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GRADE 3 MATH

REGION 13
EDUCATION SERVICE CENTER

Strand 4: Geometry and Measurement

3.6 Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional geometric figures to develop generalizations about their properties.

3.6A

3.6 Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional geometric figures to develop generalizations about their properties. The student is expected to:

A classify and sort two- and three-dimensional solids, including cones, cylinders, spheres, triangular and rectangular prisms, and cubes based on attributes using formal geometric language. *(RC3, RS)*

The two verbs for this standard are classify and sort. For this state standard, students use formal geometric language to classify and sort figures.

Classify determine the name of a figure based on its attributes or defining characteristics

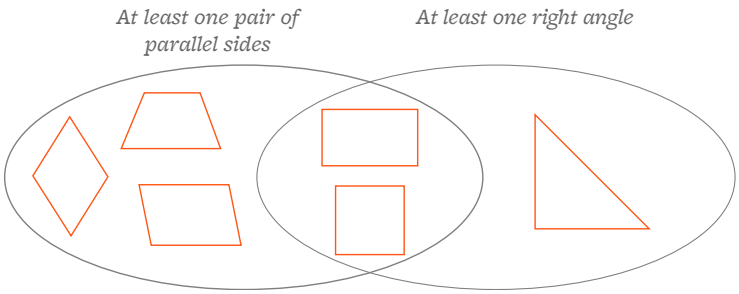
Sort put figures into groups based on their attributes

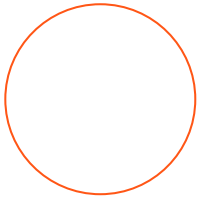
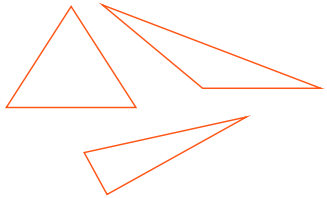
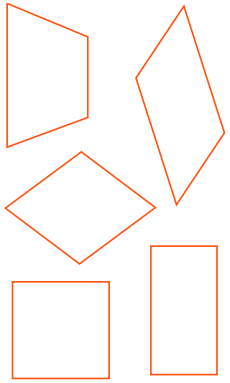
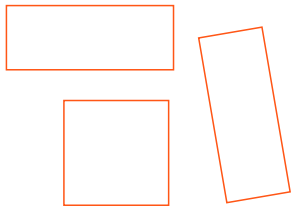
Example/Activity

Attributes that may be used to sort figures:
- four sides vs. three sides vs. six sides
- curved sides vs. sides that are not curved
- all congruent sides vs. two pairs of congruent sides vs. no congruent sides
- one pair of parallel sides vs. two pairs of parallel sides
- all rectangular faces vs. some rectangular faces vs. no rectangular faces
- faces that include a circle vs. faces that do not include a circle

The following is an example of classifying and sorting a set of two-dimensional figures based on attributes.

Attributes of Two-Dimensional Figures

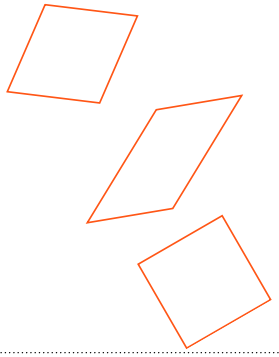


Name of Figure	Diagram	Defining Characteristics
circle		» curved » no straight sides » closed **Note:** The official definition of a circle is that every point on the edge is the same distance from the center of the circle. The "same distance" part is what keeps the circle from being an oval. It is NOT necessary that 1st grade students understand this. This is teacher content knowledge only.
triangle		» three sides » three vertices » three angles » closed
quadrilateral		» four sides » four vertices » four angles This is a large class of figures that includes rectangles, rhombuses, squares, parallelograms, and trapezoids.
rectangle		» special kind of quadrilateral » four sides » four vertices » four right angles » closed » opposite sides parallel » Sides do not have to be congruent, but they may be congruent. If they are all congruent, the figure is also called a square.

