Ratios and Proportional Relationship

Module 1

August 14th – October 3rd

Lesson 1: An Experience in Relationships as Measuring Rate

Classwork

Example 1: How fast is our class?

Record the results from the paper passing exercise in the table below.

Trial	Number of Papers Passed	Time (in seconds)	Ratio of Number of Papers Passed to Time	Rate	Unit Rate
1					
2					
3					
4					

Example 2: Our Class by Gender

	Number of boys	Number of girls	Ratio of boys to girls
Class 1			
Class 2			
Whole 7^{th} grade			

Create a pair of equivalent ratios by making a comparison of quantities discussed in this Example.

Exercise 1: Which is the Better Buy?

Value-Mart is advertising a Back-to-School sale on pencils. A pack of 30 sells for $7.97 whereas a 12-pack of the same brand cost for $ 4.77. Which is the better buy? How do you know?

Problem Set:

1. Find each rate and unit rate.
   a. 420 miles in 7 hours

b. 360 customers In 30 days
c. 40 meters in 16 seconds
d. $7.96 for 5 pounds

2. Write three ratios that are equivalent to the one given: 18 right-handed students for every 4 left-handed students.

3. Mr. Rowley has 16 homework papers and 14 exit tickets to return. Ms. Rivera has 64 homework papers and 60 exit tickets to return. For each teacher, write a ratio to represent the number of homework papers to number of exit tickets they have to return. Are the ratios equivalent? Explain.

4. Jonathan's parents told him that for every 5 hours of homework or reading he completes, he will be able to play 3 hours of video games. His friend Lucas's parents told their son that he can play 30 minutes for every hour of homework or reading time he completes. If both boys spend the same amount of time on homework and reading this week, which boy gets more time playing video games and how do you know?

5. At Euclid Middle School, of the 30 girls who tried out for the lacrosse team, 12 were selected and of the 40 boys who tried out, 16 were selected. Are the ratios of number of students on the team to number of student trying out the same for both boys and girls? How do you know?

6. Devon is trying to find the unit price on a 6-pack of energy drinks on sale for $2.99. His sister says that at that price, each energy drink would cost just over $2.00. Is she correct and how do you know? If she is not, how would Devon's sister find the correct price?

7. Each year Lizzie's school purchases student agenda books, which are sold in the school store. This year, the school purchased 350 books at a cost of $1,137.50. If the school would like to make a profit of $1,500 to help pay for field trips and school activities, what is the least amount they can charge for each agenda book? Explain how you found your answer.

Lesson 2: Proportional Relationships

Classwork

Example 1: Pay by the Ounce Frozen Yogurt!

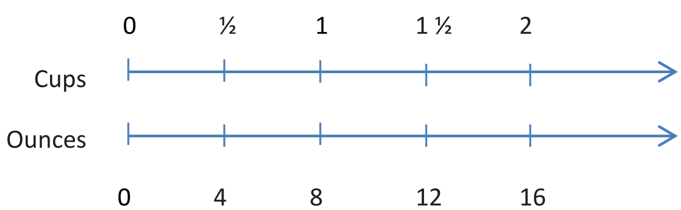
A new self-serve frozen yogurt store opened this summer that sells its yogurt at a price based upon the total weight of the yogurt and its toppings in a dish. Each member of Isabelle's family weighed their dish and this is what they found.

Weight (ounces)	12.5	10	5	8
Cost ($)	5	4	2	3.20

Cost ____ Weight.

Example 2: A Cooking Cheat Sheet!

In the back of a recipe book, a diagram provides easy conversions to use while cooking.

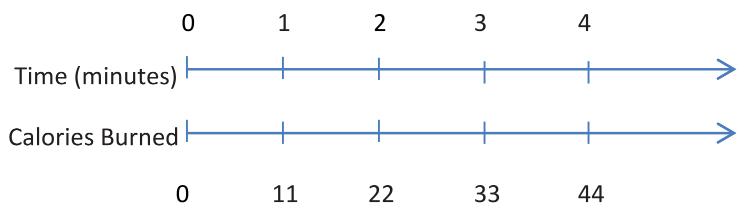


Ounces ____Cups.

Exercise 1

During Jose's physical education class today, students visited activity stations. Next to each station was a chart depicting how many Calories (on average) would be burned by completing the activity.

Calories burned while Jumping Rope



a. Is the number of Calories burned proportional to time? How do you know?

b. If Jose jumped rope for 6.5 minutes, how many calories would he expect to burn?

Example 3: Summer Job

Alex spent the summer helping out at his family's business. He was hoping to earn enough money to buy a new $220 gaming system by the end of the summer. Halfway through the summer, after working for 4 weeks, he had earned $112. Alex wonders, "If I continue to work and earn money at this rate, will I have enough money to buy the gaming system by the end of the summer?"

To check his assumption, he decided to make a table. He entered his total money earned at the end of week 1 and his total money earned at the end of Week 4.

Week	0	1	2	3	4	5	6	7	8
Total Earnings		$28			$112				

a. Work with a partner to answer Alex's question.

b. Are Alex's total earnings proportional to the number of weeks he worked? How do you know?

Problem Set

A cran-apple juice blend is mixed in a ratio of cranberry to apple of 3 to 5.

. Complete the table to show different amounts that are proportional.

Amount of Cranberry			
Amount of Apple			

a. Why are these quantities proportional?

John is filling a bathtub that is 18 inches deep. He notices that it takes two minutes to fill the tub with three inches of water. He estimates it will take ten more minutes for the water to reach the top of the tub if it continues at the same rate. Is he correct? Explain.

Lesson 3: Identifying Proportional and Non-Proportional Relationships in Tables

Classwork

You have been hired by your neighbors to babysit their children on Friday night. You are paid $8 per hour. Complete the table relating your pay to the number of hours you worked.

Hours Worked	Pay
1	
2	
3	
4	
4 ½	
5	
6	
6.5	

Based on the table above, is pay proportional to hours worked? How do you know?

Examples 1–4

For Examples 1–3, determine if y is proportional to x. Justify your answer.

1. The table below represents the amount of snow fall in 5 counties (in inches) to hours of a recent winter storm.

x Time (hrs)	y Snowfall (In)
2	10
6	12
8	16
2.5	5
7	14

2. The table below shows the relationship between cost of renting a movie to the number of days on rent.

x Number of Days	y Cost

6	2
9	3
24	8
3	1

3. The table below shows the relationship between the amount of candy (pounds) bought and the total cost.

x Pounds	y Cost
5	10
4	8
6	12
8	16
10	20

4. Randy is planning to drive from New Jersey to Florida. Randy recorded the distance traveled and the total number of gallons used every time he stopped for gas.

