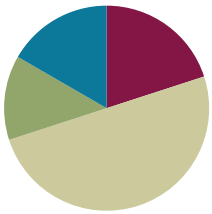
Lesson 14

Objective: Define and construct triangles from given criteria. Explore symmetry in triangles.

Suggested Lesson Structure



Fluency Practice	(12 minutes)
Application Problem	(8 minutes)
Concept Development	(30 minutes)
Student Debrief	(10 minutes)
Total Time	**(60 minutes)**

Fluency Practice (12 minutes)

- Divide Three Different Ways **4.NBT.6** (4 minutes)
- Physiometry **4.G.3** (4 minutes)
- Classify the Triangle **4.G.2** (4 minutes)

Divide Three Different Ways (4 minutes)

Materials: (S) Personal white boards

Note: This fluency reviews G4–M3–Lessons 30–32's content. Alternatively, have students select a solution strategy.

T: (Write 148 ÷ 3.) Find the quotient using number disks.
S: (Solve with number disks.)
T: Find the quotient using the area model.
S: (Solve with the area model.)
T: Find the quotient using the standard algorithm.
S: (Solve with the standard algorithm.)

Continue with 1,008 ÷ 4.

Physiometry (4 minutes)

Materials: (S) Personal white boards

Note: Kinesthetic memory is strong memory. This fluency reviews terms learned in G4–M4–Lesson 12.

T: Stand up.

T: I'm trying to make my body position look symmetrical.

T: (Raise left arm so that fingers are pointing directly to the wall. Leave the other arm hanging down.) Is my position symmetrical now?

S: No.

Continue with other symmetrical and non-symmetrical positions.

T: With your arms, model a line that runs parallel to the floor. Are you modeling a position that has symmetry?

S: Yes.

T: Model a ray. Are you modeling a position of symmetry?

S: No.

T: Model a line segment. Are you modeling a position of symmetry?

S: Yes.

Classify the Triangle (4 minutes)

Materials: (S) Personal white boards

Note: This fluency reviews G4–M4–Lesson 13.

T: (Project triangle.) What's the measure of the largest given angle in this triangle?

S: 110°.

T: Is the triangle equilateral, scalene, or isosceles?

S: Scalene.

T: Why?

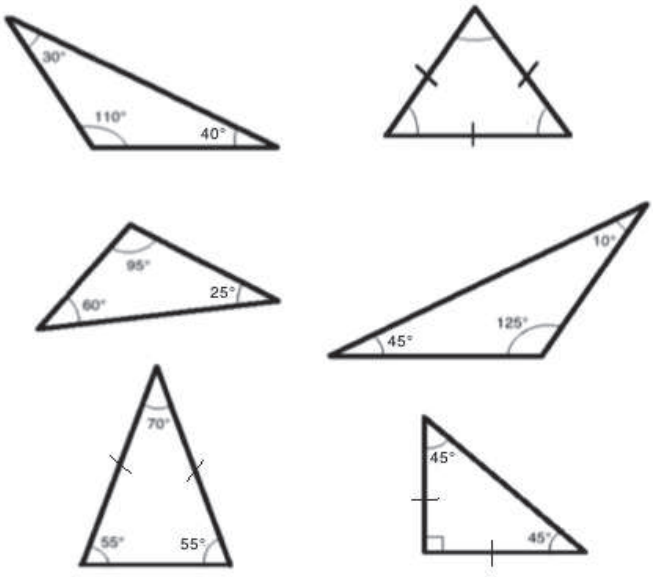
S: Because all the sides are different lengths.

T: Is the same triangle acute, right, or obtuse?

S: Obtuse.

T: Why?

S: Because there's an angle greater than 90°.

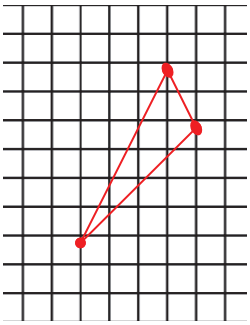


Continue the process for the other triangles.

Application Problem (8 minutes)

Draw three points on your grid paper so that, when connected, they can form a triangle. Use your straightedge to connect the three points to form a triangle. Switch papers with your partner. Determine how the triangle your partner constructed can be classified: right, acute, obtuse, equilateral, isosceles, or scalene.

- What categories does your partner's triangle belong to?
- What attributes did you look at in order to classify the triangle?
- What tools did you use to help draw your triangle and then classify your partner's triangle?