square

- special kind of quadrilateral
- four sides
- four vertices
- right angles
- closed
- all sides congruent; no exceptions
- opposite sides parallel

rhombus



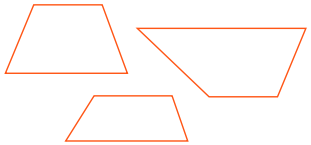
- special kind of quadrilateral
- four sides
- four vertices
- four angles
- all sides congruent; no exceptions
- closed
- opposite sides parallel

Angles do not have to be right angles, but if they are all right angles, the figure is also called a square.

parallelogram

- special kind of quadrilateral
- four sides
- four angles
- four vertices
- opposite sides congruent
- opposite sides parallel

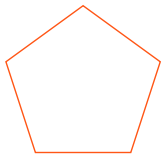
trapezoid



- special kind of quadrilateral
- four sides
- four vertices
- four angles
- one pair of parallel sides
- The other two sides are not parallel, but they may be congruent.

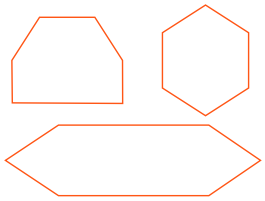
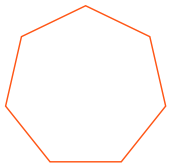
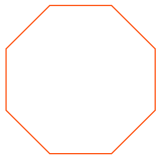
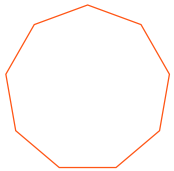
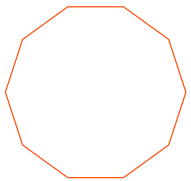
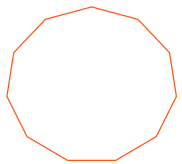
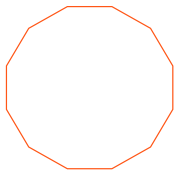
Note: The top left trapezoid has two congruent sides; the others do not.

pentagon

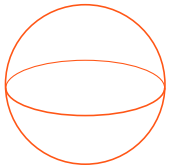
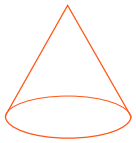
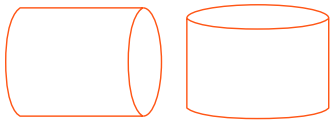
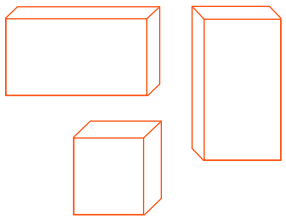
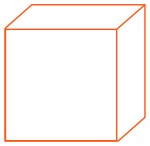
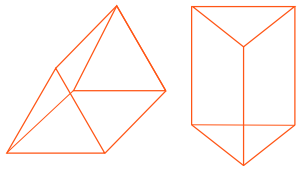


- five sides
- five vertices
- five angles
- closed

Vocabulary Note: "penta" means 5; "gon" means sides.

hexagon		» six sides » six vertices » six angles » closed Vocabulary Note: "hexa" means 6; "gon" means sides.
heptagon		» 7 sides » 7 vertices » 7 angles » Closed Vocabulary Note: "hepta" means 7; "gon" means sides.
octagon		» 8 sides » 8 vertices » 8 angles » closed Vocabulary Note: "octa" means 8; "gon" means sides.
nonagon		» 9 sides » 9 vertices » 9 angles » closed Vocabulary Note: "nona" means 9; "gon" means sides.
decagon		» 10 sides » 10 vertices » 10 angles » closed Vocabulary note: "deca" means 10; "gon" means sides.
11-gon		» 11 sides » 11 vertices » 11 angles » closed
dodecagon		» 12 sides » 12 vertices » 12 angles Vocabulary Note: "dodeca" means 12; "gon" means sides.