Assume miles driven is proportional to Gallons Consumed in order to complete the table.

Gallons Consumed	2	4		8	10	12
Miles Driven	54		189	216		

Problem Set

In each table determine if y is proportional to x. Explain why or why not.

1.

x	y
3	12
5	20
2	8
8	32

2.

x	y
3	15
4	17
5	19
6	21

3.

x	y
6	4
9	6
12	8
3	2

4. Kayla made observations about the selling price of a new brand of coffee that sold in three different sized bags. She recorded those observations in the following table:

Ounces of Coffee	6	8	16
Price in Dollars	$2.10	$2.80	$5.60

Is the price proportional to the amount of coffee? Why or why not?

Use the relationship to predict the cost of a 20 oz. bag of coffee?

5. You and your friends go to the movies. The cost of admission is $9.50 per person. Create a table showing the relationship between number of people going to the movies and the total cost of admission.

Explain why the cost of admission is proportional to the amount of people.

6. For every 5 pages Gil can read, his daughter can read 3 pages. Let g equal the number of pages Gil reads and let d equal the number of pages his daughter reads. Create a table showing the relationship between the number of pages Gil reads and the number of pages his daughter reads.

Is the number of pages Gil's daughter reads proportional to the number of pages he reads? Explain why or why not.

7. The table shows the relationship between the number of parents in a household and the number of children in the same household. Is the number of children proportional to the number of parents in the household? Explain why or why not.

Number of Parents	Number of Children
0	0
1	3
1	5
2	4
2	1

8. The table below shows the relationship between the number of cars sold and money earned for a car salesperson. Is the money earned proportional to the number of cars sold? Explain why or why not.

Number of Cars Sold	Money Earned
1	250
2	600
3	950
4	1076
5	1555

9. Make your own example of a relationship between two quantities that are NOT proportional. Describe the situation and create a table to model it. Explain why one quantity is not proportional to the other.

Lesson 4: Identifying Proportional & Non-Proportional Relationships in Tables

Classwork

Example: Which Team Will Win the Race?

You have decided to run in a long distance race. There are two teams that you can join. Team A runs at a constant rate of 2.5 miles per hour. Team B runs 4 miles the first hour and then 2 miles per hour after that.

Task: Create a table for each team showing the distances that would be run for times of 1, 2, 3, 4, ,5 and 6 hours.

Team A	
Time (hrs)	Distance (miles)

Team B	
Time (hrs)	Distance (miles)

a. For which team is distance proportional to time? Explain your reasoning.

b. Explain how you know distance for the other team is not proportional to time.

c. If the race were 2.5 miles long, which team would win? Explain.
If the race were 3.5 miles long, which team would win? Explain.
If the race were 4.5 miles long, which team would win? Explain.

d. For what length race would it be better to be on Team B than Team A? Explain

e. Using this relationship, if the members on the team ran for 10 hours, how far would each member run on each team?

f. Will there always be a winning team, no matter what the length of the course? Why or why not?

g. If the race is 12 miles long, which team should you choose to be on if you wish to win? Why would you choose this team?

h. How much sooner would you finish on that team compared to the other team?

Problem Set

1. Joseph earns $15 for every lawn he mows. Is the amount of money he earns proportional to the number of lawns he mows? Make a table to help you identify the type of relationship.

Number of Lawns Mowed				
Earnings ($)				

2. At the end of the summer, Caitlin had saved $120 from her summer job. This was her initial deposit into a new savings account at the bank. As the school year starts, Caitlin is going to deposit another $5 each week from her allowance. Is her account balance proportional to the number of weeks of deposits? Use the table below. Explain your reasoning.

Time (in weeks)				
Account Balance ($)				

3. Lucas and Brianna read three books each last month. The table shows the number of pages in each book and the length of time it took to read the entire book.

Pages Lucas Read	208	156	234
Time (hours)	8	6	9

Pages Brianna Read	168	120	348
Time (hours)	6	4	12

   a. How many observations can you make about any similarities or difference that exist between the reading rates of the two students.

   b. Both Lucas and Brianna had specific reading goals they needed to accomplish. What different strategies did each person employ in reaching those goals?

Lesson 5: Identifying Proportional and Non-Proportional Relationships in Graphs

Classwork

Opening Exercise

Isaiah sold candy bars to help raise money for his scouting troop. The table shows the amount of candy he sold to the money he received.

Is the amount of candy bars sold proportional to the money Isaiah received? How do you know?

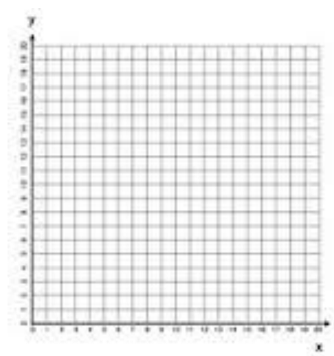
____

____

x Candy Bars Sold	y Money Received ($)
2	3
4	5
8	9
12	12

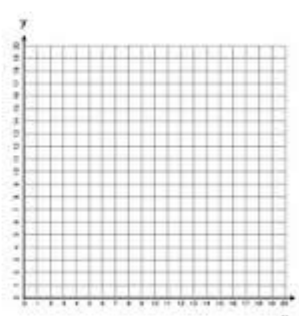
Example 1: From a Table to Graph

x	y
2	3



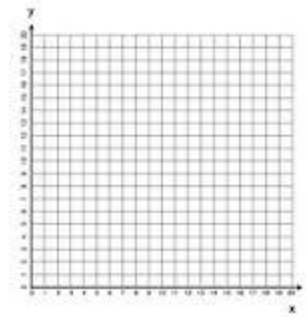
Example 2

x	y
2	3
4	6
8	12
12	14



Example 3

x	y
0	6
3	9
6	12
9	15
12	18



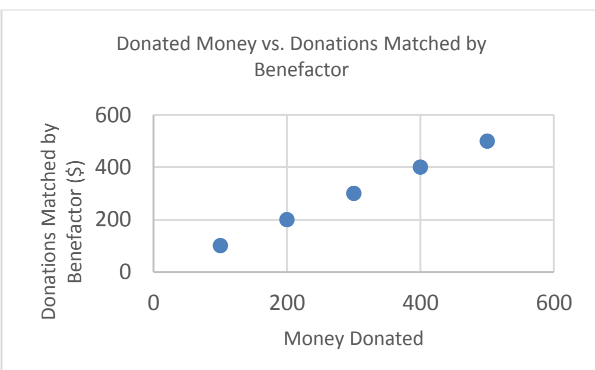
Similarities with Example 1:

Differences from Example 1:

Problem Set

Determine whether or not the following graphs represent two quantities that are proportional to each other. Give reasoning.

a.