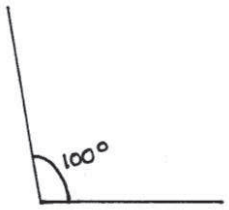


Note: This Application Problem reviews G4–4–Lesson 13. Students classify the triangle according to both side length and angle measure. Through discussion, students are reminded that each triangle can be classified in at least two ways. Some will discover that if they have drawn an equilateral triangle, it can be classified in three different ways. (Note that because students are drawing triangles by connecting three random points, there may not be examples of equilateral or isosceles triangles.) The Application Problem bridges to today's lesson where students will construct triangles from given criteria.

Concept Development (30 minutes)

Materials: (T) Grid paper, ruler, protractor (S) Grid paper, ruler, protractor

Problem 1: Construct an obtuse isosceles triangle.



T: Let's construct an obtuse triangle that is also isosceles. What tools should we use?

S: We can use a protractor to measure an angle larger than 90°. Let's make it 100°.

MP.6

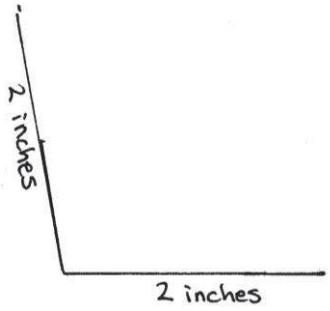
T: (Teacher demonstrates.) Now it's your turn.

S: (Draw a 100° angle.)

T: Now what? What do we know about the sides of an isosceles triangle?

S: At least two of the sides have to be the same length.

T: Use your ruler to measure each of the sides that are next to the angle.



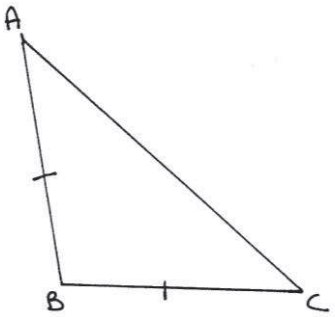
Let's make them each 2 inches.

S: (Measure and draw each side to be 2 inches.)

S: Now we just have to connect the endpoints of the first two sides to form the triangle.

S: (Finish drawing the triangle.)

T: Do we have an obtuse triangle that is also an isosceles triangle? It looks like it, but let's measure to be sure. First, let's see if it's an obtuse triangle. What does an obtuse triangle need to have?



S: An obtuse angle. →We have one angle that measures 100°. That makes it obtuse.

MP.6

T: Now, let see if it's an isosceles triangle. What did we do to make sure that this triangle is isosceles?

S: We made at least two of the sides the same length. → Two of the sides measure 2 inches. That makes it isosceles.

S: It's both isosceles and obtuse!

T: Let's call it ΔABC. Mark the triangle to show the relationship of the sides.

Problem 2: Construct a right scalene triangle.

T: Let's try another. Let's construct a right scalene triangle. Talk to your partner about what to draw first.

S: Let's draw two sides of the triangle. We know that they have to be different lengths. → No, that doesn't work because maybe we won't have a right angle. We have to draw the right angle first.

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Challenge students working above grade level to construct and classify triangles of a given criteria. For example, ask, "Construct triangles having a 45° angle and side lengths of 2 cm and 3 cm. How many types of triangles can you make?" Students may work independently or in pairs.

T: Construct a right angle.

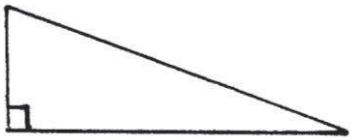
S: (Construct a right angle.)

T: Now what?

S: Well, if it's scalene, we need three different side lengths. We already drew two of the sides, but we need to make sure that they are different lengths.

T: Measure to be sure that they are different lengths.

S: (Measure.)



S: Oops! Two of my sides are the same length. That would make it isosceles. I need to try again.

T: What next?

S: Now we can connect the two sides that we just drew so that we have a triangle. (Draw the triangle's third segment.)

T: Ok. Talk over the final step with your partner.

S: We need to make sure it's both right and scalene. → We can use the protractor to make sure there

is a 90° angle. → Yes, it's 90°. Now measure the sides to make sure that they are all different lengths. → I have a right scalene triangle.

T: Let's remember to label and mark the triangle with symbols to show angles and side lengths if necessary. Will this triangle have tick marks?

S: No! Only isosceles and equilateral triangles will.

Problem 3: Explore classifications of triangles.

T: Look back at the triangle that you drew for today's Application Problem. Raise your hand if drew a scalene triangle. Raise your hand if you drew an equilateral triangle. Raise your hand if you drew a scalene equilateral triangle.

S: That's silly. You can't have an scalene equilateral triangle!

T: Discuss with a partner: True or false, a triangle can be both scalene and equilateral. Explain.

S: That's false. All of the sides have to be the same length if it's equilateral, but a scalene triangle has to have sides that are all different lengths. The sides can't be the same length and different lengths at the same time!