Three-Dimensional Solids

Name of Figure	Diagram	Defining Characteristics/Attributes
sphere		» three-dimensional » curved surface » distance from the center **Note:** The official definition of a sphere is a three-dimensional figure in which every point on the edge is the same distance from the center of the sphere. The "same distance" part is what keeps the sphere from being shaped like an egg. It is NOT necessary that 2nd grade students understand this. This is teacher content knowledge only.
cone		» base is a circle. » curved face » 1 vertex
cylinder		A cylinder has two parallel circular bases connected by a curved surface. Bases are circles, even if the cylinder is lying on its side. "Base" does not mean "bottom." » 2 bases » curved face
rectangular prism		Bases are rectangles. Any two rectangles that are parallel to each other can be called "bases." "Base" does not mean "bottom." » faces are rectangles or squares. » 8 vertices » 6 faces (includes the bases) » 8 edges
cube		Bases are squares. Any two squares that are parallel to each other can be called "bases." "Base" does not mean "bottom." » faces are squares. » 8 vertices » 6 faces (includes the bases) » 8 edges » All faces are congruent.
triangular prism		The bases of a prism are the two faces that are parallel and congruent. Therefore, the bases are triangles no matter how the prism is oriented on the page. "Base" does not mean "bottom." » faces are rectangles and triangles » 6 vertices » 6 faces (includes the bases) » 9 edges

3.6B

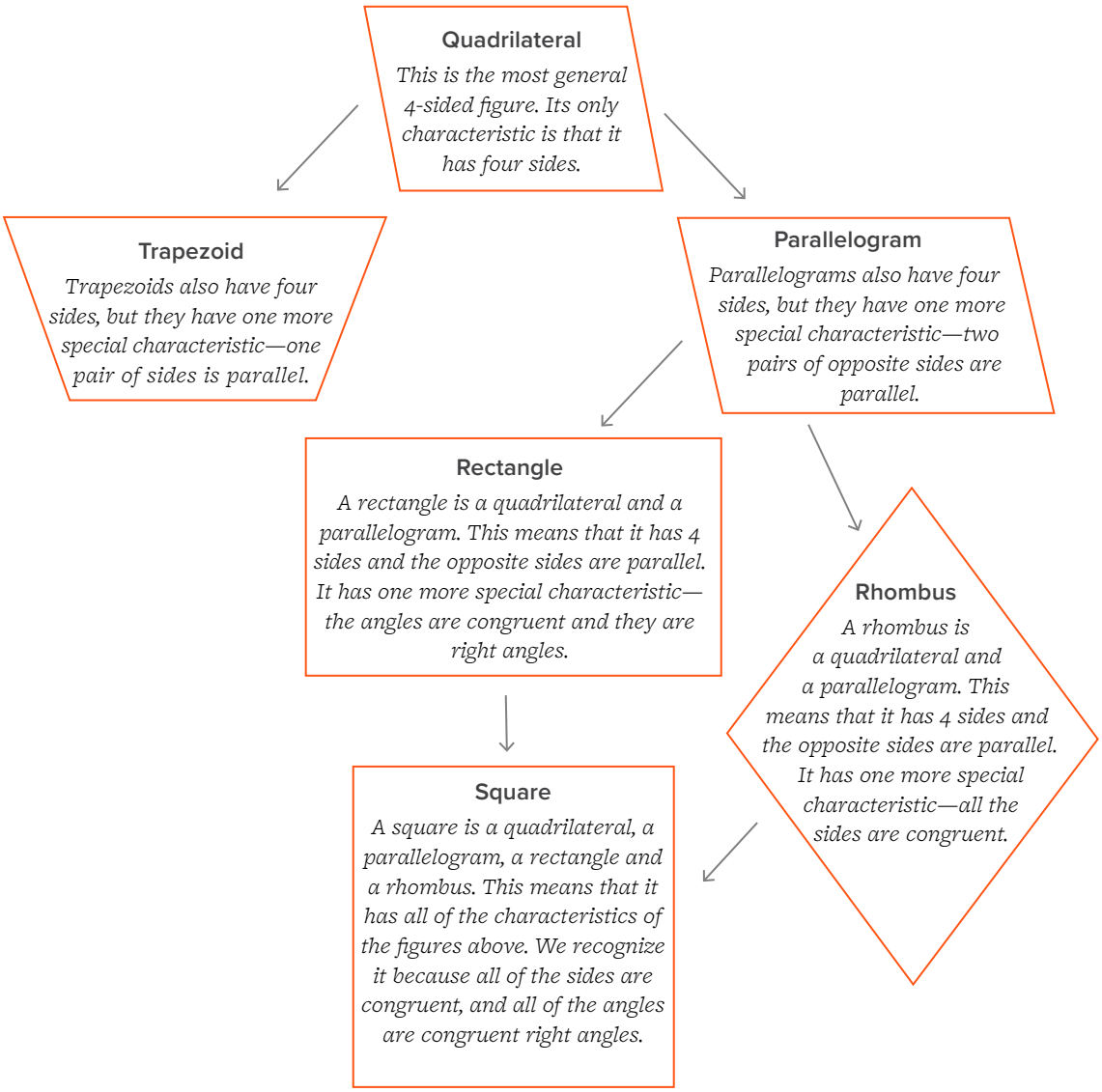
3.6 Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional geometric figures to develop generalizations about their properties. The student is expected to:

B use attributes to recognize rhombuses, parallelograms, trapezoids, rectangles, and squares as examples of quadrilaterals and draw examples of quadrilaterals that do not belong to any of these subcategories. *(RC3, SS)*

Quadrilaterals are figures with 4 sides. When the sides or angles of a quadrilateral have specific characteristics, the quadrilateral gets a special name. The name "quadrilateral" is the most general term for a four-sided figure, while the name "square" is the most specialized name.

Example/Activity

The following chart shows the relationships between these special types of quadrilaterals.



3.6C

3.6 Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional geometric figures to develop generalizations about their properties. The student is expected to:

C determine the area of rectangles with whole number side lengths in problems using multiplication related to the number of rows times the numbers of unit squares in each row. *(RC3, RS)*

In third grade, students are formally introduced to the topic of area. In 2nd grade, they covered objects with squares and found the area. This standard teaches students how to calculate area based on multiplication models they are already familiar with.

For this SE, students will determine the area of a rectangle using square inches, square centimeters, square feet, square meters, etc. They may use concrete or pictorial models of square units to represent the rows and the number in each row. Rather than counting the individual square units, students will make the connection between repeated addition and multiplication and are then expected to use multiplication to determine the area.

Example/Activity

Remember all the arrays that students used to learn their multiplication facts (**3.4D**)? They were also learning how to find the area of a rectangle! A few slight shifts in thinking need to be made so the focus is on the area, not only on the multiplication fact.

Shift #1: The focus is now on the **rectangle** itself.

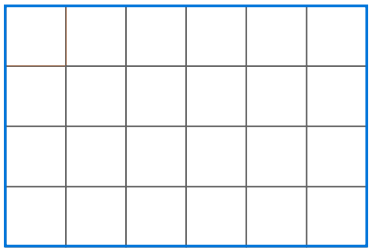
Shift #2: Area is the number of **square units** it takes to fill the rectangle. Area is always made up of units that are squares. When students were working with arrays, they might have put objects in each cell of the array. Now the focus is on the squares themselves like grid models for multiplication.

Shift #3: Area is number of rows x number of squares in each row

4 rows with 6 squares in each row

4 groups of 6 is 24,

so the area of the rectangle is 24 square units.



Caution! Be sure to focus on rows or columns when multiplying. This will help students avoid confusion when they find perimeter.

Area is recorded in square units because area is the number of actual squares that cover the object.

3.6D

3.6 Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional geometric figures to develop generalizations about their properties. The student is expected to:

D decompose composite figures formed by rectangles into non-overlapping rectangles to determine the area of the original figure using the additive property of area. *(RC3, SS)*

First, let's examine the standard for its meaning.
Decompose In geometry, decompose means to separate the combined figure into two separate figures.

Composite figures are geometric figures that have been combined to create new geometric figures. In third grade, the composite figures are made up of rectangles, including squares as a special kind of rectangle. The rectangles do not overlap.