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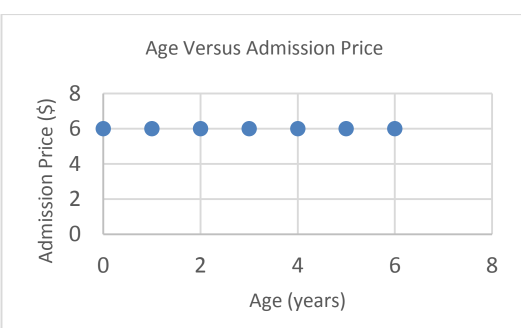
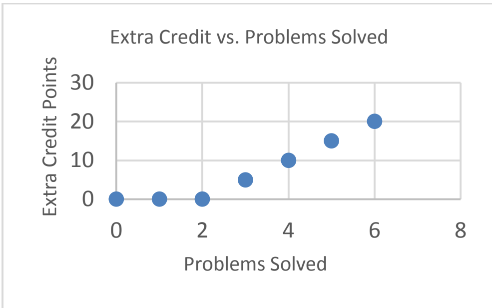


c.



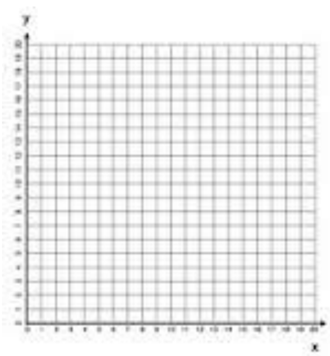
Create a table and a graph for the ratios 2:22, 3 to 15 and 1/11. Does the graph show that the two quantities are proportional to each other? Explain why or why not.

x	y

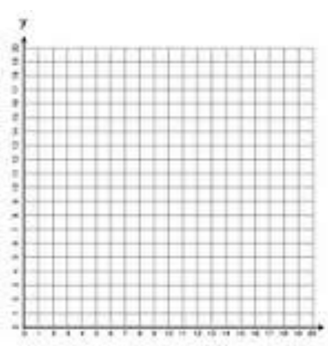
4. Graph the following tables and identify if the two quantities are proportional to each other on the graph.

a.

x	y
1	4
2	5
3	6
4	7



b.



x	y
3	1
6	2
9	3
12	4

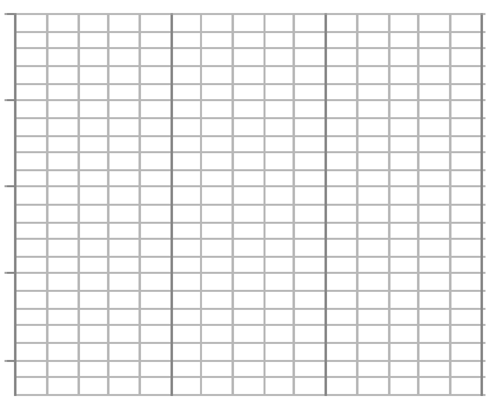
Lesson 6: Identifying Proportional and Non-Proportional Relationships in Graphs

Today's activity is an extension of Lesson 5. You will be working in groups to table, graph and identify whether or not the two quantities are proportional to each other.

Classwork

Poster Layout

Use for notes

Problem	Table
Graph 	Proportional or not? Explain.

Gallery Walk: Take notes and answer the following questions:

1. Which graphs in the art gallery walk represented proportional relationships and which did not? List the group number.
Proportional Relationship Non-proportional Relationship

2. What are the characteristics of the graphs that represent proportional relationships?

3. For the graphs representing proportional relationships, what does (0,0) mean in the context of the given situation?

Poster 1:

Poster 2:

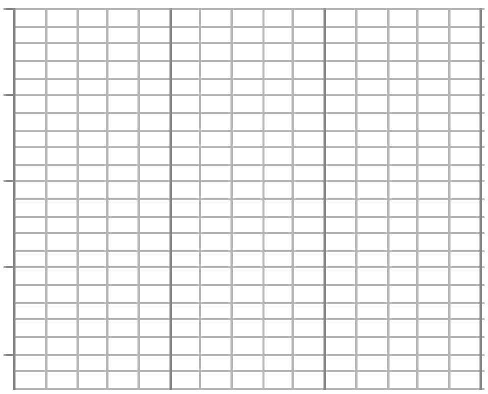
Poster 3:

Poster 4:

Problem Set

1. Sally's aunt put money in a savings account for her on the day Sally was born. The savings account pays interest for keeping her money in the bank. The ratios below represent years to amount of money in her savings account.
   - After one year, the interest had accumulated and the total was $312 in Sally's account.
   - After three years, the total was $340. After six years, the total was $380.
   - After nine years, the total was $430. After 12 years, the total amount in Sally's savings account was $480.

   Using the same four-fold method from class, create a table then graph and determine whether the amount of money accumulated and time elapsed are proportional to each other or not. Use your table and graph to support your reasoning.

Problem	Table
Graph 	Proportional or not? Explain.

Lesson 7: Unit Rate as the Constant of Proportionality

Classwork

Example 1: National Forest Deer Population in Danger?

Wildlife conservationists are concerned that the deer population might not be constant across the National Forest. The scientists found that there were 144 deer in a 16 square mile area of the forest. In another part of the forest, conservationists counted 117 deer in a 13 square mile area. Yet a third conservationist counted 24 deer in a 216 square mile plot of the forest. Do conservationists need to be worried?

a. Why does it matter if the deer population is not constant in a certain area of the national forest? **(in other words, what factors could affect the population in certain areas?)**

b. What is the population density of deer per square mile?

Table:

The Unit Rate of deer per 1 square mile is _______.

Constant of Proportionality:

Meaning of Constant of Proportionality in this problem:

c. Use the unit rate of deer per square mile to determine how many deer are there for every 207 square miles.

d. Use the unit rate to determine the number of square miles in which you would find 486 deer?

Vocabulary:

A **constant** specifies a unique number.

A **variable** is a letter that represents a number.

If a proportional relationship is described by the set of ordered pairs that satisfies the equation $y = kx$, where k is a positive constant, then k is called the **constant of proportionality**. It is the value that describes the multiplicative relationship between two quantities, x and y. The (x, y) pairs represent all the pairs of values that make the equation true.

