Family Support Materials

Rigid Transformations and Congruence

Here are the video lesson summaries for Grade 8, Unit 1: Rigid Transformations and Congruence. Each video highlights key concepts and vocabulary that students learn across one or more lessons in the unit. The content of these video lesson summaries is based on the written Lesson Summaries found at the end of lessons in the curriculum. The goal of these videos is to support students in reviewing and checking their understanding of important concepts and vocabulary. Here are some possible ways families can use these videos:

- Keep informed on concepts and vocabulary students are learning about in class.
- Watch with their student and pause at key points to predict what comes next or think up other examples of vocabulary terms (the bolded words).
- Consider following the Connecting to Other Units links to review the math concepts that led up to this unit or to preview where the concepts in this unit lead to in future units.

Grade 8, Unit 1: Rigid Transformations and Congruence	Vimeo	YouTube
Video 1: Rigid Transformations (Lessons 1–6)	Link	Link
Video 2: Properties of Rigid Transformations (Lessons 7–10)	Link	Link
Video 3: Congruence (Lessons 11–13)	Link	Link
Video 4: Angles in a Triangle (Lessons 14–16)	Link	Link

Video 1

Video 'VLS G8U1V1 Rigid Transformations (Lessons 1–6)' available here: https://player.vimeo.com/video/439303649.

Video 2

Video 'VLS G8U1V2 Properties of Rigid Transformations (Lessons 7–10)' available here: https://player.vimeo.com/video/439582650.

Video 3

Video 'VLS G8U1V3 Congruence (Lessons 11–13)' available here: https://player.vimeo.com/video/442078342.

Video 4

Video 'VLS G8U1V4 Angles in a Triangle (Lessons 14–16)' available here: https://player.vimeo.com/video/442745503.

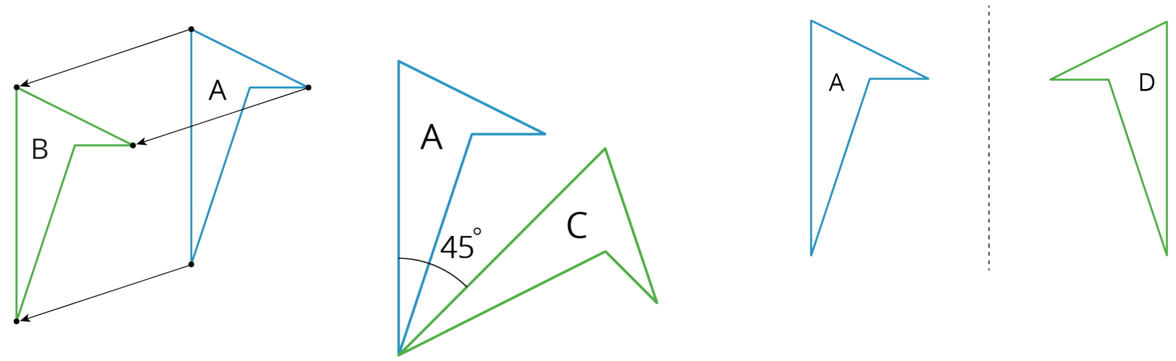
Connecting to Other Units

- *Coming soon*

Rigid Transformations

Family Support Materials 1

This week your student will learn to describe the movement of two-dimensional shapes with precision. Here are examples of a few of the types of movements they will investigate. In each image, Shape A is the original and Shapes B, C, and D show three different types of movement:

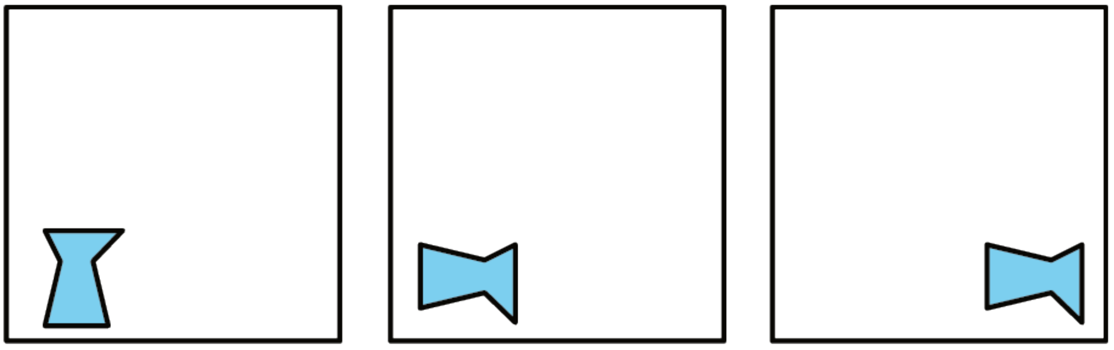


Students will also experiment with shapes and drawings to build their intuition by:

- cutting shapes out
- tracing shapes on tracing paper to compare with other shapes
- drawing shapes on grid paper
- measuring lengths and angles
- folding paper

Here is a task to try with your student:

1. Describe how the shape changes from one panel to the next.

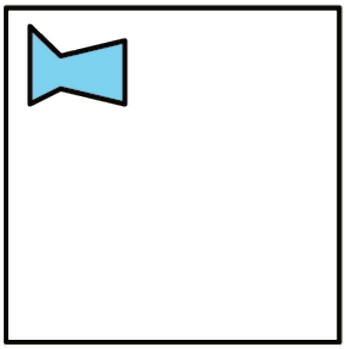


2. Draw a fourth panel that shows what the image would look like if the shape in the third panel is rotated 180 degrees counterclockwise around the middle of the panel.

Solution:

1. Turn it 90 degrees clockwise then move the shape to the right side.

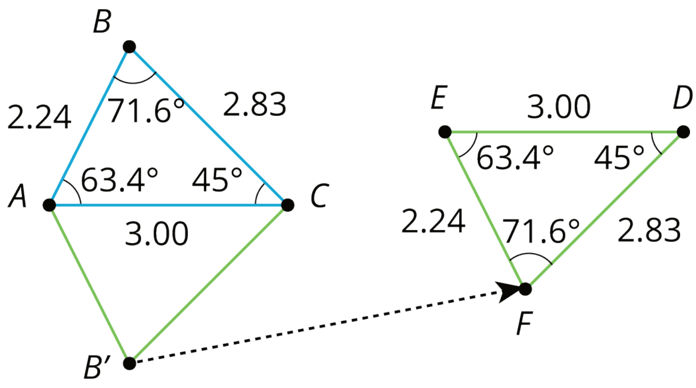
2.



Properties of Rigid Transformations

Family Support Materials 2

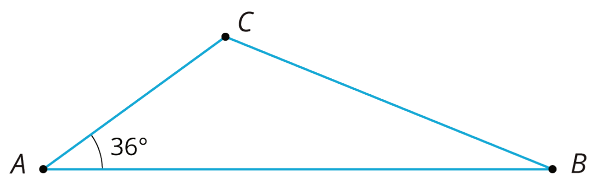
This week your student will investigate rigid transformations, which is the name for moves (and sequences of moves) that preserve length and angle measures like translations, rotations, and reflections. For example, in this image the triangle ABC was reflected across the line AC and then translated to the right and up slightly.



When we construct figures using rigid transformations, we know that the measures of the images of segments and angles will be equal to the measures of the original segments and angles.

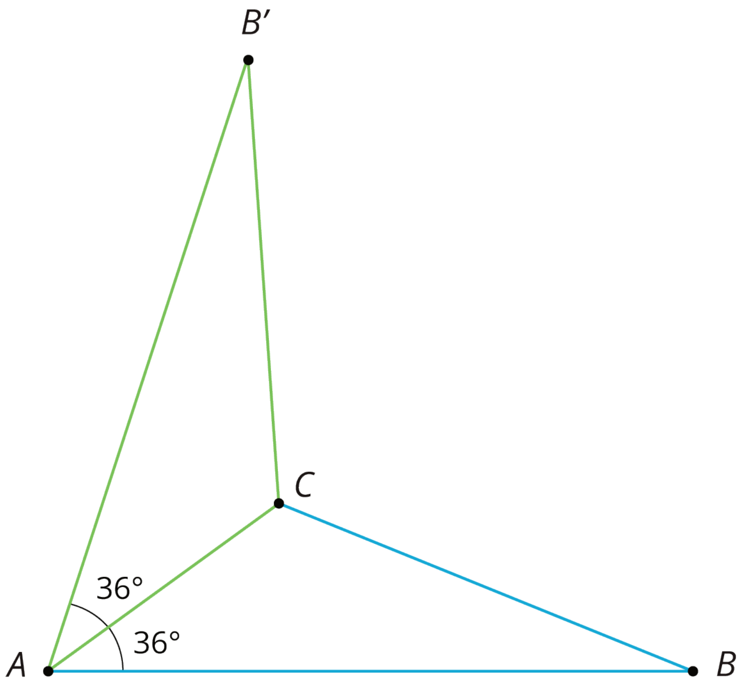
Here is a task to try with your student:

1. Reflect triangle ABC across side AC to form a new triangle $AB'C$.
2. What is the measure of angle $B'AC$?
3. Name two side lengths that have the same measure.



Solution:

1.



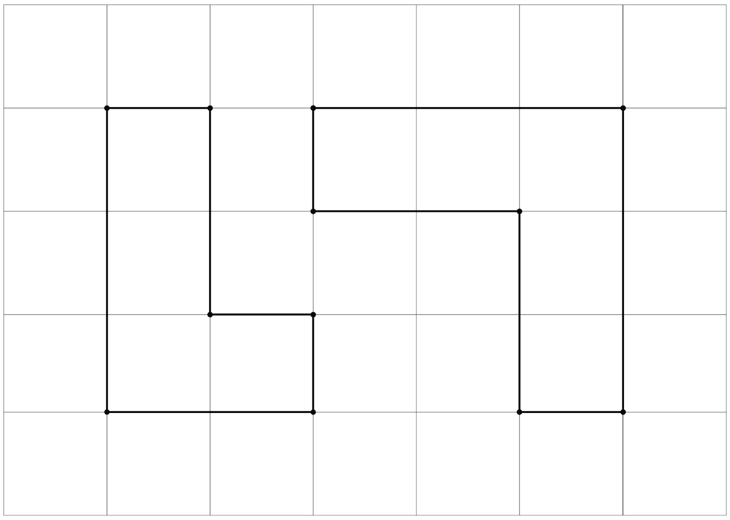
2. 36 degrees. Angle $B'AC$ corresponds to angle BAC.

3. Sides AB' and AB have the same length as do sides $B'C$ and BC.

Congruence

Family Support Materials 3

This week your student will learn what it means for two figures to be congruent. Let's define congruence by first looking at two figures that are not congruent, like the two shown here. What do these figures have in common? What is different about them?

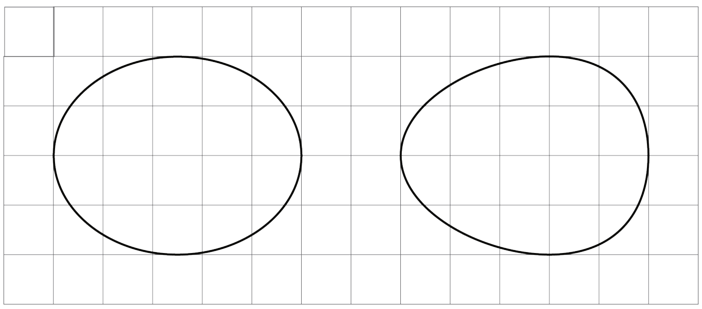


If two figures are congruent, that means there is a sequence of rigid transformations we could describe that would make one of the figures look like the other. Here, that isn't possible. While each has 6 sides and 6 vertices and we can make a list of corresponding angles at the vertices, these figures are not considered congruent because their side lengths do not correspond. The figure on the left has side lengths 3, 2, 1, 1, 2, 1. The figure on the right has side lengths 3, 3, 1, 2, 2, 1.