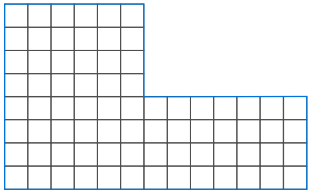
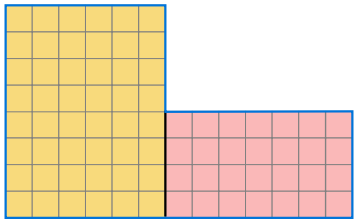
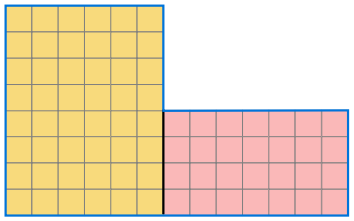
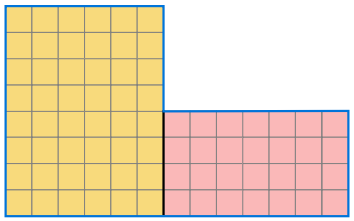
Additive property of area: areas of two figures can be added to find the area of the composite figure.

To find the area of the composite figure:

1. Draw a line to separate the rectangles in the composite figure.
2. Figure out the dimensions of each rectangle.
3. Find the area of each rectangle.
4. Add the areas.

Continued on next page.

Example/Activity

Figure	Discussion
	The composite figure is made up of more than 1 rectangle.
	1. To find the area, the figure must be separated into 2 separate rectangles. In composite area problems, there is typically more than one way to separate the figures. The rectangles have been separated with a black line and each rectangle has been colored a different color.
 8 rows of 6 4 rows of 7	2. Now we have to find the side lengths for each rectangle. Yellow rectangle has 8 rows with 6 unit squares in each row. Pink rectangle has 4 rows with 7 unit squares in each row.
 8 rows of 6 = 48 square units 4 rows of 7 = 28 square units	3. Find the area of each rectangle.
48 square units + 28 square units = 76 square units = the area of the composite figure	4. Add the areas of each figure. Be sure to include the units.

3.6E

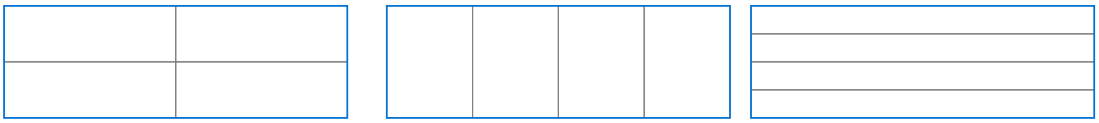
3.6 Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional geometric figures to develop generalizations about their properties. The student is expected to:

E decompose two congruent two-dimensional figures into parts with equal areas and express the area of each part as a unit fraction of the whole and recognize that equal shares of identical wholes need not have the same shape. *(RC3, SS)*

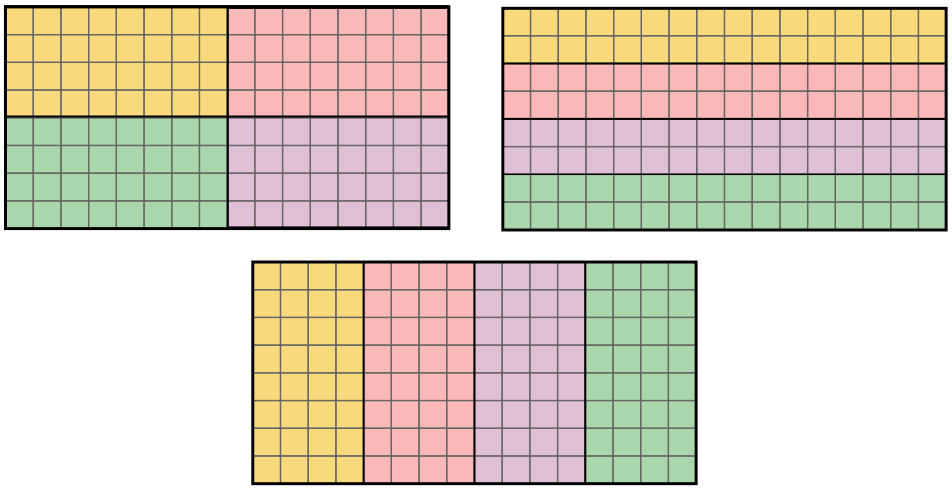
3.6E is the geometric version of **3.3F** and **G**. This standard focuses on equal areas of the fractional parts, while **3.3F** and **G** focus on equivalent fractional parts in which the parts may be eighths or fourths.

