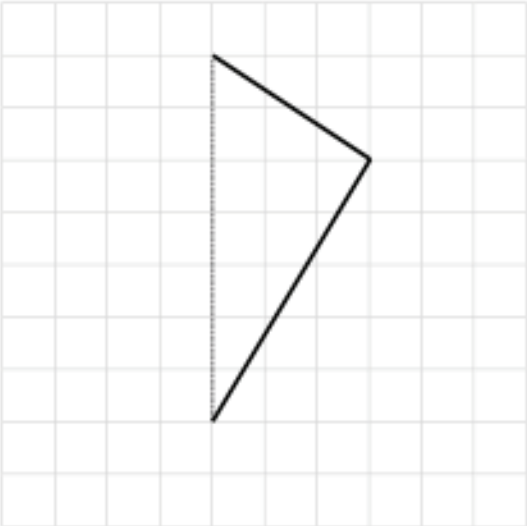
a)



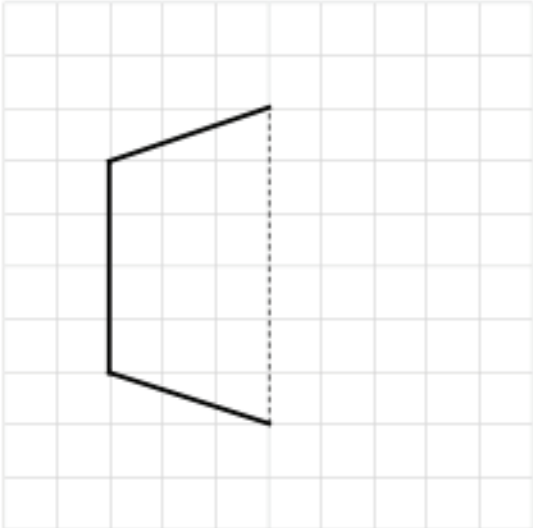
b)



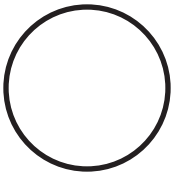
c)



d)

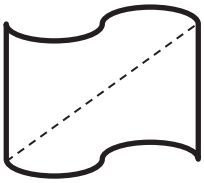


4. The figure below is a circle. How many lines of symmetry does the figure have? Explain.



Name _____ Date _____

1. Is the line drawn a line of symmetry? Circle your choice.

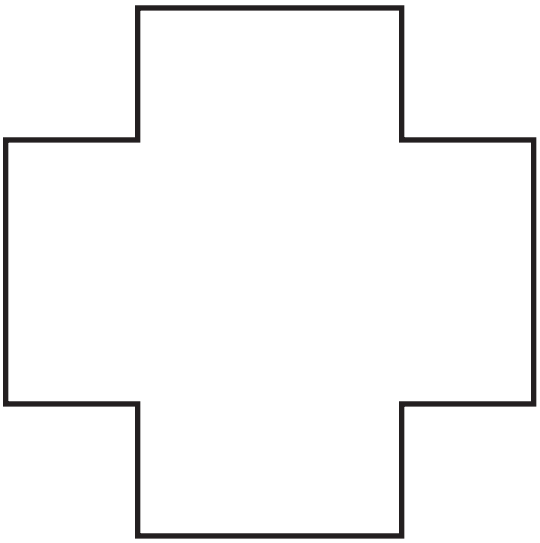


Yes No

Yes No

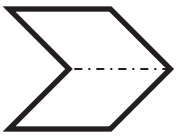
Yes No

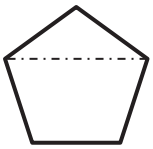
2. Draw as many lines of symmetry as you can find in the figure below.



Name _____ Date _____

1. Circle the figures that have a correct line of symmetry drawn.

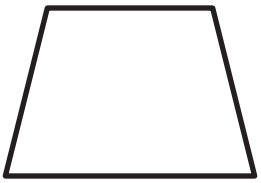
a. 

b. 

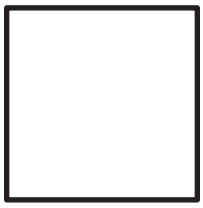
c. 

d. 

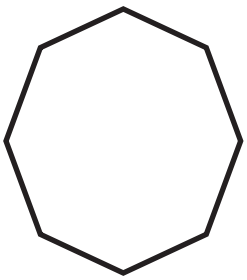
2. Find and draw all lines of symmetry for the following figures. Write the number of lines of symmetry that you found in the blank underneath the shape.