Note: In a given situation, it would be reasonable to assign any variable as a placeholder for the given quantities. For example, a set of ordered pairs (t, d) would be all the points that satisfy the equation $d = rt$, where r is the positive constant, or the constant of proportionality. This value for r specifies a unique number for the given situation.

Example 2: You Need WHAT???

Brandon came home from school and informed his mother that he had volunteered to make cookies for his entire grade level. He needed 3 cookies for each of the 96 students in 7th grade. Unfortunately, he needed the cookies for an event at school on the very next day! Brandon and his mother determined that they can fit 36 cookies on two cookie sheets.

a. Is the number of cookies proportional to the number of sheets used in baking? Create a table that shows data for the number of sheets needed for the total number of cookies needed.

Table:

The Unit Rate is __________.

Constant of Proportionality:

Meaning of Constant of Proportionality in this problem:

b. It took 2 hours to bake 8 sheets of cookies. If Brandon and his mother begin baking at 4:00 pm, when will they finish baking the cookies?

Example 3: French Class Cooking

Suzette and Margo want to prepare crepes for all of the students in their French class. A recipe makes 20 crepes with a certain amount of flour, milk, and 2 eggs. The girls know that they already have plenty of flour and milk but need to determine the number of eggs needed to make 50 crepes because they are not sure they have enough eggs for the recipe.

a. Considering the amount of eggs necessary to make the crepes, what is the constant of proportionality?

b. What does the constant or proportionality mean in the context of this problem?

c. How many eggs will be needed for 50 crepes?

Problem Set

For each of the following problems, define the constant of proportionality to answer the follow-up question.

1. Bananas are $0.59/pound.
   a. What is the constant of proportionality?
   b. How much does 25 pounds of bananas cost?

2. The dry cleaning fee for 3 pairs of pants is $18.
   a. What is the constant of proportionality?
   b. How much will the dry cleaner charge for 11 pairs of pants?

3. For every $5 that Micah saves, his parents give him $10.
   a. What is the constant of proportionality?
   b. If Micah saves $150, how much money will his parents give him?

4. Each school year, the 7th graders who study Life Science participate in a special field trip to the city zoo. In 2010, the school paid $1260 for 84 students to enter the zoo. In 2011, the school paid $1050 for 70 students to enter the zoo. In 2012, the school paid $1395 for 93 students to enter the zoo.
   a. Is the price the school pays each year in entrance fees proportional to the number of students entering the zoo?
   b. Explain why or why not.
   c. Identify the constant of proportionality and explain what it means in the context of this situation.
   d. What would the school pay if 120 students entered the zoo?
   e. How many students would enter the zoo if the school paid $1,425?

Lesson 8: Representing Proportional Relationships with Equations

Classwork

Points to remember:

- Proportional relationships have a constant ratio, or unit rate.
- The constant ratio, or unit rate, can also be called the constant of proportionality.

Example 1: Do We have Enough Gas to Make it to the Gas Station?

Your mother has accelerated onto the interstate beginning a long road trip and you notice that the low fuel light is on, indicating that there is a half a gallon left in the gas tank. The nearest gas station is 26 miles away. Your mother keeps a log where she records the mileage and the number of gallons purchased each time she fills up the tank. Use the information in the table below to determine whether you will make it to the gas station before the gas runs out. You know that if you can determine the amount of gas that her car consumes in a particular number of miles, then you can determine whether or not you can make it to the next gas station.

Mother's Gas Record

Gallons	Miles driven
8	*224*
10	*280*
4	*112*

a. Find the constant of proportionality and explain what it represents in this situation.

b. Write and equation that will relate the miles driven to the number of gallons of gas.

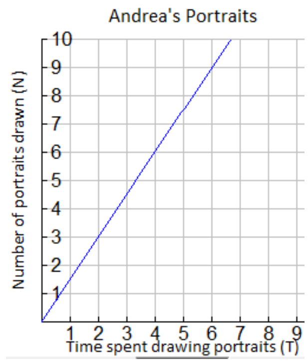
c. Knowing that there is a half gallon left in the gas tank when the light comes on, will she make it to the nearest gas station? Explain why or why not.

d. Using the equation found in part b, determine how far your mother can travel on 18 gallons of gas. Solve the problem in two ways.

e. Using the equation found in part *b*, determine how many gallons of gas would be needed to travel 750 miles.

Example 2: Andrea's Portraits

Andrea is a street artist in New Orleans. She draws caricatures (cartoon-like portraits of tourists). People have their portrait drawn and then come back later to pick it up from her. The graph below shows the relationship between the number of portraits she draws and the amount of time in hours needed to draw the portraits.



a. Write several ordered pairs from the graph and explain what each coordinate pair means in the context of this graph.

b. Write several equations that would relate the number of portraits drawn to the time spent drawing the portraits.

c. Determine the constant of proportionality and explain what it means in this situation.

Problem Set

Write an equation that will model the proportional relationship given in each real world situation.

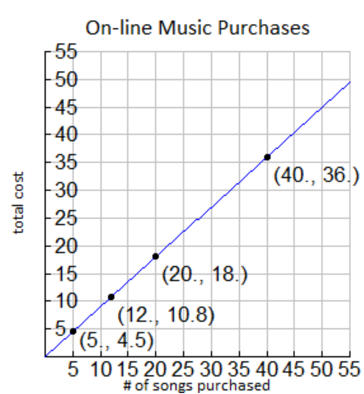
1. There are 3 cans that store 9 tennis balls. Consider the number of balls per can.
   a. Find the constant of proportionality for this situation.
   b. Write an equation to represent the relationship.

2. In 25 minutes Li can run 10 laps around the track. Consider the number of laps she can run per minute.
   a. Find the constant of proportionality in this situation.
   b. Write an equation to represent the relationship.

3. Jennifer is shopping with her mother. They pay $2 per pound for tomatoes at the vegetable stand.
   a. Find the constant of proportionality in this situation.
   b. Write an equation to represent the relationship.

4. It cost $5 to send 6 packages through a certain shipping company. Consider the number of packages per dollar.
   a. Find the constant of proportionality for this situation.
   b. Write an equation to represent the relationship.

5. On average, Susan downloads 60 songs per month. An online music vendor sells package prices for songs that can be downloaded on to personal digital devices. The graph below shows the package prices for the most popular promotions. Susan wants to know if she should buy her music from this company or pay a flat fee of $58.00 for the month offered by another company. Which is the better buy?



a. Find the constant of proportionality for this situation.