Example/Activity

The three rectangles below are congruent. They must be decomposed (broken up) into parts with equal areas. The gray lines break each of the rectangles into fourths, but they break them up in different ways. The parts have the same area, but they are different shapes.



Students may have difficulty understanding that these fractional parts have the same area, even though each of the fractional parts is actually one-fourth. If this is true for your students, try using rectangles with grid lines. You'll have to be careful with the ones you choose. For instance, if the fractional part you are working on is "fourths," then both the rows and columns must be divisible by 4. Here is an example:



If you count the square units in each fourth, you will find 32 square units. The fourths are shaped differently, but they are all fourths, and they are all 32 square units.

3.7

3.7A

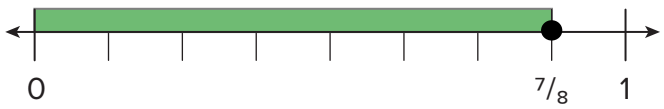
3.7 Geometry and measurement. The student applies mathematical process standards to select appropriate units, strategies, and tools to solve problems involving customary and metric measurement. The student is expected to:

A represent fractions of halves, fourths, and eighths as distances from zero on a number line. *(RC1, SS)*

3.3B gives a thorough description of fractions on the number line. This is foundational to understanding a ruler. The difference in **3.7A** is in thinking about distance from 0. This distance, from 0 to 1, is the whole.

Example/Activity

To think about fractions being distance, students have to use linear models of fractions rather than area models, because distance measures length from one place to another. This example shows that the whole, the distance from 0 to 1, has been broken into 8 equal spaces. Be sure that students are focusing on the spaces, not the hash marks. Continue to remind students that length is a "distance traveled", not a point on the number line.



The green bar, like a Cuisenaire® rod, covered 7 of the 8 parts, or ⅞ of the distance between 0 and 1. The point marks the end of the rod and sits at ⅞

Another length model for fractions is fraction strips. If you use fraction strips, students will still need a number line to lay the fraction strips on. The number line needs to have space between 0 and 1 that is the same length as the whole fraction strip.

3.7B

3.7 Geometry and measurement. The student applies mathematical process standards to select appropriate units, strategies, and tools to solve problems involving customary and metric measurement. The student is expected to:

B determine the perimeter of a polygon or a missing length when given perimeter and remaining side lengths in problems. *(RC3, RS)*

Perimeter is often seen as a formula or a mathematical process to “add up all the sides.” Another way to think about perimeter is that it is the length around an object or the number of length units around the sides of a figure.

Because students in third grade use rectangles with square units drawn, they may also use these same rectangles to find the perimeter of the rectangle before learning how to calculate it.

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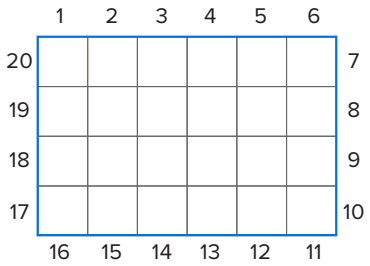
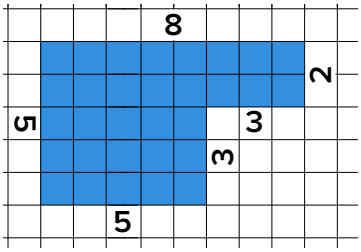
Example/Activity

Here is the rectangle from **3.6C**. When the sides of the square units that are on the edge of the rectangle are counted, their number is the perimeter.

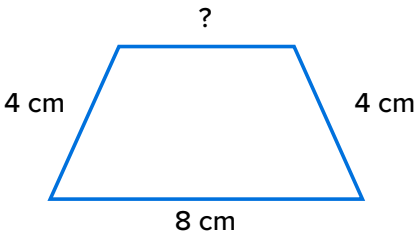


Perimeter is easily seen and easily calculated using grid paper. The sides can be added together to find the perimeter of the following polygon.