For the last part of this unit, students will use the congruence to investigate some interesting facts about parallel lines and about the angles in a triangle.

Here is a task to try with your student:

1. Explain why these two ovals are not congruent. Each grid square is 1 unit along a side.



2. Draw two new ovals congruent to the ones in the image.

Solution:

1. While each oval has a horizontal measurement of 5 units and a vertical measurement of 4 units, the oval on the left’s “tallest” measurement is halfway between the left and right sides while the oval on the right’s “tallest” measurement is closer to the right side than the left side.

2. There are many possible ways to draw new ovals congruent to the original two. If a tracing of the original oval lines up exactly when placed on top of the new image (possibly after some rotation or flipping of the paper the tracing is on), then the two figures are congruent.

Family Support Materials

Dilations, Similarity, and Introducing Slope

Here are the video lesson summaries for Grade 8, Unit 2: Dilations, Similarity, and Introducing Slope. Each video highlights key concepts and vocabulary that students learn across one or more lessons in the unit. The content of these video lesson summaries is based on the written Lesson Summaries found at the end of lessons in the curriculum. The goal of these videos is to support students in reviewing and checking their understanding of important concepts and vocabulary. Here are some possible ways families can use these videos:

- Keep informed on concepts and vocabulary students are learning about in class.
- Watch with their student and pause at key points to predict what comes next or think up other examples of vocabulary terms (the bolded words).
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Grade 8, Unit 2: Dilations, Similarity, and Introducing Slope	Vimeo	YouTube
Video 1: Dilations (Lessons 1–5)	Link	Link
Video 2: Similarity (Lesson 6–9)	Link	Link
Video 3: Slope (Lessons 10–12)	Link	Link

Video 1

Video 'VLS G8U2V1 Dilations (Lessons 1–5)' available here: https://player.vimeo.com/video/457852098.

Video 2

Video 'VLS G8U2V2 Similarity (Lesson 6–9)' available here: https://player.vimeo.com/video/457854496.

Video 3

Video 'VLS G8U2V3 Slope (Lessons 10–12)' available here: https://player.vimeo.com/video/457855739.

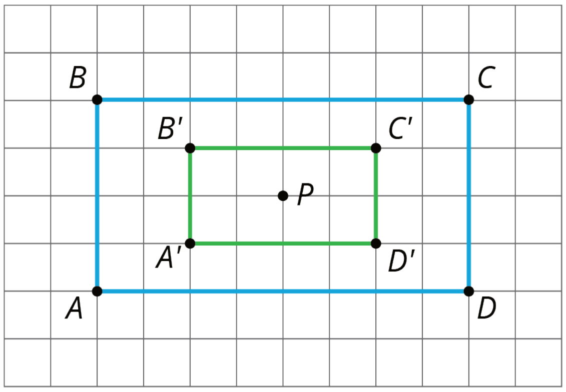
Connecting to Other Units

- *Coming soon*

Dilations

Family Support Materials 1

This week your student will expand their understanding of transformations to include non-rigid transformations. Specifically, they will learn to make and describe dilations of figures. A dilation is a process to make a scaled copy of a figure, and is described using a center point and a number (the scale factor). The scale factor can be any positive number, including fractions and decimals. If the scale factor is less than 1, the dilated figure is smaller than the original, if it is greater than 1 the dilated figure is larger than the original. In this dilation, the center point P and the scale factor is $\frac{1}{2}$.



When dilating figures, the distance from the center of dilation to a point on the figure is multiplied by the scale factor to get the location of the corresponding point. In this example, the distance between center P and B multiplied by $\frac{1}{2}$ results in the distance between P and B'. Notice also how the side lengths of the dilated figure, $A'B'C'D'$ are all exactly $\frac{1}{2}$ the side lengths of the original figure, $ABCD$, while the angle measures remain the same.

Here is a task to try with your student:

Rectangle A measures 10 cm by 24 cm. Rectangle B is a scaled copy of Rectangle A.

1. If the scale factor is $\frac{1}{2}$, what are the dimensions of Rectangle B?
2. If the scale factor is 3, what are the dimensions of Rectangle B?
3. If Rectangle B has dimensions 15 cm by 36 cm, what is the scale factor?

Solution:

1. Rectangle B has dimensions 5 cm by 12 cm, since $10 \cdot \frac{1}{2} = 5$ and $24 \cdot \frac{1}{2} = 12$.

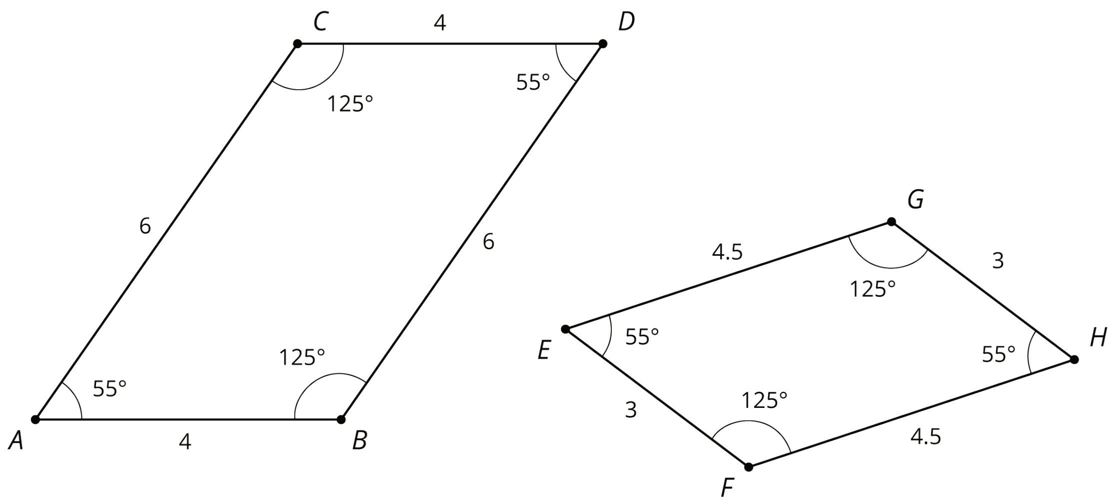
2. Rectangle B has dimensions 30 cm by 72 cm, since $10 \cdot 3 = 30$ and $24 \cdot 3 = 72$.

3. The scale factor is $\frac{3}{2}$ since $15 \div 10 = \frac{3}{2}$ and $36 \div 24 = \frac{3}{2}$.

Similarity

Family Support Materials 2

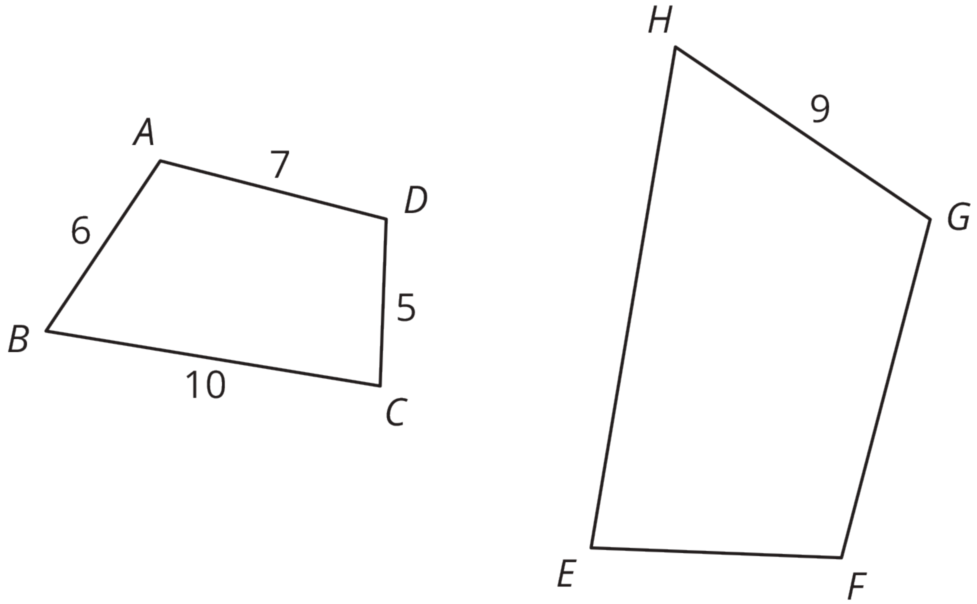
This week your student will investigate what it means for two figures to be similar. Similarity in mathematics means there is a sequence of translations, rotations, reflections, and dilations that takes one figure to the other. When two figures are similar, there are always many different sequences of transformations that can show that they are similar. Here is an example of two similar figures:



If we needed to show that these two figures are similar, we can first identify that the scale factor to go from $ABDC$ to $EFHG$ is $\frac{3}{4}$, since $3 \div 4 = 4.5 \div 6 = \frac{3}{4}$. Then, using a dilation with scale factor $\frac{3}{4}$, a translation, and a rotation, we can line up an image of $ABDC$ perfectly on top of $EFHG$.

Here is a task to try with your student:

Quadrilateral $ABCD$ is similar to quadrilateral $GHEF$.



What is the perimeter of quadrilateral $EFGH$?

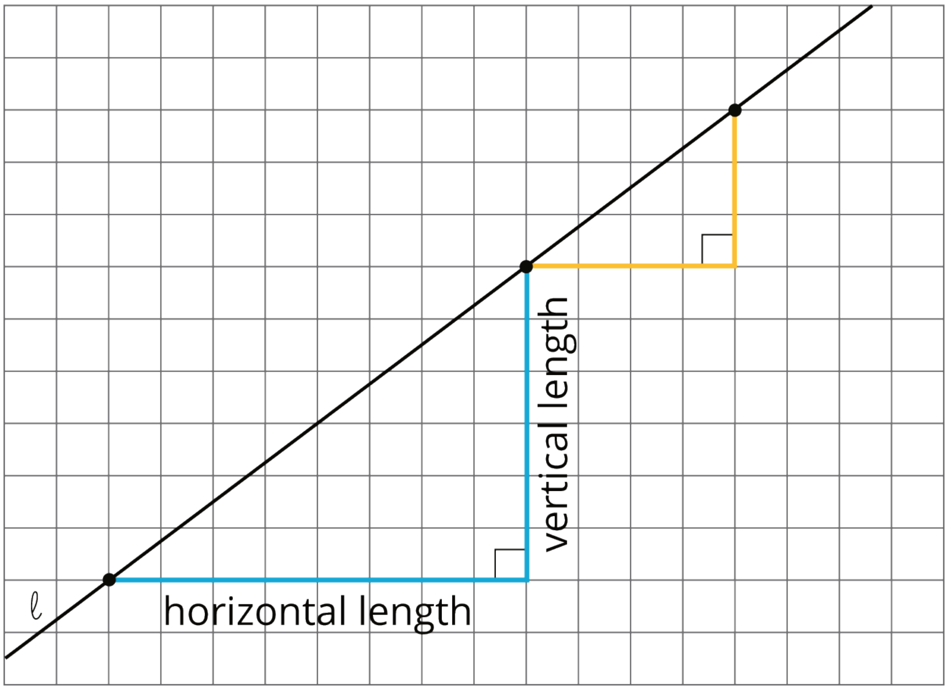
Solution:

The perimeter is 42. The scale factor is 1.5, since $9 \div 6 = 1.5$. This means the side lengths of $EFGH$ are 9, 10.5, 7.5, and 15, which are the values of the corresponding sides of $ABCD$ multiplied by 1.5. We could also just multiply the perimeter of $ABCD$, 28, by 1.5.

