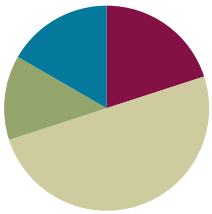
Lesson 14

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 board

Note: This fluency activity reviews the content of Module 3 Lessons 28–30. Alternatively, have students select a solution strategy.

T: (Write 148 ÷ 3.) Find the quotient by drawing place value disks.
S: (Solve by drawing place value disks.)
T: Find the quotient using the area model.
S: (Solve using the area model.)
T: Find the quotient using the standard algorithm.
S: (Solve using the standard algorithm.)

Continue with 1,008 ÷ 4.

Physiometry (4 minutes)

Note: Kinesthetic memory is strong memory. This fluency exercise reviews terms learned in Lesson 12.

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

T: (Raise left arm so fingers point 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)

Note: This fluency activity reviews 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.

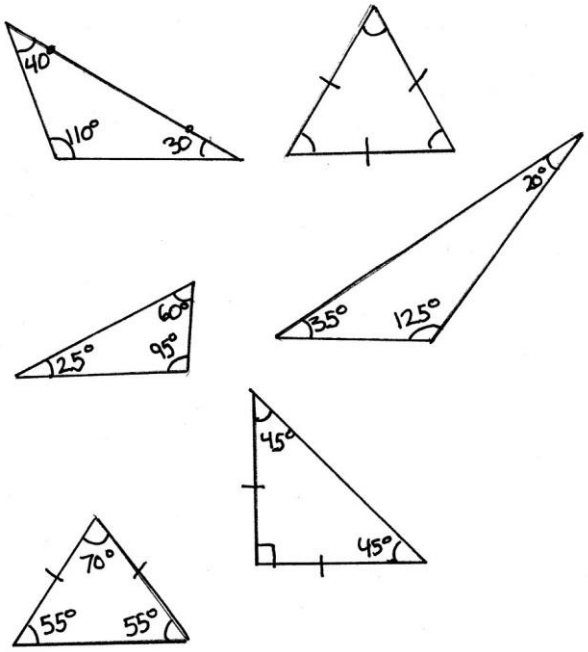
T: Is the same triangle acute, right, or obtuse?

S: Obtuse.

T: Why?

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

Continue the process for the other triangles.

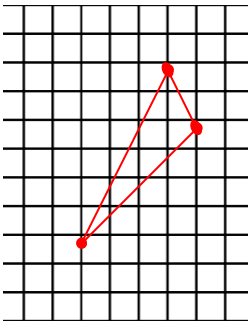


Application Problem (8 minutes)

Materials: (S) Square grid paper, ruler, protractor

Draw three points on your grid paper so that, when connected, they 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.

- How can you classify your partner's triangle?
- What attributes did you look at to classify the triangle?
- What tools did you use to help draw your triangle and classify your partner's triangle?

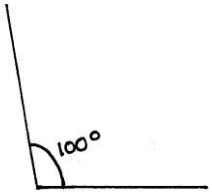


My partner's triangle is an obtuse scalene triangle. I looked at the angle measures and the side lengths in order to classify the triangle. I used my protractor, ruler, and grid paper to help me draw my triangle and to classify my partner's triangle.

Note: This Application Problem reviews 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 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 Concept Development, where students construct triangles from given criteria.

Concept Development (30 minutes)

Materials: (T/S) Square grid paper, ruler, protractor



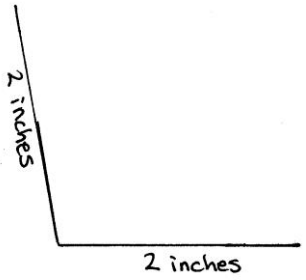
Problem 1: Construct an obtuse isosceles triangle.

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°.

T: (Model.) Now, it's your turn.

S: (Draw a 100° angle.)



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

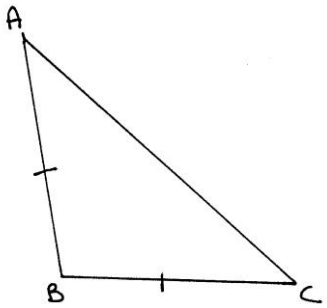
S: At least two of the sides have to be the same length.

MP.6

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.

T: Now, let's 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.

MP.6

S: It's both isosceles and obtuse!

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

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Challenge students working above grade level to construct and classify triangles of a given criteria. For example, say, "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.

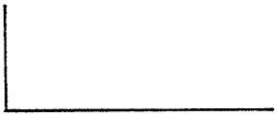
Problem 2: Construct a right scalene triangle.

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.

T: Construct a right angle.

S: (Construct a right angle.)

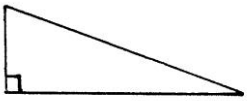


T: Now what?

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, we can 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 you 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 a 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, 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 should solve these problems using the RDW approach used for Application Problems.

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.

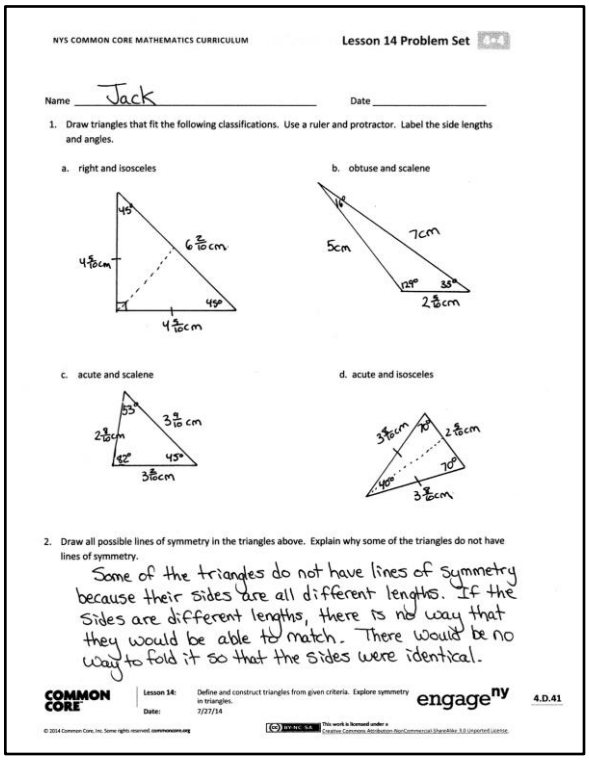
Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set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

Any combination of the questions below may be used to lead the discussion.