Once the concept of perimeter is developed, students will find perimeter by measuring side lengths using inches or centimeters. Additionally, they will use their knowledge of perimeter to help them find a missing side length when given the perimeter and the remaining side lengths.

The following polygon has a perimeter of 22 units. What is the length of the missing side?



Perimeter = 22 cm

Once students begin to use a process to find perimeter, rather than counting the sides, they often get it mixed up with the process for finding area. Why does this happen? One possible reason is that the meaning of multiplication gets "lost" when finding area. To find area, students multiply the number of rows by the number of columns to get the total number of squares or square units.

Perimeter focuses on adding lengths. It does not deal with the number of squares. It counts the linear units on the edges of the rectangle.

Students need to understand this very well before they are introduced to an approach that includes multiplication. If you introduce a formula for perimeter, keep the focus on length units and contrast it with the formula for finding area (the number of squares).

When possible, teach area and perimeter together, rather than in isolation. Having students work on finding area and perimeter at the same time forces them to note the difference between the two.

3.7C

3.7 Geometry and measurement. The student applies mathematical process standards to select appropriate units, strategies, and tools to solve problems involving customary and metric measurement. The student is expected to:

C determine the solutions to problems involving addition and subtraction of time intervals in minutes using pictorial models or tools such as a 15-minute event plus a 30-minute event equals 45 minutes. *(RC3, SS)*

This standard comprises students' first experience in solving problems with time. In previous grades, the focus has been on telling what time is on a clock, not talking about the length of events.

When paired with the process standard, **3.1C**, students may be asked to use tools such as analog and/or digital clocks to solve problems involving addition or subtraction of intervals of time in minutes. A focus of this SE includes the conversion of 60 minutes to an hour. In addition to the examples below, problems may include either a start time OR an end time with an interval. Intervals can be less than or more than 1 hour.

Example/Activity

Students may use strip diagrams or number lines to help them make sense of the problems, just as they did with solving word problems in previous Student Expectations in the state standards.

Below is an example of the same problem solved by using two models: strip diagrams and open number lines. As you read the explanations and the models, notice how the context of the problem, including the units, is kept with the models as long as possible in the solution. Notice also the similarities between the two models.

Continued on next page.

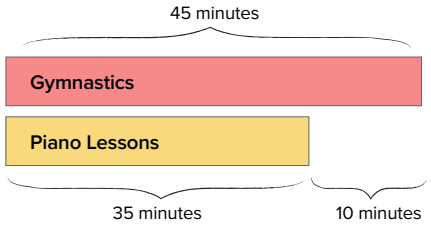
Examples for Solving Time Problems Using Models

Each of the solutions below solves the following problem:

Katrina goes to gymnastics for 45 minutes and goes to her piano lesson for 35 minutes. How much longer is gymnastics than the piano lesson?

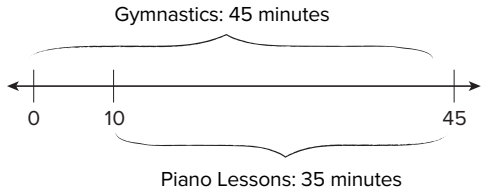
Strip Diagram

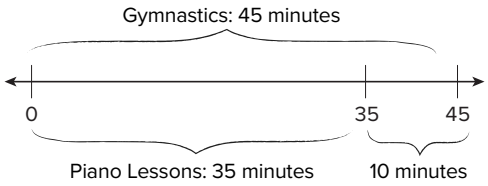
Strip diagrams are made based on the content of the problem. This problem had two amounts: the time for a gymnastics class and the time for a piano lesson. Therefore, there are two strips, one for each length of time. They were positioned this way so that it is clear that the two numbers need to be subtracted.



Open Number Line

Open number lines are a way of recording the action in the story. The amount above the number line shows the time for gymnastics; the amount below the number line shows the time for the piano lesson. They were positioned this way so that it is clear that the two numbers need to be subtracted.