Slope

Family Support Materials 3

This week your student will use what they have learned about similar triangles to define the slope of a line. A slope triangle for a line is a triangle whose longest side lies on the line and whose other two sides are vertical and horizontal. Here are two slope triangles for the line ℓ:

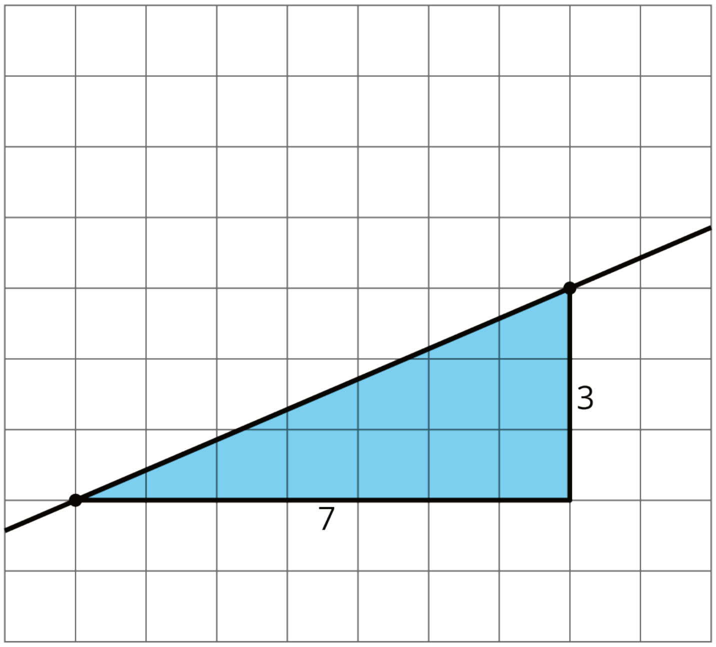


For lines, it turns out that the quotient of the vertical side length and the horizontal side length of a slope triangle does not depend on the triangle. That is, all slope triangles for a line have the same quotient between their vertical and horizontal side and this number is called the slope of the line. The slope of line ℓ shown here can be written as $\frac{6}{8}$ (from the larger triangle), $\frac{3}{4}$ (from the smaller triangle), 0.75, or any other equivalent value.

By combining what they know about the slope of a line and similar triangles, students will begin writing equations of lines—a skill they will continue to use and refine throughout the rest of the year.

Here is a task to try with your student:

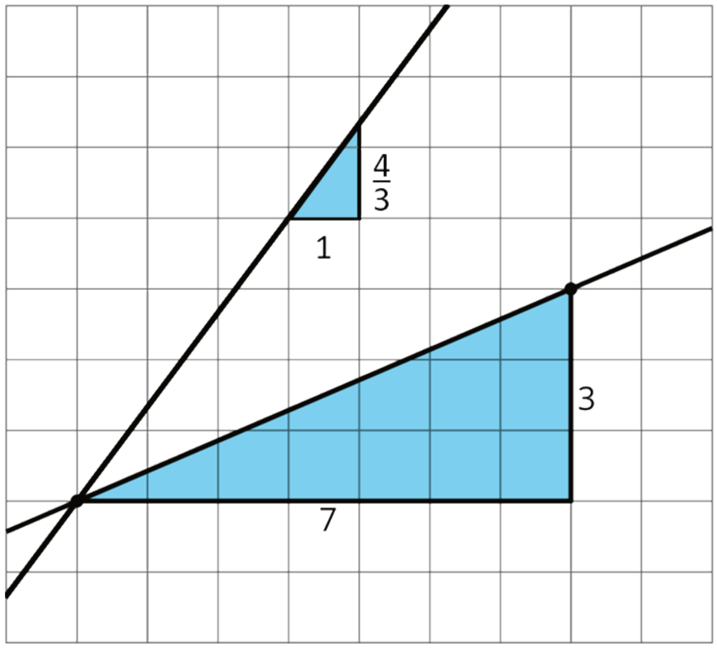
Here is a line with a slope triangle already drawn in.



1. What is the slope of the line?
2. Draw another line with a slope of $\frac{4}{3}$ that goes through the point on the left. Include a slope triangle for the new line to show how you know this line has a slope of $\frac{4}{3}$.

Solution:

1. The slope of the line is $\frac{3}{7}$.
2.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Family Support Materials

Linear Relationships

Here are the video lesson summaries for Grade 8, Unit 3: Linear Relationships. Each video highlights key concepts and vocabulary that students learn across one or more lessons in the unit. The content of these video lesson summaries is based on the written Lesson Summaries found at the end of lessons in the curriculum. The goal of these videos is to support students in reviewing and checking their understanding of important concepts and vocabulary. Here are some possible ways families can use these videos:

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Grade 8, Unit 3: Linear Relationships	Vimeo	YouTube
Video 1: Representing Proportional Relationships (Lessons 1–4)	Link	Link
Video 2: Representing Linear Relationships (Lessons 5–8)	Link	Link
Video 3: Finding Slopes (Lessons 9–10)	Link	Link
Video 4: Linear Equations (Lessons 11–13)	Link	Link

Video 1

Video 'VLS G8U3V1 Representing Proportional Relationships (Lessons 1–4)' available here: https://player.vimeo.com/video/469396489.

Video 2

Video 'VLS G8U3V2 Representing Linear Relationships (Lessons 5–8)' available here: https://player.vimeo.com/video/470710599.

Video 3

Video 'VLS G8U3V3 Finding Slopes (Lessons 9–10)' available here: https://player.vimeo.com/video/469397707.

Video 4

Video 'VLS G8U3V4 Linear Equations (Lessons 11–13)' available here: https://player.vimeo.com/video/470020696.

Connecting to Other Units

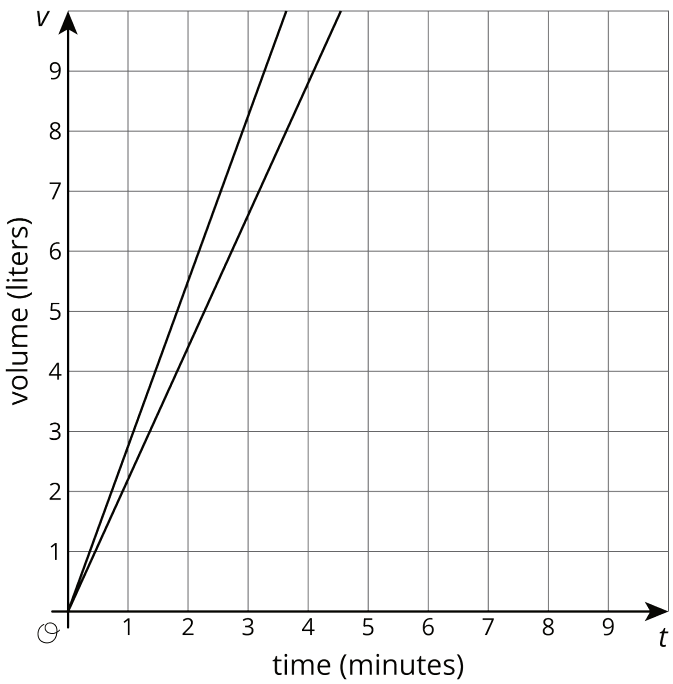
- *Coming soon*

Proportional Relationships

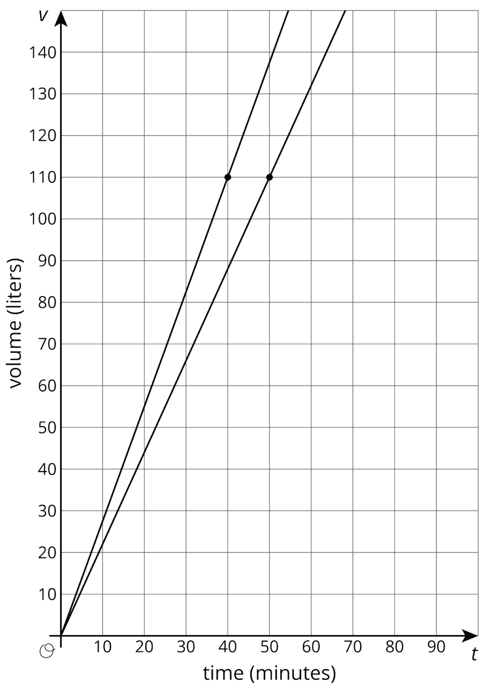
Family Support Materials 1

This week your student will consider what it means to make a useful graph that represents a situation and use graphs, equations, tables, and descriptions to compare two different situations.

There are many successful ways to set up and add scale to a pair of axes in preparation for making a graph of a situation. Sometimes we choose specific ranges for the axes in order to see specific information. For example, if two large, cylindrical water tanks are being filled at a constant rate, we could show the amount of water in them using a graph like this:



While this graph is accurate, it only shows up to 10 liters, which isn't that much water. Let's say we wanted to know how long it would take each tank to have 110 liters. With 110 as a guide, we could set up our axes like this:



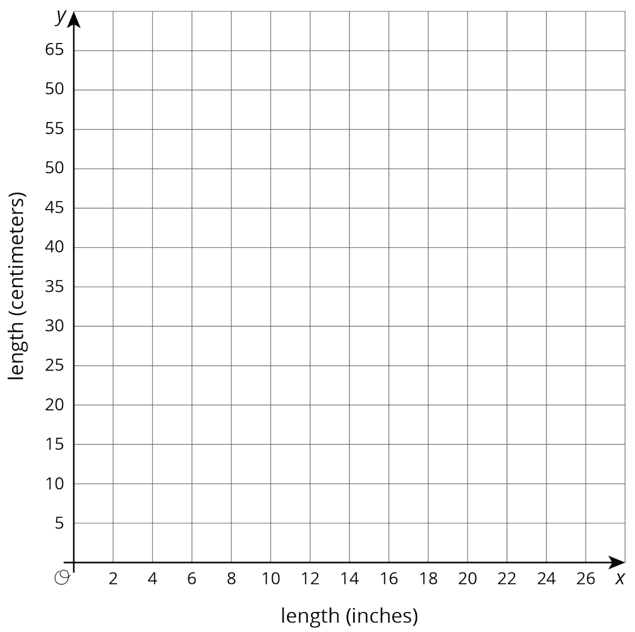
Notice how the vertical scale goes beyond the value we are interested in. Also notice how each axis has values that increase by 10, which, along with numbers like 1, 2, 5, 25, is a friendly number to count by.

Here is a task to try with your student:

This table shows some lengths measured in inches and the equivalent length in centimeters.

length (inches)	length (centimeters)
1	2.54
2	
10	
	50.8

1. Complete the table.
2. Sketch a graph of the relationships between inches and centimeters. Scale the axis so that all the values in the table can been seen on the graph.