T: True or false, an equilateral triangle is also obtuse?

S: False. You can't do that either. The sides won't be equal. One of them will be longer. → We know that equilateral triangles have three acute angles that measure the same.

T: I'm imagining an equilateral right triangle. Can it exist?

S: No. Equilateral triangles have three acute angles that measure the same.

T: I'm imagining a scalene acute triangle. Can it exist?

S: Yes! The triangle that I drew is classified that way!

T: I'm imagining a triangle that is isosceles and equilateral. Can it exist?

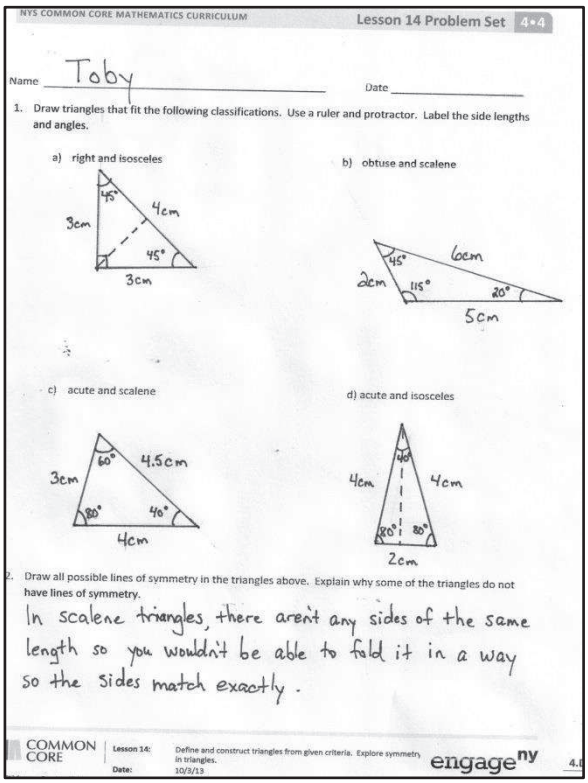
S: Yes! An equilateral triangle is an isosceles triangle, too, because it has at least two equal sides. That means it can have three equal sides.

NOTES ON MULTIPLE MEANS OF REPRESENTATION:

Scaffold naming triangles using two criteria for English language learners and others. Refer to definitions and accompanying diagrams of *equilateral, isosceles, scalene, acute, obtuse,* and *right triangles* on a word wall and/or have students refer to their personal math dictionaries. Before constructing triangles, It may be beneficial to show examples of triangles that students classify and discuss in the language of their choice.

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 14 Problem Set 4•4

Name Toby Date

1. Draw triangles that fit the following classifications. Use a ruler and protractor. Label the side lengths and angles.

a) right and isosceles

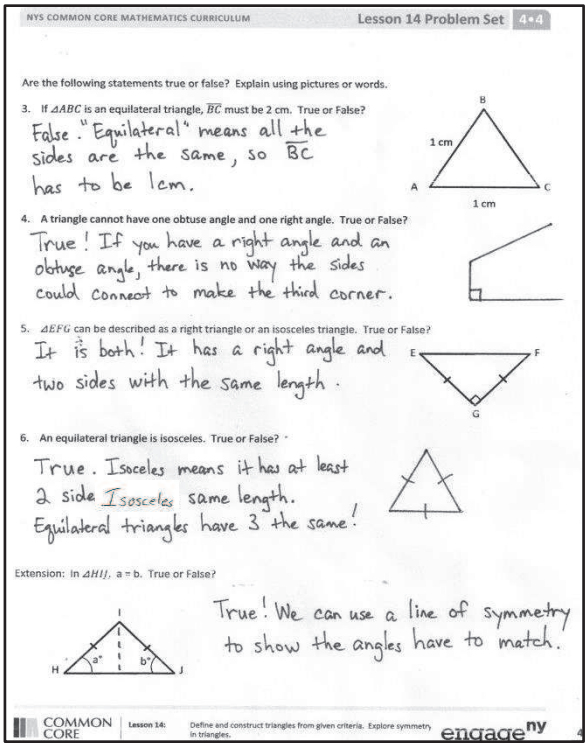
b) obtuse and scalene

c) acute and scalene

d) acute and isosceles

2. Draw all possible lines of symmetry in the triangles above. Explain why some of the triangles do not have lines of symmetry.

In scalene triangles, there aren't any sides of the same length so you wouldn't be able to fold it in a way so the sides match exactly.


NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 14 Problem Set 4•4

Are the following statements true or false? Explain using pictures or words.

3. If $\triangle ABC$ is an equilateral triangle, $\overline{BC}$ must be 2 cm. True or False?

False. "Equilateral" means all the sides are the same, so $\overline{BC}$ has to be 1cm.