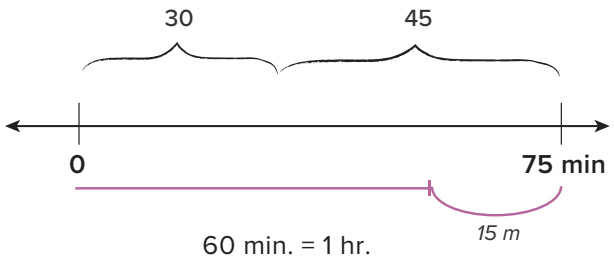
Although the diagrams are different, notice the similarities.

1. The two amounts listed in the problem are clear and visible.
2. It is clear that the problem is looking for the time difference between the gymnastics lesson and the piano lesson.
3. The answer to the problem, 10 minutes, is clearly visible on the diagrams.

With the length of time intervals provided, this SE also focuses on the conversion of 60 minutes to an hour. A 30 minute event plus a 45 minute event could be thought of in this way:

30 minutes + 45 minutes = 75 minutes.
60 minutes is the same and 1 hour.
Therefore, 75 minutes is the same as 1 hr. 15 min.

Strip diagrams and open number lines can also be used to model this type of problem.



60 min. = 1 hr.
75 min. = 1 hr. 15 min.

3.7D

3.7 Geometry and measurement. The student applies mathematical process standards to select appropriate units, strategies, and tools to solve problems involving customary and metric measurement. The student is expected to:

D determine when it is appropriate to use measurements of liquid volume (capacity) or weight. *(RC3, SS)*

3.7D helps students learn to discern between measuring something according to how much space it takes up (capacity) versus how much it weighs. Mass is not included in this SE because mass is not the same as weight.

Liquid volume: the amount of space that a liquid (or dry), pourable substance takes up

3.7E states that students will use the customary and metric system to determine liquid volume/capacity. Typical units of measurement for liquid volume and capacity are:

» fluid ounce, cup, pint, quart, gallon
» milliliter, liter, kiloliter

Capacity the maximum amount something can contain

Weight how heavy an object is, determined by the pull of gravity on the object

3.7E states that students will use the customary system to determine weight. Typical units of measurement for weight include:

» ounce
» pound
» ton

For this SE students should be able to distinguish between liquid ounces and ounces that measure weight. Since fluid ounces (fl oz) are often called ounces, we need to help students understand this distinction. Fluid ounces are associated with liquid volume (capacity), and ounces are associated with weight. For instance, an amount known as 1 fluid ounce of honey might weigh 1.5 ounces.

Example/Activity

Sample Questions for students to explore and discuss:

» How much salt is needed to fill the box? (liquid volume/capacity)
» What does the infant weigh? (weight)
» How many quarts/liters does it take to fill the bucket? (liquid volume)
» How heavy is the cat? (weight)

The next two questions could be used to distinguish between liquid ounces and ounces that measure weight.

» How much water is needed to fill the medicine dropper?
» How many ounces does the candy bar weigh?

3.7E

3.7 Geometry and measurement. The student applies mathematical process standards to select appropriate units, strategies, and tools to solve problems involving customary and metric measurement. The student is expected to:

E determine liquid volume (capacity) or weight using appropriate units and tools. *(RC3, SS)*

Liquid Volume (Capacity) and Weight are defined in SE 3.7D.

3.7E requires students to use the customary and metric systems to determine liquid volume (capacity).

They should be able to select and use appropriate tools and units.

- Typical customary units for measuring liquid volume and capacity are fluid ounce, cup, pint, quart, and gallon.
- Typical metric units for measuring liquid volume and capacity are milliliter, liter, and kiloliter.
- Tools to measure liquid volume and capacity include but are not limited to quart measures, a gallon milk jug, a one-liter beaker, etc.

Tools need to hold liquid and have a known measure (like a gallon milk jug) or have measurement markings on them.

3.7E also requires students to use the customary system to determine weight. They should be able to select and use appropriate tools and units.

- Typical customary units for measuring weight are ounce, pound, and ton.
- Tools for measuring weight include but are not limited to spring scales, two-pan balance, etc.

This standard does not require students to determine mass.

This state standard can be taught with Science Matter and Energy TEKS 3.5A.

If you are not sure whether your campus has these tools, check out the science lab. They are probably all there waiting to be used.