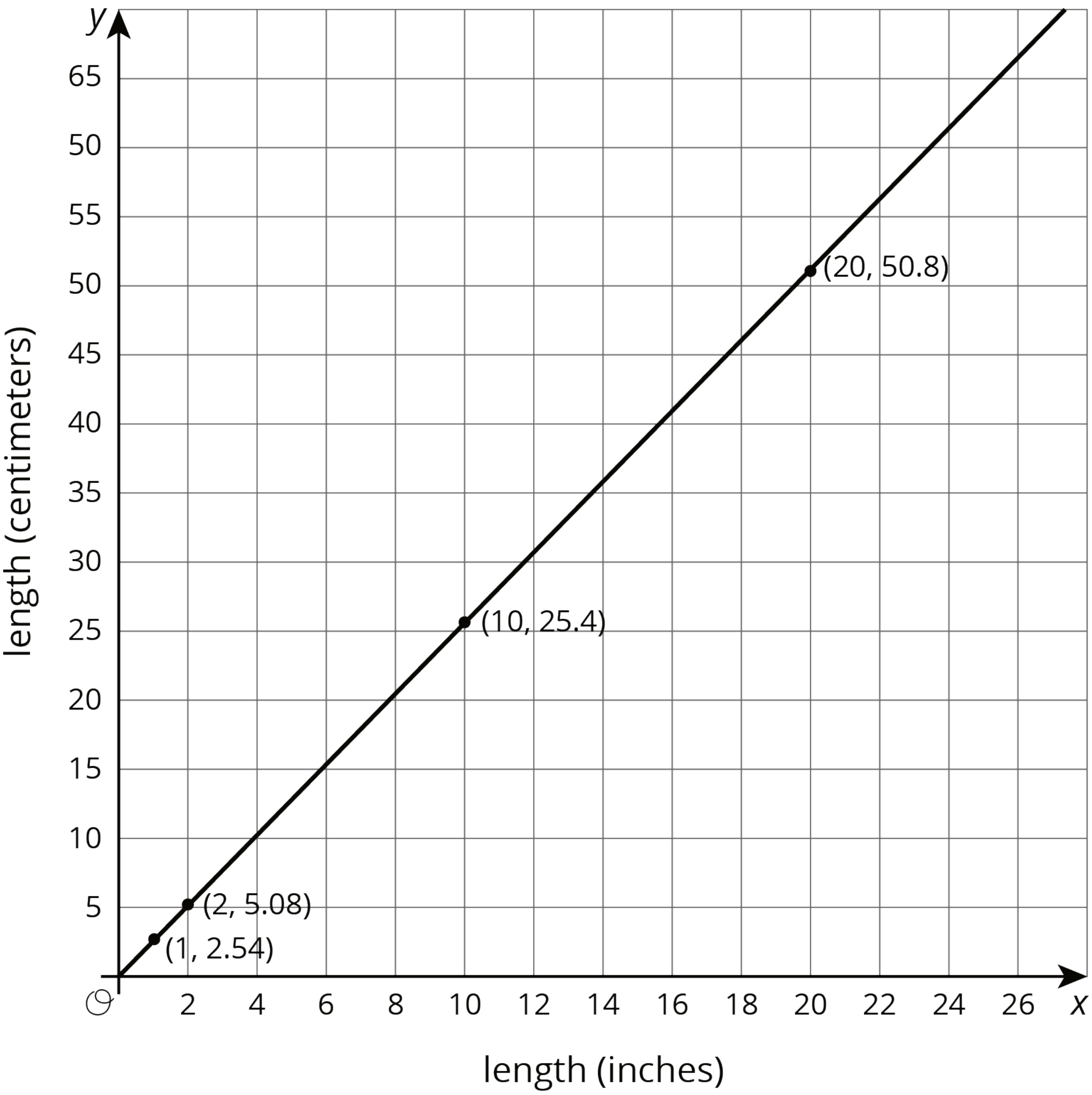


Solution:

1.

length (inches)	length (centimeters)
1	2.54
2	5.08
10	25.4
20	50.8

2.



Representing Linear Relationships

Family Support Materials 2

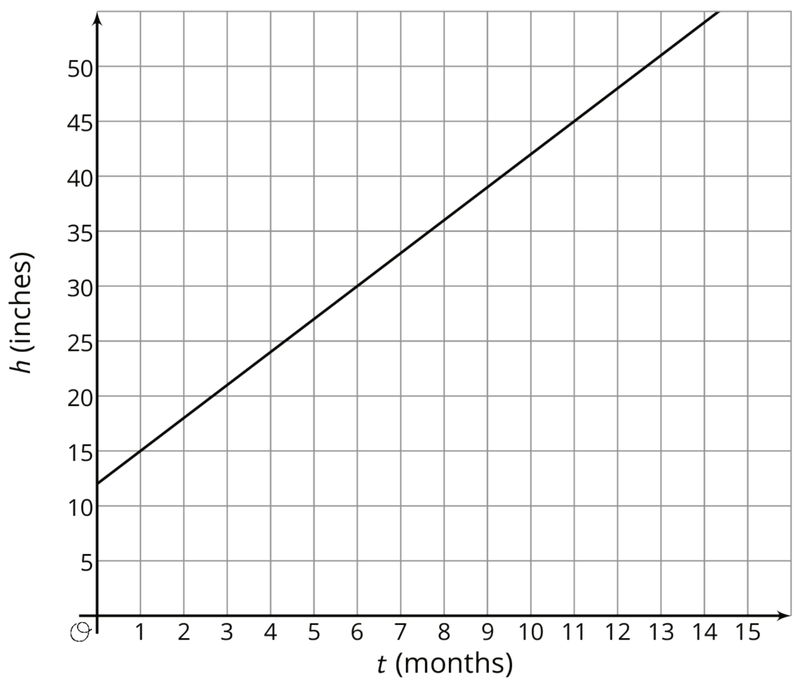
This week your student will learn how to write equations representing linear relationships. A linear relationship exists between two quantities where one quantity has a constant rate of change with respect to the other. The relationship is called linear because its graph is a line.

For example, say we are 5 mile into a hike heading toward a lake at the end of the trail. If we walk at a speed of 2.5 miles per hour, then for each hour that passes we are 2.5 miles further along the trail. After 1 hour we would be 7.5 miles from the start. After 2 hours we would be 10 miles from the start (assuming no stops). This means there is a linear relationship between miles traveled and hours walked. A graph representing this situation is a line with a slope of 2.5 and a vertical intercept of 5.

Here is a task to try with your student:

The graph shows the height in inches, h, of a bamboo plant t months after it has been planted.

1. What is the slope of this line? What does that value mean in this context?
2. At what point does the line intersect the h-axis? What does that value mean in this context?



Solution:

1. 3. Every month that passes, the bamboo plant grows an additional 3 inches.
2. $(0, 12)$. This bamboo plant was planted when it was 12 inches tall.

Finding Slopes

Family Support Materials 3

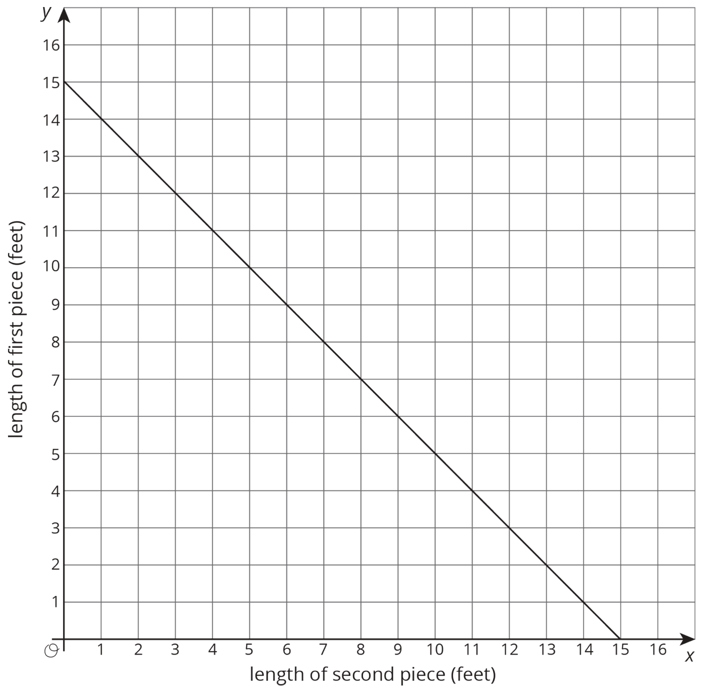
This week your student will investigate linear relationships with slopes that are not positive. Here is an example of a line with negative slope that represents the amount of money on a public transit fare card based on the number of rides you take:

The slope of the line graphed here is -2.5 since $\text{slope} = \frac{\text{vertical change}}{\text{horizontal change}} = \frac{-40}{16} = -2.5$. This corresponds to the cost of 1 ride. The vertical intercept is 40, which means the card started out with \$40 on it.

One possible equation for this line is $y = -2.5x + 40$. It is important for students to understand that every pair of numbers (x, y) that is a solution to the equation representing the situation is also a point on the graph representing the situation. (We can also say that every point (x, y) on the graph of the situation is a solution to the equation representing the situation.)

Here is a task to try with your student:

A length of ribbon is cut into two pieces. The graph shows the length of the second piece, x, for each length of the first piece, y.



1. How long is the original ribbon? Explain how you know.
2. What is the slope of the line? What does it represent?
3. List three possible pairs of lengths for the two pieces and explain what they mean.

Solution:

1. 15 feet. When the second piece is 0 feet long, the first is 15 feet long, so that is the length of the ribbon.
2. -1. For each length the second piece increases by, the first piece must decrease by the same length. For example, if we want the second piece to be 1 foot longer, then the first piece must be 1 foot shorter.
3. Three possible pairs: $(14.5, 0.5)$, which means the second piece is 14.5 feet long so the first piece is only a half foot long. $(7.5, 7.5)$, which means each piece is 7.5 feet long, so the original ribbon was cut in half. $(0, 15)$, which means the original ribbon was not cut at all to make a second piece, so the first piece is 15 feet long.

Family Support Materials

Linear Equations and Linear Systems

Here are the video lesson summaries for Grade 8, Unit 4: Linear Equations and Linear Systems. Each video highlights key concepts and vocabulary that students learn across one or more lessons in the unit. The content of these video lesson summaries is based on the written Lesson Summaries found at the end of lessons in the curriculum. The goal of these videos is to support students in reviewing and checking their understanding of important concepts and vocabulary. Here are some possible ways families can use these videos:

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Grade 8, Unit 4: Linear Equations and Linear Systems	Vimeo	YouTube
Video 1: Solving Linear Equations in One Variable (Lessons 1–4)	Link	Link
Video 2: Solving Any Linear Equation (Lessons 5–6)	Link	Link
Video 3: Equations with Different Numbers of Solutions (Lessons 7–8)	Link	Link
Video 4: Systems of Equations (Lessons 10–12)	Link	Link
Video 5: Solving Systems of Equations (Lessons 13–15)	Link	Link

Video 1

Video 'VLS G8U4V1 Solving Linear Equations in One Variable (Lessons 1–4)' available here: https://player.vimeo.com/video/481928840.

Video 2

Video 'VLS G8U4V2 Solving Any Linear Equation (Lessons 5–6)' available here: https://player.vimeo.com/video/481932761.

Video 3

Video 'VLS G8U4V3 Equations with Different Numbers of Solutions (Lessons 7–8)' available here: https://player.vimeo.com/video/481727762.

Video 4

Video 'VLS G8U4V4 Systems of Equations (Lessons 10–12)' available here: https://player.vimeo.com/video/481741092.

Video 5

Video 'VLS G8U4V5 Solving Systems of Equations (Lessons 13–15)' available here: https://player.vimeo.com/video/487590758.