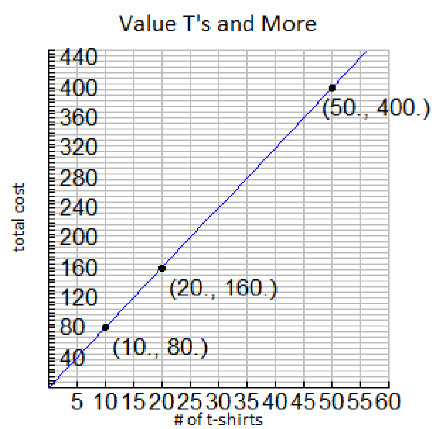
b. Write an equation to represent the relationship.

c. Use your equation to find the answer to Susan's question above. Justify your answer with mathematical evidence and a written explanation.

6. Allison's middle school team has designed t-shirts containing their team name and color. Allison and her friend Nicole have volunteered to call local stores to get an estimate on the total cost of purchasing t-shirts. Print-o-Rama charges a set-up fee as well as a fixed amount for each shirt ordered. The total cost is shown below for the given number of shirts. Value T's and More charges $8 per shirt. Which company should they use?

Print-o-Rama

# shirts	Total cost
10	95
25	
50	375
75	
100	



a. Does either pricing model represent a proportional relationship between quantity of t-shirts and total cost? Explain.

b. Write an equation relating cost and shirts for Value T's and More.

c. What is the constant of proportionality ValueTt's and More? What does it represent?

d. How much is Print-o-Rama's set up fee?

e. Write a proposal to your teacher indicating which company the team should use. Be sure to support your choice. Determine the number of shirts that you need for your team.

Lesson 9: Representing Proportional Relationships with Equations

Classwork

Example 1: Jackson's Birdhouses

Jackson and his grandfather constructed a model for a birdhouse. Many of their neighbors offered to buy the birdhouses. Jackson decided that building birdhouses could help him earn money for his summer camp, but he is not sure how long it will take him to fill all of the requests for birdhouses. If Jackson can build 7 birdhouses in 5 hours, write an equation that will allow Jackson to calculate the time it will take him to build any given number of birdhouses.

a. Write an equation that you could use to find out how long it will take him to build any number of birdhouses.

b. How many birdhouses can Jackson build in 40 hours?

c. How long will it take Jackson to build 35 birdhouses? Use the equation from part a to solve the problem.

d. How long will it take to build 71 birdhouses? Use the equation from part a to solve the problem.

Example 2: Al's Produce Stand

Al's Produce Stand sells 7 ears of corn for $1.50. Barbara's Produce stand sells 13 ears of corn for $2.75. Write two equations, one for each produce stand that models the relationship between the number of ears of corn sold and the cost. Then use each equation to help complete the tables below.

Al's Produce Stand / Barbara's Produce Stand

Ears	7	14	21		Ears	13	14	21	
Cost	$1.50			$50.00	Cost	$2.85			$50.00

Problem Set

Work in a cooperative group to solve the following problems.

a. A person who weighs 100 pounds on Earth weighs 16.6 lb on the moon.

b. Which variable is the independent variable? Explain why.

c. What is an equation that relates weight on Earth to weight on the moon?

d. How much would a 185 pound astronaut weigh on the moon? Use an equation to explain how you know.

e. How much would a man that weighed 50 pounds on the moon weigh back on Earth?

2. Use this table to answer the following questions.

Gallons	Miles driven
0	0
2	62
4	124
10	310

a. Which variable is the dependent variable and why?

b. Is miles driven proportionally related to gallons of gas consumed? If so what is the equation that relates miles driven to gallons?

c. In any ratio relating gallons and miles driven, will one of the values always be larger, if so, which one?

d. If the number of gallons is known, can you find the miles driven? Explain how this value would be calculated.

e. If the number of miles driven is known, can you find the number of gallons consumed?

f. How many miles could be driven with 18 gallons of gas?

g. How many gallons are used when the car has been driven 18 miles?

h. How many miles have been driven when ½ of a gallon is used?

i. How many gallons have been used when the car has been driven ½ mile?

3. Suppose that the cost of renting a snowmobile is $37.50 for 5 hours.

a. If the c = cost and h = hours, which variable is the dependent variable? Explain why?

b. What would be the cost of renting 2 snow mobiles for 5 hours each?

4. In mom's car, the number of miles driven is proportional to the number of gallons of gas used.

Gallons	Miles driven
4	112
6	168
	224
10	280

a. Write the equation that will relate the number of miles driven to the gallons of gas.

b. What is the constant of proportionality?

c. How many miles could you go if you filled your 22-gallon tank?

d. If your family takes a trip of 600 miles, how many gallons of gas would be needed to make the trip?

e. If you drive 224 miles during one week of commuting to school and work, how many gallons of gas would you use?

Lesson 10: Interpreting Graphs of Proportional Relationships

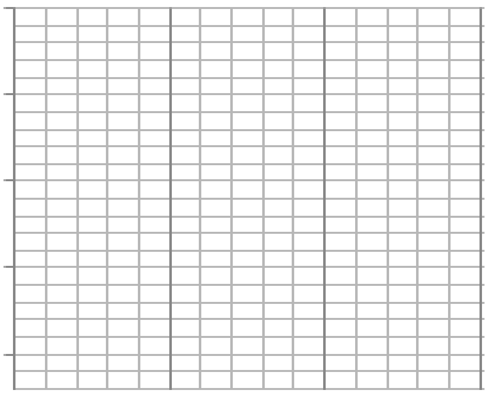
Classwork

Example 1

Grandma's Special Chocolate Chip Cookie recipe, which yields 4 dozen cookies, calls for 3 cups of flour.

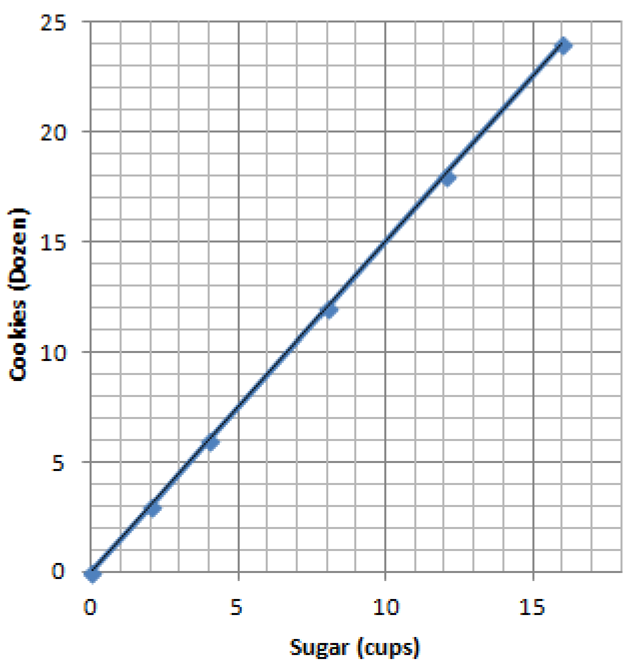
Using this information, complete the chart:

Table – Create a chart comparing the amount of flour used to the amount of cookies.	**Question:** Is the number of cookies proportional to the amount of flour used? Explain	**Unit Rate** – What is the unit rate and what is the meaning in the context of the problem?