4. A triangle cannot have one obtuse angle and one right angle. True or False?

True! If you have a right angle and an obtuse angle, there is no way the sides could connect to make the third corner.

5. $\triangle EFG$ can be described as a right triangle or an isosceles triangle. True or False?

It is both! It has a right angle and two sides with the same length.

6. An equilateral triangle is isosceles. True or False?

True. Isosceles means it has at least 2 side Isosceles same length. Equilateral triangles have 3 the same!

Extension: In $\triangle HIJ$, a = b. True or False?

True! We can use a line of symmetry to show the angles have to match.

Student Debrief (10 minutes)

Lesson Objective: Define and construct triangles from given criteria. Explore symmetry in triangles.

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.

- In Problem 4, explain how you got your answer of true or false.
- Discuss your answer to Problem 6. How are these two triangles closely related?
- In Problem 1, which of the triangles was most challenging to draw? Why?
- When you were drawing a triangle that had two attributes, how did you determine what to draw first, the side length or the angle measure?
- From Problem 2, can you determine which types of triangles never have lines of symmetry?
- If a triangle has one line of symmetry, what kind of triangle does it have to be? If a triangle has three lines of symmetry, what kind of triangle does it have to be?
- Why is it important to verify our triangles' attributes after we have constructed them?

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.

Name _____ Date _____

1. Draw triangles that fit the following classifications. Use a ruler and protractor. Label the side lengths and angles.

   a. right and isosceles

   b. obtuse and scalene

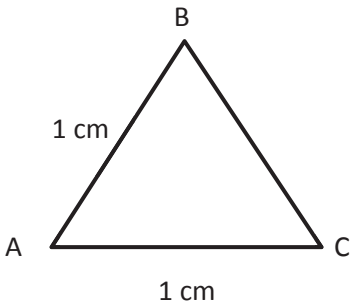
   c. acute and scalene

   d. acute and isosceles

2. Draw all possible lines of symmetry in the triangles above. Explain why some of the triangles do not have lines of symmetry.

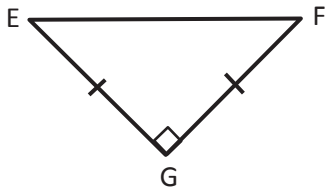
Are the following statements true or false? Explain using pictures or words.

3. If $\triangle ABC$ is an equilateral triangle, $\overline{BC}$ must be 2 cm. True or False?



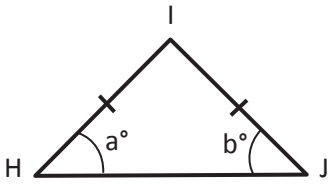
4. A triangle cannot have one obtuse angle and one right angle. True or False?

5. $\triangle EFG$ can be described as a right triangle and an isosceles triangle. True or False?



6. An equilateral triangle is isosceles. True or False?

Extension: In $\triangle HIJ$, a = b. True or False?



Name _____ Date _____

1. Draw an obtuse isosceles triangle, and then draw any lines of symmetry if they exist.

2. Draw a right scalene triangle, and then draw any lines of symmetry if they exist.

3. Every triangle has at least ____ acute angles.

Name _____ Date _____

1. Draw triangles that fit the following classifications. Use a ruler and protractor. Label the side lengths and angles.

   a. right and isosceles

   b. right and scalene

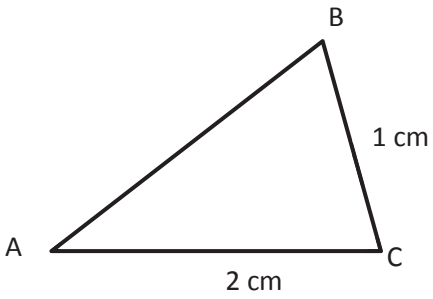
   c. obtuse and isosceles

   d. acute and scalene

2. Draw all possible lines of symmetry in the triangles above. Explain why some of the triangles do not have lines of symmetry.

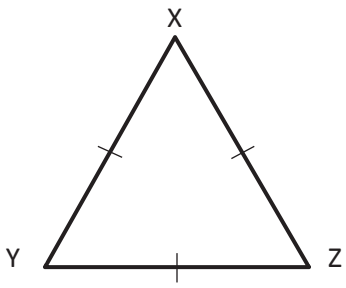
Are the following statements true or false? Explain.

3. ΔABC is an isosceles triangle. $\overline{AB}$ must be 2 cm. True or False?



4. A triangle cannot have both an acute angle and a right angle. True or False?

5. $\measuredangle XYZ$ can be described as both equilateral and acute. True or False?



6. A right triangle is always scalene. True or False?

Extension: In $\measuredangle ABC$, x = y. True or False?