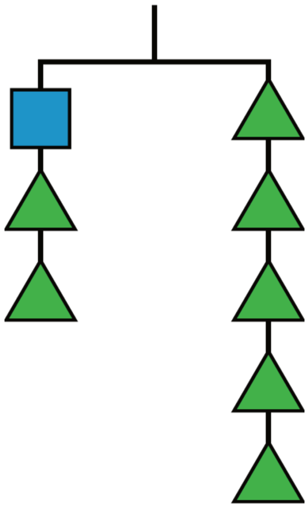
Connecting to Other Units

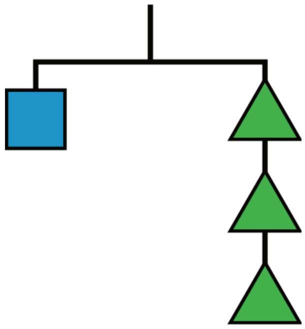
- *Coming soon*

Puzzle Problems

Family Support Materials 1

This week your student will work on solving linear equations. We can think of a balanced hanger as a metaphor for an equation. An equation says that the expressions on either side have equal value, just like a balanced hanger has equal weights on either side.





a = 3*b*

a + 2*b* = 5*b*

If we have a balanced hanger and add or remove the same amount of weight from each side, the result will still be in balance.

We can do this with equations as well: adding or subtracting the same amount from both sides of an equation keeps the sides equal to each other. For example, if $4x + 20$ and $\text{-}6x + 10$ have equal value, we can write an equation $4x + 20 = \text{-}6x + 10$. We could add -10 to both sides of the equation or divide both sides of the equation by 2 and keep the sides equal to each other. Using these moves in systematic ways, we can find that $x = \text{-}1$ is a solution to this equation.

Here is a task to try with your student:

Elena and Noah work on the equation $\frac{1}{2}(x + 4) = \text{-}10 + 2x$ together. Elena's solution is $x = 24$ and Noah's solution is $x = \text{-}8$. Here is their work:

Elena:

$$\frac{1}{2}(x+4) = \text{-}10 + 2x$$
$$x + 4 = \text{-}20 + 2x$$
$$x + 24 = 2x$$
$$24 = x$$
$$x = 24$$

Noah:

$$\frac{1}{2}(x+4) = \text{-}10 + 2x$$
$$x + 4 = \text{-}20 + 4x$$
$$\text{-}3x + 4 = \text{-}20$$
$$\text{-}3x = \text{-}24$$
$$x = \text{-}8$$

Do you agree with their solutions? Explain or show your reasoning.

Solution:

No, they both have errors in their solutions.

Elena multiplied both sides of the equation by 2 in her first step, but forgot to multiply the $2x$ by the 2. We can also check Elena's answer by replacing x with 24 in the original equation and seeing if the equation is true.

$$\frac{1}{2}(x+4) = \text{-}10 + 2x$$
$$\frac{1}{2}(24+4) = \text{-}10 + 2(24)$$
$$\frac{1}{2}(28) = \text{-}10 + 48$$
$$14 = 38$$

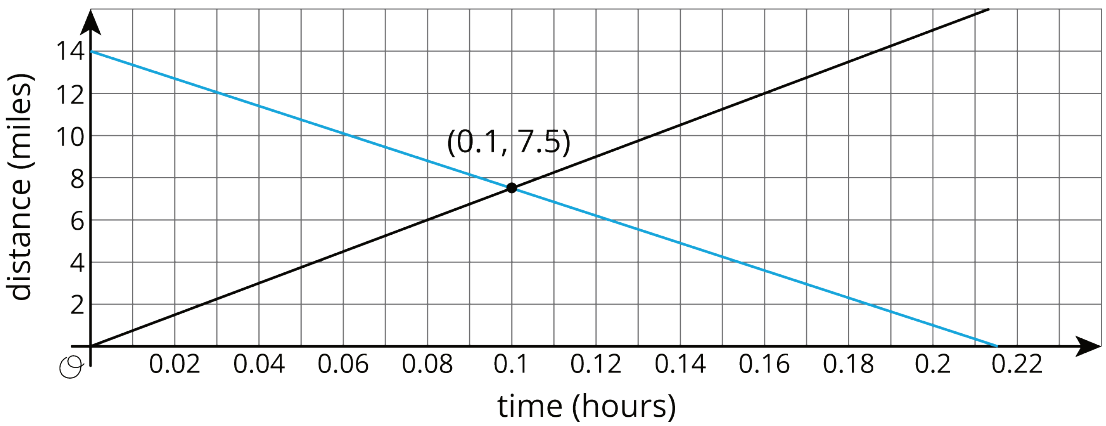
Since 14 is not equal to 38, Elena's answer is not correct.

Noah divided both sides by -3 in his last step, but wrote -8 instead of 8 for $\text{-}24 \div \text{-}3$. We can also check Noah's answer by replacing x with -8 in the original equation and seeing if the equation is true. Noah's answer is not correct.

Systems of Linear Equations

Family Support Materials 2

This week your student will work with systems of equations. A system of equations is a set of 2 (or more) equations where the letters represent the same values. For example, say Car A is traveling 75 miles per hour and passes a rest area. The distance in miles it has traveled from the rest area after t hours is $d = 75t$. Car B is traveling toward the rest area and its distance from the rest area at any time is $d = 14 - 65t$. We can ask if there is ever a time when the distance of Car A from the rest area is the same as the distance of Car B from the rest area. If the answer is "yes," then the solution will correspond to one point that is on both lines, such as the point $(0.1, 7.5)$ shown here. 0.1 hours after Car A passes the rest area, both cars will be 7.5 miles from the rest area.



We could also answer the question without using a graph. Since we are asking when the d values for each car will be the same, we are asking for what t value, if any, makes $75t = 14 - 65t$ true. Solving this equation for t, we find that $t = 0.1$ is a solution and at that time the cars are 7.5 miles away since $75t = 75 \cdot 0.1 = 7.5$. This finding matches the graph.

Here is a task to try with your student:

Lin and Diego are biking the same direction on the same path, but start at different times. Diego is riding at a constant speed of 18 miles per hour, so his distance traveled in miles can be represented by d and the time he has traveled in hours by t, where $d = 18t$. Lin started riding a quarter hour before Diego at a constant speed of 12 miles per hour, so her total distance traveled in miles can be represented by d, where $d = 12\left(t + \frac{1}{4}\right)$. When will Lin and Diego meet?

Solution:

To find when Lin and Diego meet, that is, when they have traveled the same total distance, we can set the two equations equal to one another: $18t = 12\left(t + \frac{1}{4}\right)$. Solving this equation for t,

$$\begin{aligned} 18t &= 12t + 3 \\ 6t &= 3 \\ t &= \frac{1}{2} \end{aligned}$$

They meet after Diego rides for one half hour and Lin rides for three quarters of an hour. The distance they each travel before meeting is 9 miles, since $9 = 18 \cdot \frac{1}{2}$. Another way to find a solution would be to graph both $d = 18t$ and $d = 12\left(t + \frac{1}{4}\right)$ on the same coordinate plane and interpret the point where these lines intersect.

Family Support Materials

Functions and Volume

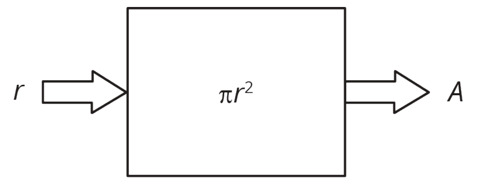
Inputs and Outputs

Family Support Materials 1

This week, your student will be working with **functions**. A function is a rule that produces a single output for a given input.

Not all rules are functions. For example, here's a rule: the input is "first letter of the month" and the output is "the month." If the input is J, what is the output? A function must give a single output, but in this case the output of this rule could be January, June, or July, so the rule is not a function.

Here is an example of a rule that is a function: input a number, square it, then multiply the result by π. Using r for the input and A for the output, we can draw a diagram to represent the function:



We could also represent this function with an equation, $A = \pi r^2$. We say that the input of the function, r, is the **independent variable** and the output of the function, A, is the **dependent variable**. We can choose any value for r, and then the value of A depends on the value of r. We could also represent this function with a table or as a graph. Depending on the question we investigate, different representations have different advantages. You may recognize this rule and know that the area of a circle depends on its radius.

Here is a task to try with your student:

Jada can buy peanuts for \$0.20 per ounce and raisins for \$0.25 per ounce. She has \$12 to spend on peanuts and raisins to make trail mix for her hiking group.

1. How much would 10 ounces of peanuts and 16 ounces of raisins cost? How much money would Jada have left?

2. Using p for pounds of peanuts and r for pounds of raisins, an equation relating how much of each they buy for a total of \$12 is $0.2p + 0.25r = 12$. If Jada wants 20 ounces of raisins, how many ounces of peanuts can she afford?

3. Jada knows she can rewrite the equation as $r = 48 - 0.8p$. In Jada's equation, which is the independent variable? Which is the dependent variable?

Solution:

1. 10 ounces of peanuts would cost \$2 since $0.2 \cdot 10 = 2$. 16 ounces of raisins would cost \$4 since $0.25 \cdot 16 = 4$. Together, they would cost Jada \$6, leaving her with \$6.

2. 35 ounces of peanuts. If Jada wants 20 ounces of raisins, then $0.2p + 0.25 \cdot 20 = 12$ must be true, which means $p = 35$.

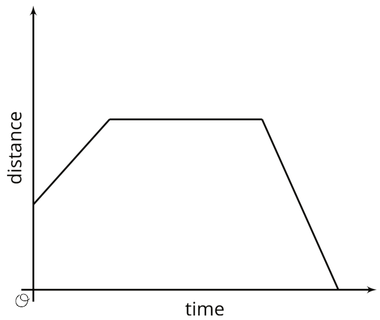
3. p is the independent variable and r is the dependent variable for Jada's equation.

Linear Functions and Rates of Change

Family Support Materials 2

This week, your student will be working with graphs of functions. The graph of a function is all the pairs (input, output), plotted in the coordinate plane. By convention, we always put the input first, which means the inputs are represented on the horizontal axis and the outputs on the vertical axis.

For a graph representing a context, it is important to specify the quantities represented on each axis. For example this graph shows Elena's distance as a function of time. If it is distance from home, then Elena starts at some distance from home (maybe at her friend's house), moves further away from her home (maybe to a park), stays there a while, and then returns home. If it is distance from school, the story is different.

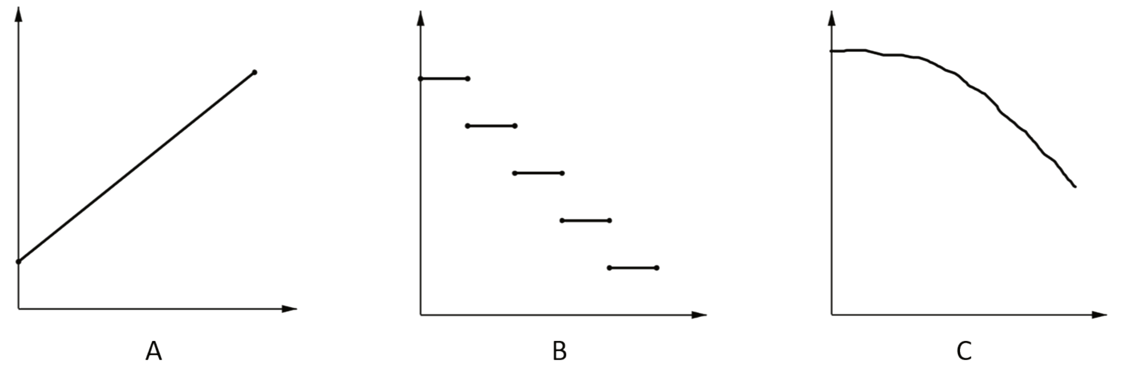


The story also changes depending on the scale on the axes: is distance measured in miles and time in hours, or is distance measured in meters and time in seconds?