- In Problem 4, explain why you answered 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 with assessing students' understanding of the concepts that were presented in today's lesson and planning more effectively for future lessons. The questions may be read aloud to the students.



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

Name Jack 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

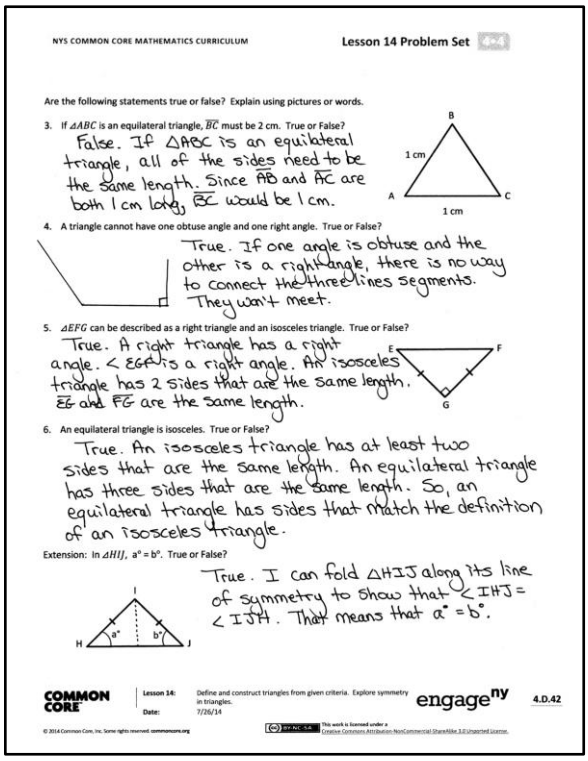
c. acute and scalene

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.

Some of the triangles do not have lines of symmetry because their sides are all different lengths. If the sides are different lengths, there is no way that they would be able to match. There would be no way to fold it so that the sides were identical.

COMMON CORE Lesson 14: Define and construct triangles from given criteria. Explore symmetry in triangles. Date: 7/27/14 engage^ny 4.D.41



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. If $\triangle ABC$ is an equilateral triangle, all of the sides need to be the same length. Since $\overline{AB}$ and $\overline{AC}$ are both 1 cm long, $\overline{BC}$ would be 1 cm.

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

True. If one angle is obtuse and the other is a right angle, there is no way to connect the three lines segments. They won't meet.

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

True. A right triangle has a right angle. $\angle EGF$ is a right angle. An isosceles triangle has 2 sides that are the same length. $\overline{EG}$ and $\overline{FG}$ are the same length.

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

True. An isosceles triangle has at least two sides that are the same length. An equilateral triangle has three sides that are the same length. So, an equilateral triangle has sides that match the definition of an isosceles triangle.

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

True. I can fold $\triangle HIJ$ along its line of symmetry to show that $\angle IHJ = \angle IJH$. That means that $a° = b°$.

COMMON CORE Lesson 14: Define and construct triangles from given criteria. Explore symmetry in triangles. Date: 7/26/14 engage^ny 4.D.42

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

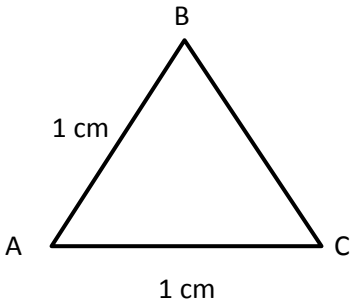
   c. Acute and scalene

   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.

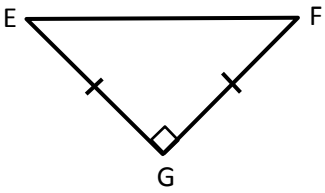
Are the following statements true or false? Explain using pictures or words.

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



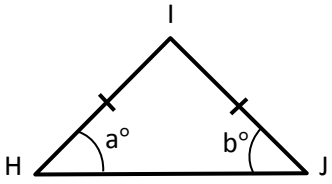
4. A triangle cannot have one obtuse angle and one right angle. True or False?

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

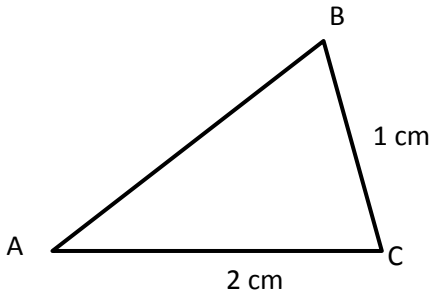
   c. Obtuse and isosceles

   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.

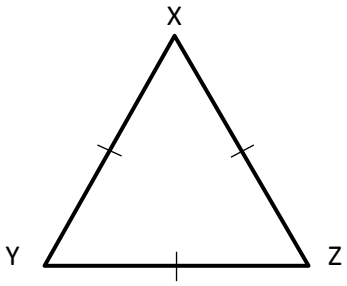
Are the following statements true or false? Explain.

3. $\triangle ABC$ 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. $\triangle XYZ$ can be described as both equilateral and acute. True or False?



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

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