Graph – Model the relationship on a graph. 	Does the **graph** show the two quantities being **proportional** to each other? Explain	**Equation** – Write an equation that can be used to represent the relationship.

Example 2

Below is a graph modeling the amount of sugar required to make Grandma's Chocolate Chip Cookies.



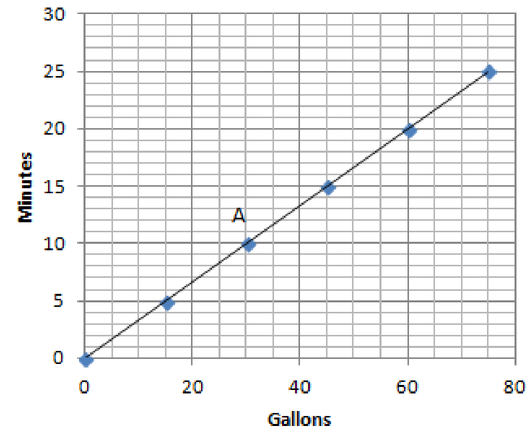
a. Record the coordinates of flour of the points from the graph in a table. What do these ordered pairs (values) represent?

b. Grandma has 1 remaining cup of sugar. How many dozen cookies will she be able to make? Plot the point on the graph above.

c. How many dozen cookies can grandma make if she has no sugar? Can you graph this on the grid provided above? What do we call this point?

Exercises

1. The graph below shows the amount of time a person can shower with a certain amount of water.



   a. Can you determine by looking at the graph whether the length of the shower is proportional to the number of gallons of water? Explain how you know.

   b. How long can a person shower with 15 gallons of water and with 60 gallons of water?

   c. What are the coordinates of point A? Describe point A in the context of the problem.

   d. Can you use the graph to identify the unit rate?

   e. Plot the unit rate on the graph. Is the point on the line of this relationship?

   f. Write the equation to represent the relationship between the number of gallons used and the length of a shower.

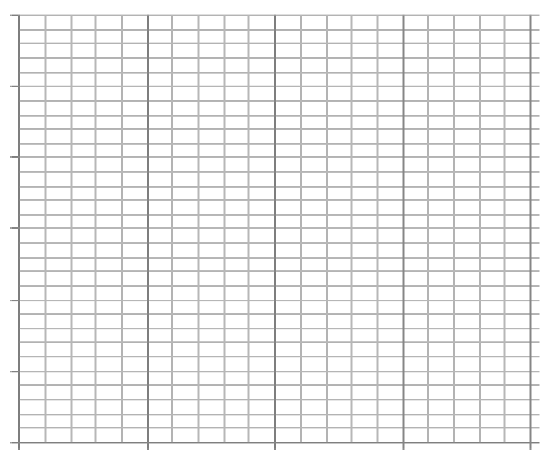
5. Your friend uses the equation $C = 50P$ to find the total cost of P people entering the local Amusement Park.

   a. Create a table and record the cost of entering the amusement park for several different-sized groups of people.

   b. Is the cost of admission proportional to the amount of people entering the Amusement Park? Explain why or why not.

   c. What is the unit rate and what does it represent in the context of the situation?

   g. Sketch a graph to represent this relationship.



   h. What point(s) MUST be on the graph of the line if the two quantities represented are proportional to each other? Explain why and describe this point in the context of the problem.

   i. Would the point (5,250) be on the graph? What does this point represent in the context of the situation?

Problem Set

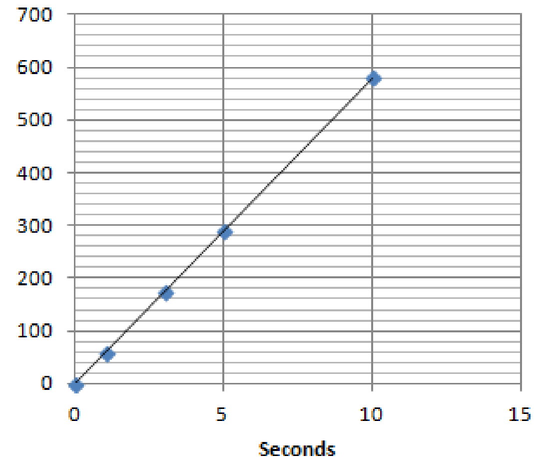
b. The graph to the right shows the distance (in ft.) ran by a Jaguar.

   a. What does the point (5, 280) represent in the context of the situation?

   b. What does the point (3, 174) represent in the context of the situation?

   c. Is the distance run by the Jaguar proportional to the time? Explain why or why not.

   d. Write an equation to represent the distance ran by the Jaguar. Explain or model your reasoning.

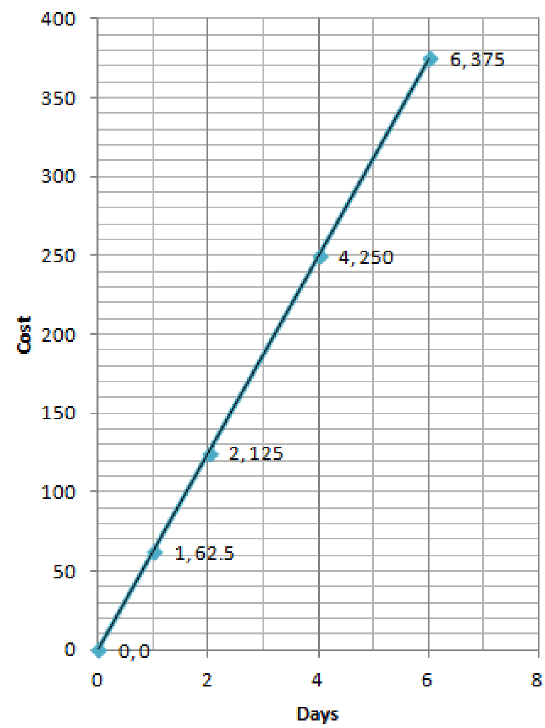


6. Championship T-shirts sell for $22 each.

   a. What point(s) MUST be on the graph for the quantities to be proportional to each other?

   b. What does the ordered pair (5, 110) represent in the context of this problem?

   c. How many T-shirts were sold if you spent a total of $88?