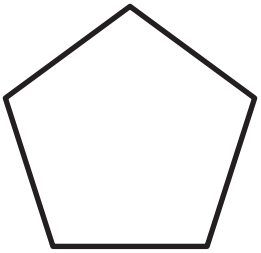
a. _____



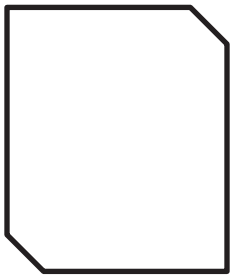
b. _____



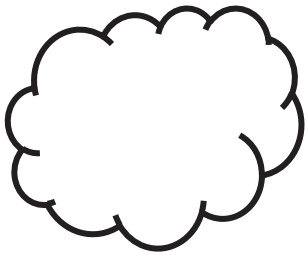
c. _____



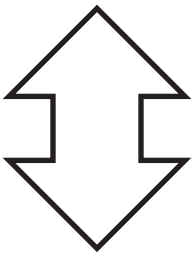
d. _____



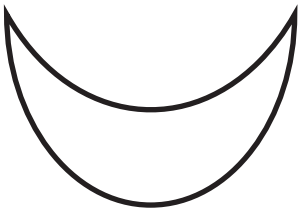
e. _____



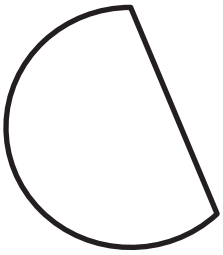
f. _____



g. _____



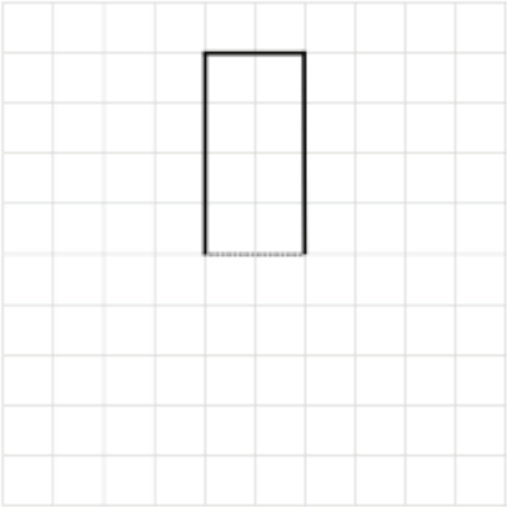
h. _____



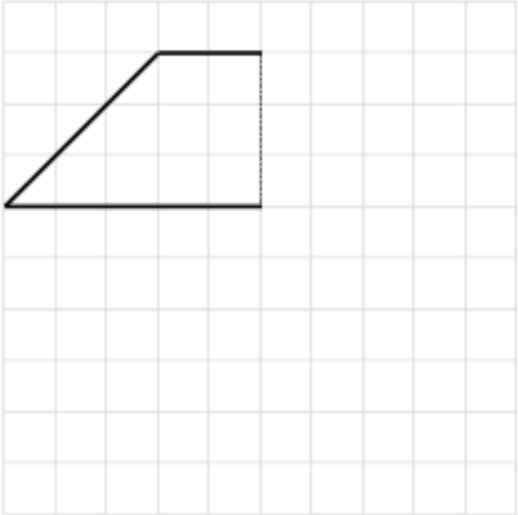
i. _____

3. Half of each figure below has been drawn. Use the line of symmetry, represented by the dashed line, to complete each figure.

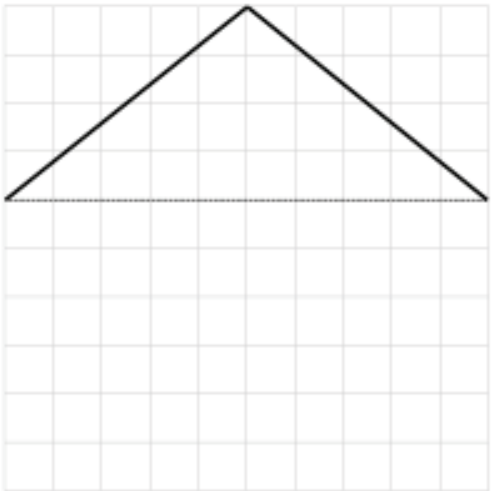
a)



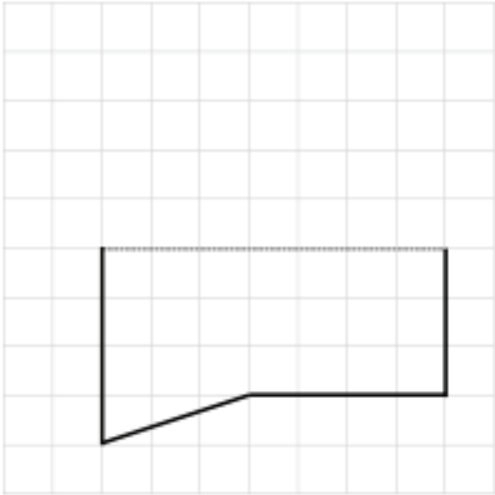
b)



c)



d)