Here is a task to try with your student:

Match each of the following situations with a graph (you can use a graph multiple times). Define possible inputs and outputs, and label the axes.

1. Noah pours the same amount of milk from a bottle every morning.
2. A plant grows the same amount every week.
3. The day started very warm but then it got colder.
4. A cylindrical glass contains some partially melted ice. The more water you pour in, the higher the water level.



Solution:

1. Graph B, input is time in days, output is amount of milk in the bottle
2. Graph A, input is time in weeks, output is height of plant
3. Graph C, input is time in hours, output is temperature
4. Graph A, input is volume of water, output is height of water

In each case, the horizontal axis is labeled with the input, and the vertical axis is labeled with the output.

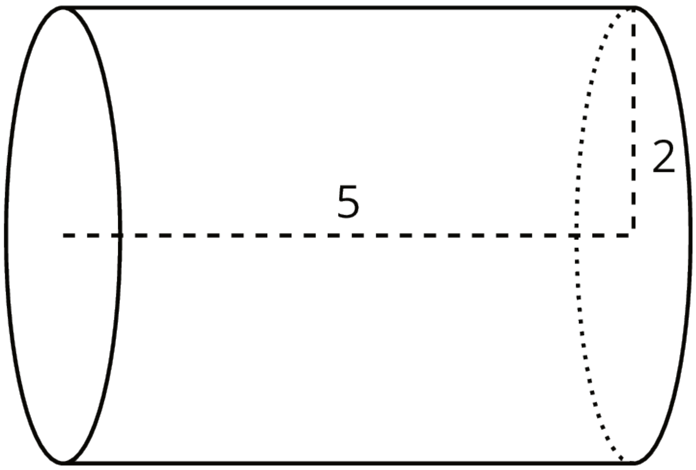
Cylinders and Cones

Family Support Materials 3

This week your student will be working with volumes of three-dimensional objects. We can determine the volume of a cylinder with radius r and height h using two ideas that we've seen before:

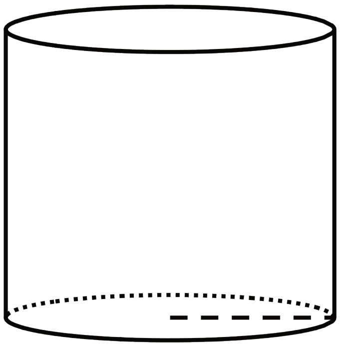
- The volume of a rectangular prism is a result of multiplying the area of its base by its height.
- The base of the cylinder is a circle with radius r, so the base area is πr^2.

Just like a rectangular prism, the volume of a cylinder is the area of the base times the height. For example, let's say we have a cylinder whose radius is 2 cm and whose height is 5 cm like the one shown here:



The base has an area of $\pi 2^2 = 4\pi$ cm^3. Using this, we can calculate the volume to be 20\ pi$ cm^3 since $4\pi \cdot 5 = 20$. If we use 3.14 as an approximation for π, we can say that the volume of the cylinder is approximately 62.8 cm^3. Students will also investigate the volume of cones and how their volume is related to the volume of a cylinder with the same radius and height.

Here is a task to try with your student:



This cylinder has a height and radius of 5 cm. Leave your answers in terms of π.

1. What is the diameter of the base?
2. What is the area of the base?
3. What is the volume of the cylinder?

Solution:

1. 10 cm. The diameter is $2 \cdot r$, and $2 \cdot 5 = 10$.
2. 25π cm^2. The area is π times the radius squared, or $5^2 \cdot \pi$.
3. 125π cm^3. The volume is the area of the base times the height. The area of the base here is 25π, so the volume is 125π cm^3 since $25\pi \cdot 5 = 125\pi$.

Dimensions and Spheres

Family Support Materials 4

This week, your student will compare the volumes of different objects. Many common objects, from water bottles to buildings to balloons, are similar in shape to rectangular prisms, cylinders, cones, and spheres—or even combinations of these shapes. We can use the volume formulas for these shapes to compare the volume of different types of objects.

For example, let's say we want to know which has more volume: a cube-shaped box with an edge length of 3 centimeters or a sphere with a radius of 2 centimeters.

The volume of the cube is 27 cubic centimeters since $\text{edge}^3 = 3^3 = 27$. The volume of the sphere is about 33.51 cubic centimeters since $\frac{4}{3}\pi \boldsymbol{\cdot} \text{radius}^3 = \frac{4}{3}\pi \boldsymbol{\cdot} 2^3 \approx 33.51$. Therefore, we can tell that the cube-shaped box holds less than the sphere.

Here is a task to try with your student:

A globe fits tightly inside a cubic box. The box has an edge length of 8 cm.

1. What is the volume of the box?
2. Estimate the volume of the globe: is it more or less than the volume of the box? How can you tell?
3. What is the diameter of the globe? The radius?
4. The formula for the volume of a sphere (like a globe) is $V = \frac{4}{3}\pi r^3$. What is the actual volume of the sphere? How close was your estimate in the previous problem?

Solution:

1. 512 cm^3. The box is a cube, so its volume is 8^3 cubic centimeters.
2. Answers vary. The number should be less than 512 cm^3 since the volume of the globe must be less than the volume of the box. Possible explanation: it fits entirely inside the box, so it takes up less space. Since you can fit the globe inside the box and there is still space left over, the box has more volume.
3. Since the globe fits tightly inside the cubic box, the diameter of the globe must be the same as the edge length of the box, 8 cm. This means the radius is 4 cm.

4. $\frac{256}{3}\pi$ or about 268 cm^3. Since the side length of the cube is 8 cm, the radius of the globe is half of that, or 4 cm. The volume of the globe is therefore $\frac{4}{3}\pi \cdot 4^3 = \frac{256}{3}\pi$.

Family Support Materials

Associations in Data

Here are the video lesson summaries for Grade 8, Unit 6: Associations in Data. Each video highlights key concepts and vocabulary that students learn across one or more lessons in the unit. The content of these video lesson summaries is based on the written Lesson Summaries found at the end of lessons in the curriculum. The goal of these videos is to support students in reviewing and checking their understanding of important concepts and vocabulary. Here are some possible ways families can use these videos:

- Keep informed on concepts and vocabulary students are learning about in class.
- Watch with their student and pause at key points to predict what comes next or think up other examples of vocabulary terms (the bolded words).
- Consider following the Connecting to Other Units links to review the math concepts that led up to this unit or to preview where the concepts in this unit lead to in future units.

Grade 8, Unit 6: Associations in Data	Vimeo	YouTube
Video 1: Using Scatter Plots to Visualize Data (Lessons 1–3)	Link	Link
Video 2: Using Lines to Model Data (Lesson 4–8)	Link	Link
Video 3: Associations in Categorical Data (Lessons 9–10)	Link	Link

Video 1

Video 'VLS G8U6V1 Using scatter plots to visualize data (Lessons 1–3)' available here: https://player.vimeo.com/video/500190466.

Video 2

Video 'VLS G8U6V2 Using Lines to Model Data (Lesson 4–8)' available here: https://player.vimeo.com/video/502223668.

Video 3

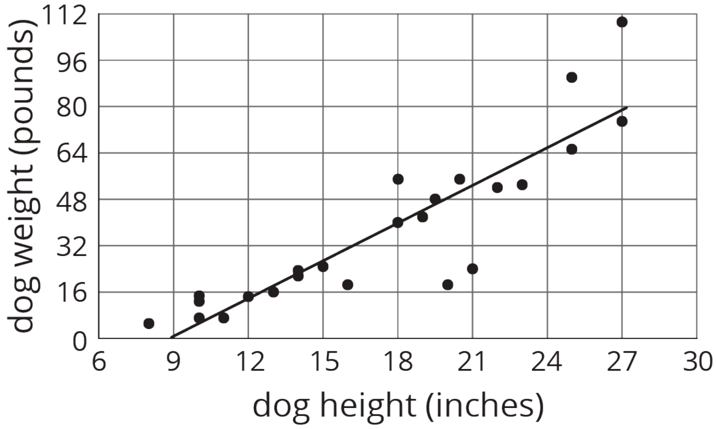
Video 'VLS G8U6V3 Associations in Categorical Data (Lessons 9–10)' available here: https://player.vimeo.com/video/507557063.

- *Coming soon*

Does This Predict That?

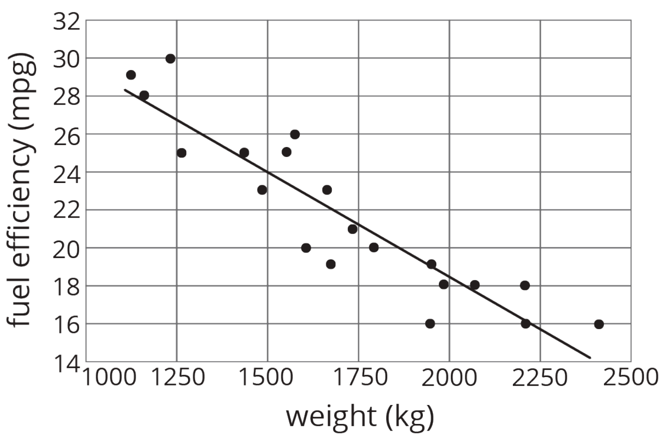
Family Support Materials 1

This week your student will work with **scatter plots**. Scatter plots show us how two different variables are related. In the example below, each plotted point corresponds to a dog, and its coordinates tell us the height and weight of that dog. The point on the lower left of the graph, for example, might represent a dog that is 8 inches tall and weighs about 5 pounds. The plot shows that, generally speaking, taller dogs weigh more than shorter dogs.



Since a larger value for one characteristic (height) generally means a larger value for the other characteristic (weight), we say that there is a **positive association** between dog height and dog weight.

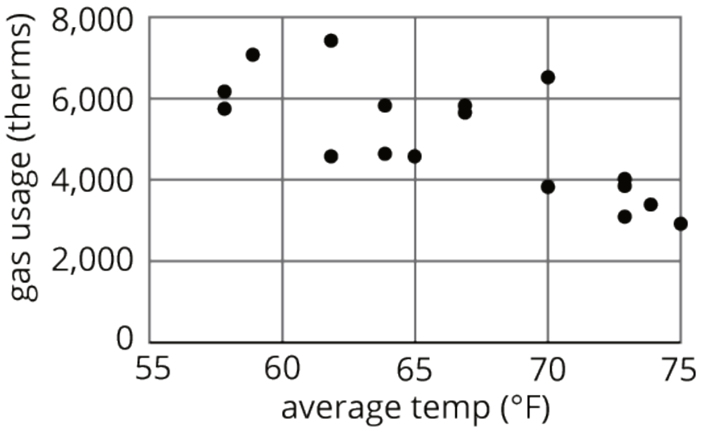
In the next example, each point corresponds to a car, and its coordinates tell us the weight and fuel efficiency of the car.



This time, we see that larger values for one characteristic (car weight) generally have lower values for the other characteristic (fuel efficiency), and so we say that there is a **negative association** between car weight and fuel efficiency.

Here is a task to try with your student:

The following scatter plot shows the relationship between average temperature and gas usage in a buildings.