7. The following graph represents the total cost of renting a car. The cost of renting a car is a fixed amount each day regardless of how many miles the car is driven. It does not matter how many miles you drive; you just pay an amount per day.

   a. What does the ordered pair (4, 250) represent?

   b. What would be the cost to rent the car for a week? Explain or model your reasoning.

8. Jackie is making a snack mix for a party. She is using M&M's and peanuts. The table below shows how many packages of M&M's she needs to how many cans of peanuts she needs to make the mix.

   a. What points MUST be on the graph for the number of cans of peanuts to be proportional to the packages of M&M's? Explain why.

   b. Write an equation to represent this relationship.

   c. Describe the ordered pair (12, 24) in the context of the problem.

Packages of M&M's	Cans of Peanuts
0	0
1	2
2	4
3	6
4	8

9. The following table shows the amount of candy and price paid.

Amount of Candy (pounds)	2	3	5
Cost (Dollars)	5	7.5	12.5

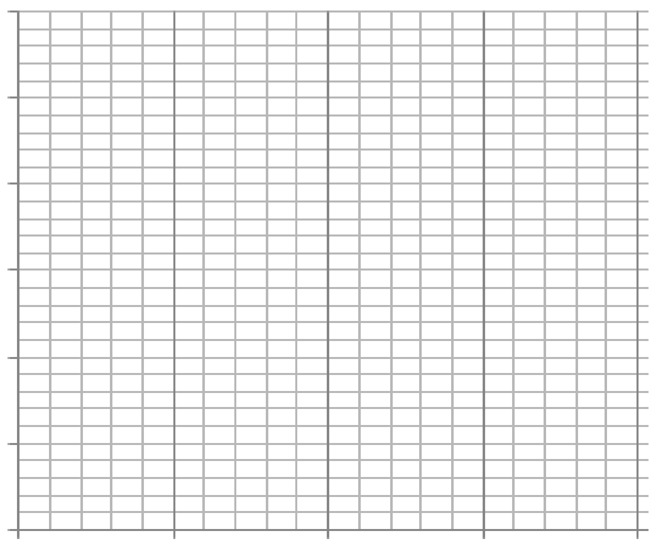
a. Is the cost of candy proportional to the amount of candy?

b. Write an equation to illustrate the relationship between the amount of candy and the cost.

c. Using the equation, predict how much it will cost for 12 pounds of candy?

d. What is the maximum amount of candy you can buy with $60?

e. Graph the relationship.



Lesson 11: Ratios of Fractions and Their Unit Rates

Classwork

Example 1: Who is Faster?

During their last workout, Izzy ran 2 ¼ miles in 15 minutes and her friend Julia ran 3 ¾ miles in 25 minutes. Each girl thought she were the faster runner. Based on their last run, which girl is correct?

Exercises

1. A turtle walks ⅞ of a mile in 50 minutes. What is the unit rate expressed in miles per hour?

   a. To find the turtle's unit rate, Meredith wrote and simplified the following complex fraction. Explain how the fraction $\frac{5}{6}$ was obtained.

$$\frac{\left(\frac{7}{\cancel{8}_{1}}\right)\cdot \overset{3}{\cancel{24}}}{\left(\frac{5}{\cancel{6}_{1}}\right)\cdot \overset{4}{\cancel{24}}} = \frac{21}{20}$$

   b. Did Meredith simplify the complex fraction correctly? Explain how you know.

2. For Anthony's birthday his mother is making cupcakes for his 12 friends at his daycare. The recipe calls for 3 ⅓ cups of flour. This recipe makes 2 ½ dozen cookies. Anthony's mother has only 1 cup of flour. Is there enough flour for each of his friends to get a cupcake? Explain and show your work.

3. Sally is making a painting for which she is mixing red paint and blue paint. The table below shows the different mixtures being used.

Red Paint (Quarts)	Blue Paint (Quarts)

$1\frac{1}{2}$	$2\frac{1}{2}$
$2\frac{2}{5}$	4
$3\frac{3}{4}$	$6\frac{1}{4}$
4	$6\frac{2}{3}$
1.2	2
1.8	3

a. What are the unit rates for the values?

b. Is the amount of blue paint proportional to the amount of red paint?

c. Describe, in words, what the unit rate means in the context of this problem.

Problem Set

1. Simplify: $2\frac{4}{7} \div 1\frac{3}{6}$

c. One lap around a dirt track is $\frac{1}{3}$ mile. It takes Bryce $\frac{1}{9}$ hour to ride one lap. What is Bryce's unit rate around the track?

4. Mr. Gengel wants to make a shelf with boards that are $1\frac{1}{3}$ feet long. If he has an 18 foot board, how many pieces can he cut from the big board?

5. The local bakery uses 1.75 cups of flour in each batch of cookies. The bakery used 5.25 cups of flour this morning.

a. How many batches of cookies did the bakery make?

b. If there are 5 dozen cookies in each batch, how many cookies did the bakery make yesterday?

6. Jason eats 10 ounces of candy in 5 days.

a. How many pounds will he eat per day? (16 ounces = 1 pound)

b. How long will it take Jason to eat 1 pound of candy?

Lesson 12: Ratios of Fractions and Their Unit Rates

During this lesson you are remodeling a room at your house and need to figure out if you have enough money. You will work individually and with a partner to make a plan of what is needed to solve the problem. After your plan is complete then you will solve the problem determining if you have enough money or if you are short money.

Classwork

Example 1: Time to Remodel

You have decided to remodel your bathroom and put tile on the floor. The bathroom is in the shape of a rectangle and the floor measures 14 feet 8 inches long, 5 feet 6 inches wide. The tile you want to use costs $5 each and each tile covers $4\frac{2}{3}$ square feet. If you have $100 to spend, do you have enough money to complete the project?

Make a Plan: Complete the chart to identify the necessary steps in the plan and find a solution.

What I Know	What I Want to Find	How to Find it

Compare your plan with a partner. Using your plans, work together to determine how much money you will need to complete the project and if you have enough money.

Exercises

1. Which car can travel further on 1 gallon of gas?

   Blue Car: Travels $18\frac{2}{5}$ miles using 0.8 gallons of gas

   Red Car: Travels $17\frac{2}{5}$ miles using 0.75 gallons of gas

Problem Set

1. You are getting ready for a family vacation. You decide to download as many movies as possible before leaving for the road trip. If each movie takes $1\frac{2}{5}$ hours to download and you downloaded for 5 ¼ hours, how many movies did you download?