4. Is there another shape that has the same number of lines of symmetry as a circle? Explain.

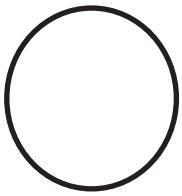
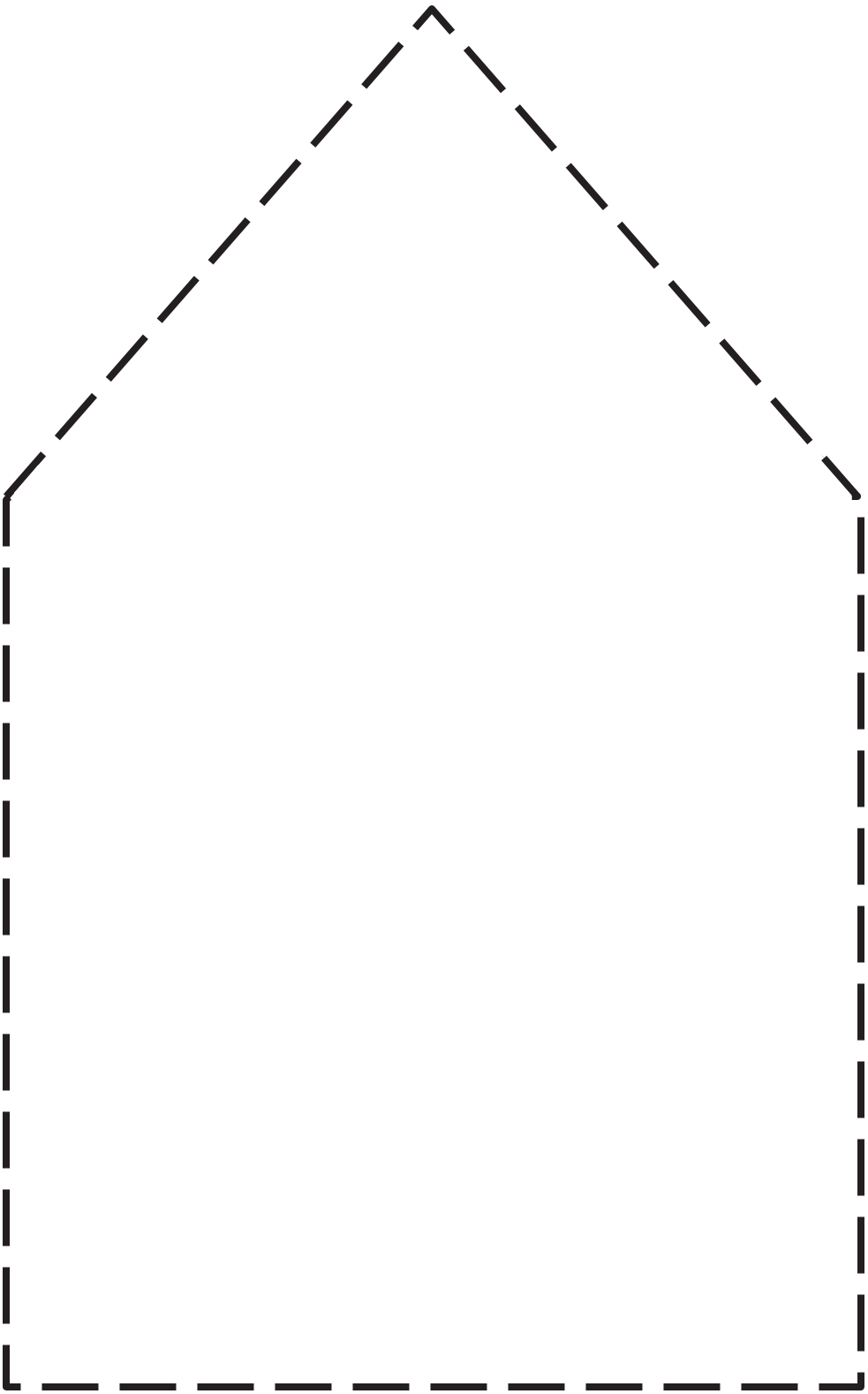