1. How many points in the graph describe the building on 70-degree days? Approximately how much gas was used on each of these days?
2. Do the variables in the gas usage for a building scatter plot show a positive association or a negative association?
3. On a 78-degree day, would the building be most likely to use (a) 1,800 therms of gas, (b) 4,200 therms of gas, or (c) 5,800 terms of gas?

Solution:

1. There are two points that describe gas usage for 70-degree days. On one of those days, the building used a little less than 4,000 therms of gas. On the other, the building used a little more than 6,000 therms.
2. Since less gas is used on warmer days, there is a negative association.
3. Following the trend in the graph, the building would likely use about 1,800 therms on a 78-degree day. You may draw in a line as in the dog and car scatter plots to help see this.

Associations in Categorical Data

Family Support Materials 2

This week your student will use two-way tables. Two-way tables are a way of comparing two variables. For example, this table shows the results of a study of the relation between meditation and state of mind of athletes before a track meet.

	meditated	did not meditate	total
calm	45	8	53
agitated	23	21	44
total	68	29	97

23 of the people who meditated were agitated, while 21 of the people who did not meditate were agitated. Does this mean that meditation has no impact or even a slight negative association with mood? Probably not. When we look for associations between variables it can be more informative to know the percentages in each category, like this:

	meditated	did not meditate
calm	66%	28%
agitated	34%	72%
total	100%	100%

Of the people who meditated, 66% were calm, and 34% were agitated. When we compare that to the percentages for people who did not meditate, we can now see more easily that the group of people who meditated has a lower percentage of athletes who are agitated. The percentages in this table are called **relative frequencies**.

Here is a task to try with your student:

The following table contains data about whether people in various age groups use their cell phone as their main alarm clock.

	use cell phone as alarm	do not use cell phone as alarm	total
18 to 29 years old	47	16	63
30 to 49 years old	66	23	87
50+ years old	31	39	70
total	144	78	220

1. Fill in the blanks in the table below with the relative frequencies for each row. These will tell us the percentage of people in each age group who use their phone as an alarm.

	use cell phone as alarm	do not use cell phone as alarm	total
18 to 29 years old	75%, since $\frac{47}{63} = 0.75$		100%
30 to 49 years old			
50+ years old			

2. Comparing just the 18 to 29 year olds and the 30 to 49 year olds, is there an association between cell phone alarm use and age?

3. Comparing the two youngest age brackets with the 50+ age bracket, is there an association between cell phone alarm use and age?

Solution:

1.

	use cell phone as alarm	do not use cell phone as alarm	total
18 to 29 years old	75%, since $\frac{47}{63} = 0.75$	25%, since $\frac{16}{63} = 0.25$	100%
30 to 49 years old	76%, since $\frac{66}{87} = 0.76$	24%, since $\frac{23}{87} = 0.24$	100%
50+ years old	44%, since $\frac{31}{70} = 0.44$	56%, since $\frac{39}{70} = 0.56$	100%

2. No: the relative frequencies are very similar.

3. Yes: using a cell phone as an alarm is associated with being in the younger age brackets. About 75% of 18 to 29 and 30 to 49-year olds use their cell phone as an alarm, but only 44% of people 50 years or older do.

Family Support Materials

Exponents and Scientific Notation

Exponent Review

Family Support Materials 1

This week your student will learn the rules for multiplying and dividing expressions with exponents. Exponents are a way of keeping track of how many times a number has been repeatedly multiplied. For example, instead of writing $8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8$, we can write 8^7 instead. The number repeatedly multiplied is called the base, which in this example is 8. The 7 here is called the exponent.

Using our understanding of repeated multiplication, we'll figure out several "rules" for exponents. For example, suppose we want to understand the expression $10^3 \cdot 10^4$. Rewriting this to show all the factors, we get $(10 \cdot 10 \cdot 10) \cdot (10 \cdot 10 \cdot 10 \cdot 10)$. Since this is really 7 10s multiplied together, we can write $10^3 \cdot 10^4 = 10^7$. By counting the repeated factors that are 10, we've added the exponents together (there are 3 of them, and then 4 more). This leads us to understanding a more general rule about exponents; when multiplying powers of the same base, we add the exponents together:

$$x^n \cdot x^m = x^{n+m}$$

Using similar reasoning, we can figure out that when working with powers of powers, we multiply the exponents together:

$$(x^n)^m = x^{n \cdot m}$$

These patterns will lead to other discoveries later on.

Here is a task to try with your student:

1. Jada and Noah were trying to understand the expression $10^4 \cdot 10^5$. Noah said, "since we are multiplying, we will get 10^{20}." Jada said, "But I don't think you can get 20 10s multiplied together from that." Do you agree with either of them?

2. Next, Jada and Noah were thinking about a similar expression, $\left(10^4\right)^5$. Noah said, "Ok this one will be 10^{20} because you will have 5 groups of 4." Jada said, "I agree it will be 10^{20}, but it's because there will be 4 groups of 5." Do you agree with either of them?

Solution:

1. Jada is correct. Rewriting $10^4 \cdot 10^5$ to show all the factors looks like $(10 \cdot 10 \cdot 10 \cdot 10) \cdot (10 \cdot 10 \cdot 10 \cdot 10 \cdot 10)$. We can see that there are a total of 9 10s being multiplied. This helps us understand what's going on when we use the rule to write $10^4 \cdot 10^5 = 10^{4+5} = 10^9$.

2. This time, Noah is correct. When we look at $\left(10^4\right)^5$, the outside exponent of 5 tells us that there are 5 10^4s being multiplied together. So $\left(10^4\right)^5 = 10^4 \cdot 10^4 \cdot 10^4 \cdot 10^4 \cdot 10^4$. This means there are 5 groups of 4 10s being multiplied together. We could write this out the long way as $\left(10^4\right)^5 = (10 \cdot 10 \cdot 10 \cdot 10)(10 \cdot 10 \cdot 10 \cdot 10)(10 \cdot 10 \cdot 10 \cdot 10)(10 \cdot 10 \cdot 10 \cdot 10)(10 \cdot 10 \cdot 10 \cdot 10)$. This helps us understand what's going on when we use the rule to write $\left(10^4\right)^5 = 10^{4 \cdot 5} = 10^{20}$.

Scientific Notation

Family Support Materials 2

This week your student will use powers of 10 to work with very large or very small numbers. For example, the United States mint has made over 500,000,000,000 pennies. In order to understand this number, we have to count all of the zeros. Since there are 11 of them this means there are 500 billion pennies. Using powers of 10, we can write this as $5 \cdot 10^{11}$. The advantage to this way of writing the number is that we can see right away how many zeros there are (11), and more efficiently compare numbers when they are both written in this form. The same is true for small quantities. For example, a single atom of carbon weighs about 0.0000000000000000000000199 grams. If we write this using powers of 10, it becomes $(1.99) \cdot 10^{-23}$.

Not only do powers of 10 make it easier to write this number, but they also help avoid errors since it would be very easy to add or take away a zero when writing out the decimal without realizing! Writing numbers in this way is called scientific notation. We can use the exponent rules learned earlier to estimate and solve problems with scientific notation.

Here is a task to try with your student:

This table shows the top speeds of different vehicles.

vehicle	speed (kilometers per hour)
sports car	$(4.15) \cdot 10^2$
Apollo Command/Service Module	$(3.99) \cdot 10^4$
jet boat	$(5.1) \cdot 10^2$
autonomous drone	$(2.1) \cdot 10^4$

1. Order the vehicles from fastest to slowest.
2. The top speed of a rocket sled is 10,326 kilometers per hour. Is this faster or slower than the autonomous drone?
3. Estimate how many times as fast the Apollo Command/Service Module is than the sports car.

Solution:

1. The order is: Apollo CSM, autonomous drone, jet boat, sports car. Since all of these values are in scientific notation, we can look at the power of 10 to compare. The speeds of the Apollo CSM and autonomous drone both have the highest power of 10 (10^4), so they are fastest. The Apollo CSM is faster than the drone because 3.99 is greater than 2.1. Similarly, the jet boat is faster than the sports car because their speeds both have the same power of 10 (10^2) but 5.1 is greater than 4.15.

2. The autonomous drone is faster than the rocket sled. In scientific notation, the rocket sled's speed is $1.0326 \cdot 10^4$, and the drone's speed is $2.1 \cdot 10^4$ and 2.1 is greater than 1.0326.

3. To find how many times as fast the Apollo CSM is than the sports car, we are trying to find out what number times $4.15 \cdot 10^2$ equals $3.99 \cdot 10^4$. So we are trying to compute $\frac{3.99 \cdot 10^4}{4.15 \cdot 10^2}$. Since we are estimating, we can simplify the calculation to $\frac{4 \cdot 10^4}{4 \cdot 10^2}$. Using exponent rules and our understanding of fractions, we have $\frac{4 \cdot 10^4}{4 \cdot 10^2} = 1 \cdot 10^{4-2} = 10^2$, so the Apollo CSM is about 100 times as fast as the sports car!

Family Support Materials

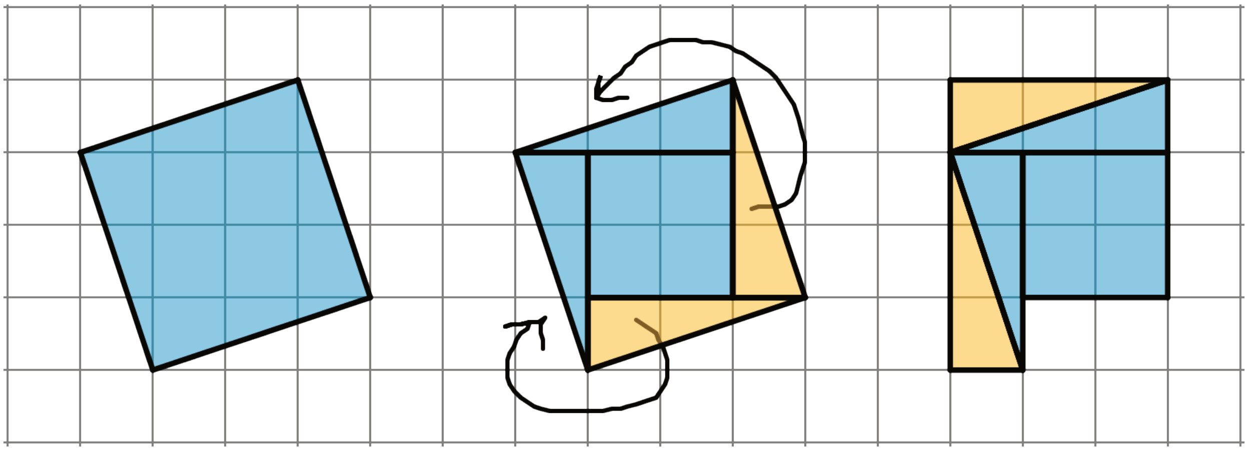
Pythagorean Theorem and Irrational Numbers

Side Lengths and Areas of Squares

Family Support Materials 1

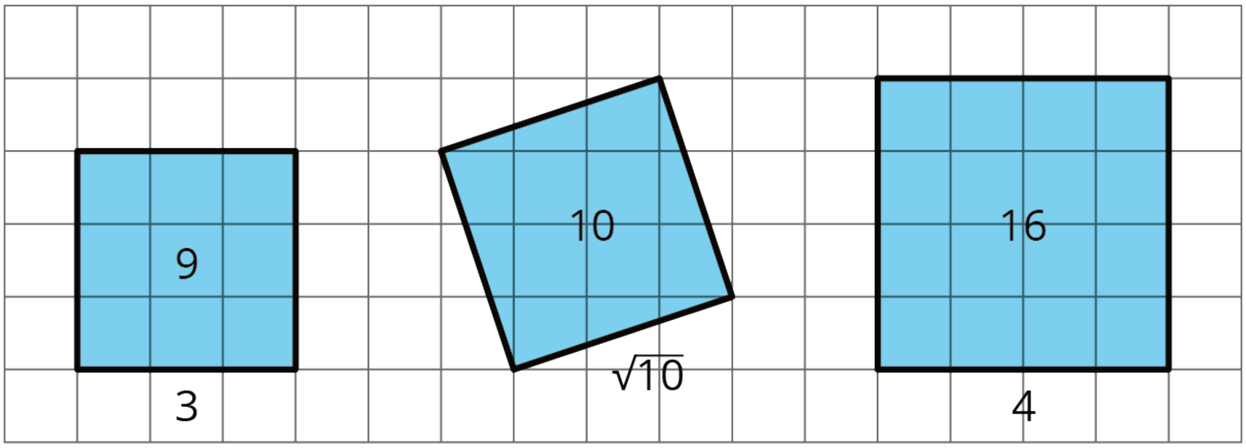
This week your student will be working with the relationship between the side length and area of squares. We know two main ways to find the area of a square:

- Multiply the square's side length by itself.
- Decompose and rearrange the square so that we can see how many square units are inside. For example, if we decompose and rearrange the tilted square in the diagram, we can see that its area is 10 square units.