Figure 1



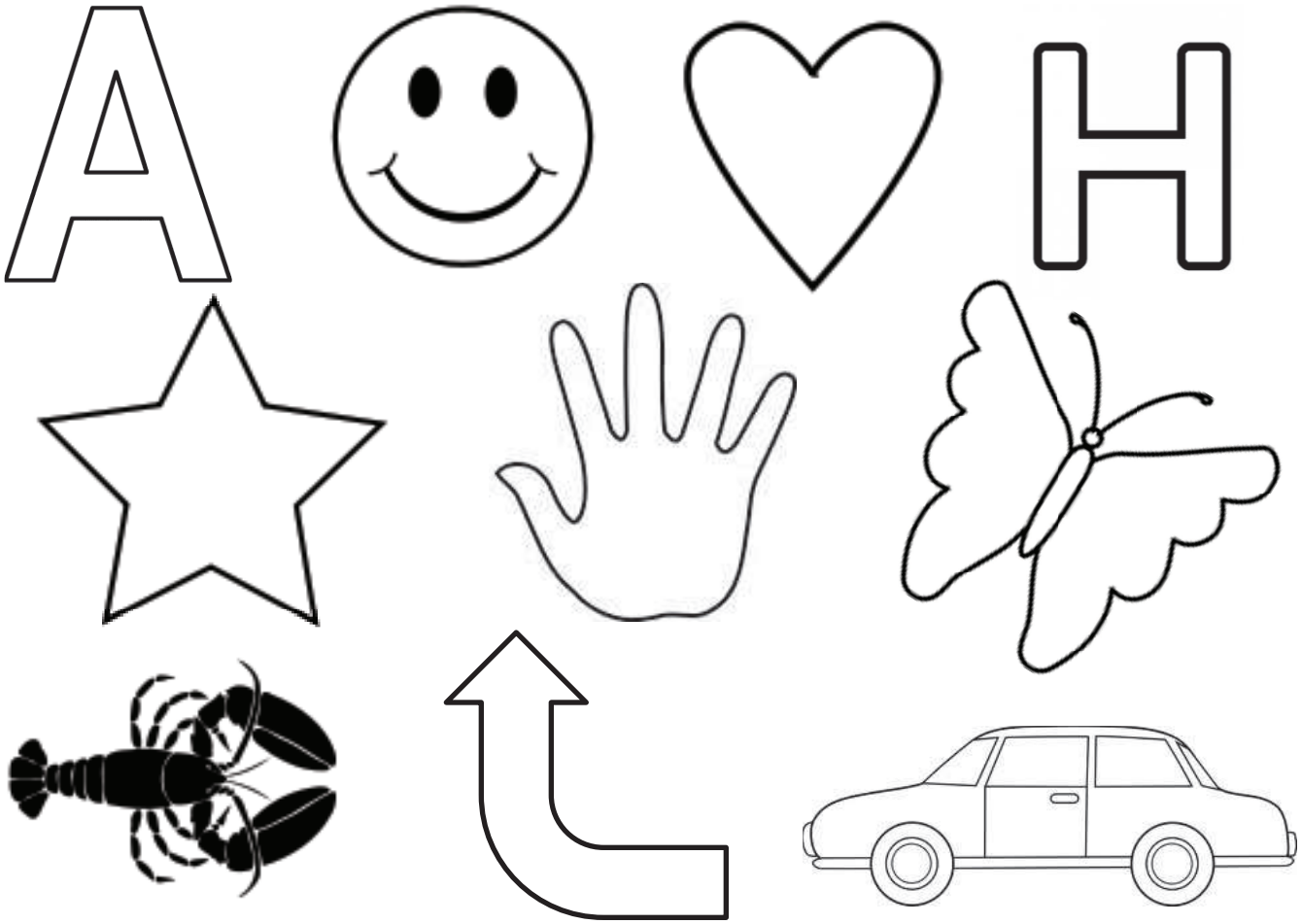


Figure 2

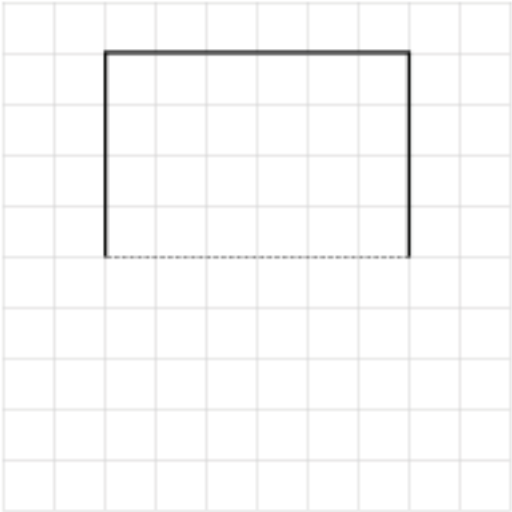


Figure 3