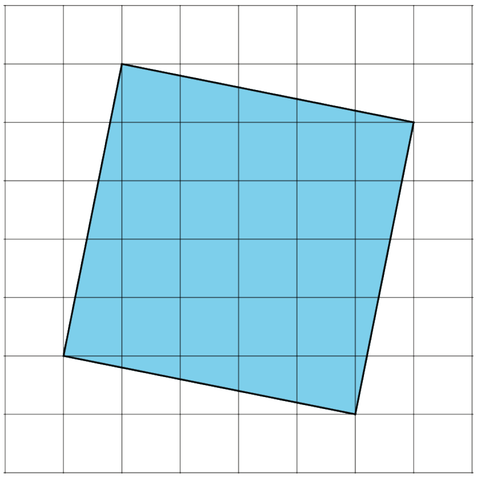
But what is the side length of this tilted square? It cannot be 3 units since $3^2 = 9$ and it cannot be 4 units since $4^2 = 16$. In order to write "the side length of a square whose area is 10 square units," we use notation called a **square root**. We write "the square root of 10" as $\sqrt{10}$ and it means "the length of a side of a square whose area is 10 square units." All of these statements are true:

- $\sqrt{9} = 3$ because $3^2 = 9$
- $\sqrt{16} = 4$ because $4^2 = 16$
- $\sqrt{10}$ is the side length of a square whose area is 10 square units, and $\left(\sqrt{10}\right)^2 = 10$



Here is a task to try with your student:

If each grid square represents 1 square unit, what is the side length of this titled square? Explain your reasoning.



Solution:

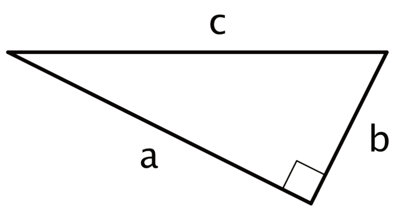
The side length is $\sqrt{26}$ because the area of the square is 26 square units and the square root of the area of a square is the side length.

The Pythagorean Theorem

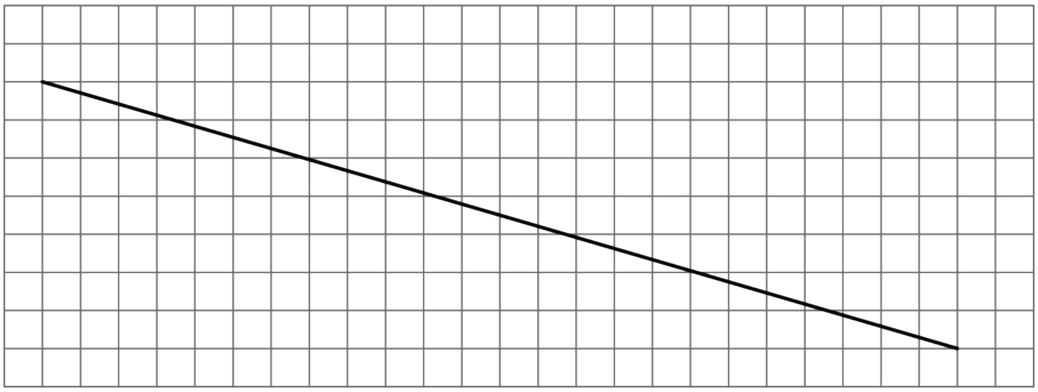
Family Support Materials 2

This week your student will work with the Pythagorean Theorem, which describes the relationship between the sides of any right triangle. A right triangle is any triangle with a right angle. The side opposite the right angle is called the hypotenuse, and the two other sides are called the legs.

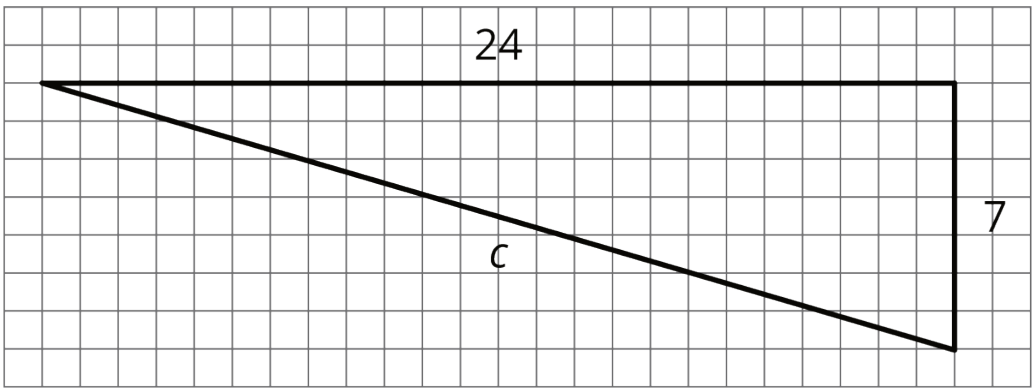
Here we have a triangle with hypotenuse c and legs a and b. The Pythagorean Theorem states that for any right triangle, the sum of the squares of the legs are equal to the square of the hypotenuse. In other words, $a^2 + b^2 = c^2$.



We can use the Pythagorean Theorem to tell if a triangle is a right triangle or not, to find the value of one side length of a right triangle if we know the other two, and to answer questions about situations that can be modeled with right triangles. For example, let's say we wanted to find the length of this line segment:



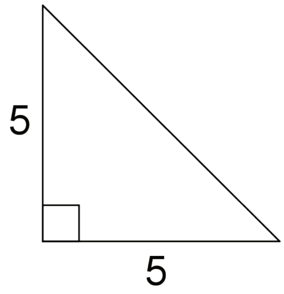
We can first draw a right triangle and determine the lengths of the two legs:



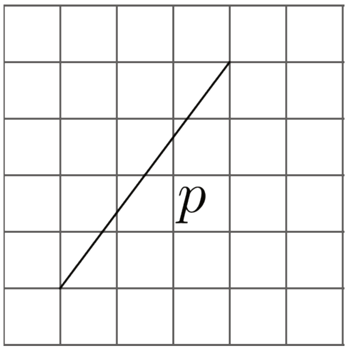
Next, since this is a right triangle, we know that $24^2 + 7^2 = c^2$, which means the length of the line segment is 25 units.

Here is a task to try with your student:

1. Find the length of the hypotenuse as an exact answer using a square root.



2. What is the length of line segment p? Explain or show your reasoning. (Each grid square represents 1 square unit.)



Solution:

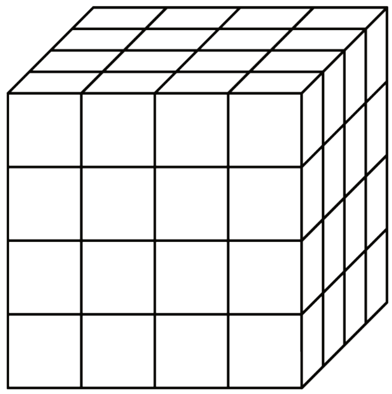
1. The length of the hypotenuse is $\sqrt{50}$ units. With legs a and b both equal to 5 and an unknown value for the hypotenuse, c, we know the relationship $5^2 + 5^2 = c^2$ is true. That means $50 = c^2$, so c must be $\sqrt{50}$ units.

2. The length of p is $\sqrt{25}$ or 5 units. If we draw in the right triangle, we have legs of length 3 and 4 and hypotenuse p, so the relationship $3^2 + 4^2 = p^2$ is true. Since $3^2 + 4^2 = 25 = p^2$, p must equal $\sqrt{25}$ or 5 units.

Side Lengths and Volumes of Cubes

Family Support Materials 3

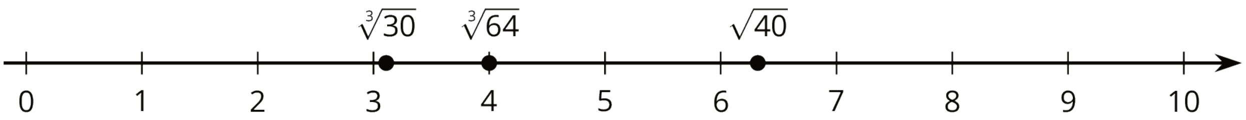
This week your student will learn about cube roots. We previously learned that a square root is the side length of a square with a certain area. For example, if a square has an area of 16 square units then its edge length is 4 units because $\sqrt{16} = 4$. Now, think about a solid cube. The cube has a volume, and the edge length of the cube is called the cube root of its volume. In this diagram, the cube has a volume of 64 cubic units:



Even without the useful grid, we can calculate that the edge length is 4 from the volume since $\sqrt[3]{64} = 4$.

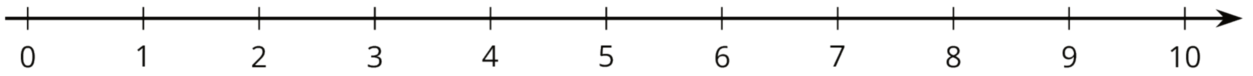
Cube roots that are not integers are still numbers that we can plot on a number line. If we have the three numbers $\sqrt{40}$, $\sqrt[3]{30}$, and $\sqrt[3]{64}$, we can plot them on the number line by estimating what integers they are near.

For example, $\sqrt{40}$ is between 6 and 7, since $\sqrt{36} < \sqrt{40} < \sqrt{49}$ and $\sqrt{36} = 6$ while $\sqrt{49} = 7$. Similarly, $\sqrt[3]{30}$ is between 3 and 4 because 30 is between 27 and 64. Our number line will look like this:



Here is a task to try with your student:

Plot the given numbers on the number line: $\sqrt{28}$, $\sqrt[3]{27}$, $\sqrt[3]{50}$



Solution:

Since $3^3 = 27$ means $\sqrt[3]{27} = 3$, we can plot $\sqrt[3]{27}$ at 3. $\sqrt[3]{50}$ is between 3 and 4 because 50 is between $3^3 = 27$ and $4^3 = 64$. $\sqrt{28}$ is between 5 and 6 because 28 is between $5^2 = 25$ and $6^2 = 36$.