2. The area of a blackboard is $1\frac{1}{3}$ square yards. A poster's area is $\frac{8}{9}$ square yards. Find a unit rate and explain, in words, what the unit rate means in the context of this problem. Is there more than one unit rate that can be calculated? How do you know?

3. A toy remote control jeep is 12 ½ inches wide while an actual jeep is pictured to be 18 ¾ feet wide. What is the value of the ratio of the width of the remote control jeep to width of the actual jeep?

4. $\frac{1}{3}$ cup of flour is used to make 5 dinner rolls.

   a. How many cups of flour are needed to make 3 dozen dinner rolls?

   b. How many rolls can you make with $5\frac{2}{3}$ cups of flour?

   c. How much flour is needed to make one dinner roll?

Lesson 13: Finding Equivalent Ratios Given the Total Quantity

Classwork

Example 1

A group of 6 hikers are preparing for a one-week trip. All of the group's supplies will be carried by the hikers in backpacks. The leader decided that it would be fair for each hiker to carry a backpack that is the same fraction of his weight as all the other hiker's. In this set-up, the heaviest hiker would carry the heaviest load. The table below shows the weight of each hiker and the weight of his/her backpack.

Complete the table. Find the missing amounts of weight by applying the same ratio as the first 2 rows.

Hiker's Weight	Backpack Weight	Total Weight (lbs)
152 lb 4 oz	14 lb 8 oz	
107 lb 10 oz	10 lb 4 oz	
129 lb 15 oz		
68 lb 4 oz		
	8 lb 12 oz	
	10 lb	

Example 2

When a business buys a fast food franchise, it is buying the recipes used at every restaurant with the same name. For example, all Pizzeria Specialty House Restaurants have different owners but they must all use the same recipes for their pizza, sauce, bread, etc. You are now working at your local Pizzeria Specialty House restaurant and listed below are the amounts of meat used on one meat-lovers pizza.

$\frac{1}{4}$ cup of sausage

$\frac{1}{3}$ cup of pepperoni

$\frac{1}{6}$ cup of bacon

$\frac{1}{8}$ cup of ham

$\frac{1}{8}$ cup of beef

What is the total amount of toppings used on a meat-lovers pizza? ________________________ cups

The meat must be mixed using this ratio to ensure that customers will receive the same great tasting meat-lovers pizza from every Pizzeria Specialty House Restaurant nationwide. The table below shows 3 different orders for meat-lovers pizza on Superbowl Sunday. Using the amounts and total for one pizza given above, fill in every row and column of the table so the mixture tastes the same.

	Order 1	Order 2	Order 3
Sausage (cups)	1		
Pepperoni (cups)			3
Bacon (cups)		1	
Ham (cups)	$\frac{1}{2}$		
Beef (cups)			$1\frac{1}{8}$
TOTAL (cups)			

Exercises

1. The table below shows 6 different-sized pans of the same recipe for macaroni and cheese. If the recipe relating the ratio of ingredients stays the same, how might it be altered to account for the different sized pans?

Noodles (cups)	Cheese (cups)	Pan Size (number of cups)
		5

3	$\frac{3}{4}$	
	$\frac{1}{4}$	
$\frac{2}{3}$		
$5\frac{1}{3}$		
		$5\frac{5}{8}$

Problem Set

2. Students in 6 classes, displayed below, ate the same ratio of cheese pizza slices to pepperoni pizza slices. Complete the following table, which represents the number of slices of pizza students in each class ate.

Slices of Cheese Pizza	Slices of Pepperoni Pizza	Total Pizza
		7
6	15	
8		
	$13\frac{3}{4}$	
$3\frac{1}{3}$		
		$2\frac{1}{10}$

3. To make green paint, students mixed yellow paint with blue paint. The table below shows how many yellow and blue drops from a dropper several students used to make the same shade of green paint.

   a. Complete the table.

Yellow (Y) (ml)	Blue (B) (ml)	Total
3 ½	5 ¼	
		5
	6 ¾	
6 ½		

b. Write an equation to represent the relationship between the amount of yellow paint and blue paint.

4.

a. Complete the following table

Distance Ran (miles)	Distance Biked (miles)	Total Amount of Exercise (miles)
		6
$3\frac{1}{2}$	7	
	$5\frac{1}{2}$	
$2\frac{1}{8}$		
	$3\frac{1}{3}$	

b. What is the relationship between distances biked and distances ran?

5. The following table shows the number of cups of milk and flour that are needed to make biscuits. Complete the table.

Milk (cups)	Flour (cups)	Total (cups)
7.5		
	10.5	
12.5	15	
		11

Lesson 14: Multistep Ratio Problems

Classwork

Example 1: Bargains

A retail clothing store advertises the following sale: Shirts are $\frac{1}{2}$ off the original price; pants are $\frac{1}{3}$ off the original price, and shoes are $\frac{1}{4}$ off the original price (called the discount rate).

a. If a pair of shoes cost $40 and is advertised at $\frac{1}{4}$ off the original price, what is the sales price?

b. At Peter's Pants Palace a pair of pants that usually sell for $33.00. If Peter advertises that the store is having $\frac{1}{3}$ off sale, what is the sale price of Peter's pants?

Example 2: Big Al's Used Cars

A used car sales person receives a commission of $\frac{1}{12}$ of the sales price of the car on each car he sells. What would the sales commission be on a car that sold for $21,999?

Example 3: Tax Time

As part of a marketing ploy, some businesses mark up their prices before they advertise a sales event. Some companies use this practice as a way to entice customers into the store without sacrificing their profits.

A furniture store wants to host a sales event to improve their profit margin and to reduce their tax liability before their inventory is taxed at the end of the year.

How much profit will be business make on the sale of a couch that is marked-up by $\frac{1}{3}$and then sold at a $\frac{1}{5}$ off discount if the original price is $2400?

Example 4: Born to Ride

A motorcycle dealer paid a certain price for a motorcycle and marked it up by $\frac{1}{5}$ of the price he paid. Later he sold it for $14,000 what is the original price?

Problem Set

a. What is $\frac{1}{32}$ commission of sales totaling $24,000?

b. DeMarkus says that a store overcharged him on the price of the video game he bought. He thought that the price was marked $\frac{1}{4}$ **of** the original price, but it was really $\frac{1}{4}$ **off** the original price. He misread the advertisement. If the original price of the game was $48, then what was the difference between the price that DeMarkus thought he should pay and the price that the store charged him?

c. What is the cost of a $1200 washing machine that was on sale for a $\frac{1}{5}$ discount?

d. If a store advertised a sale that gave customers a $\frac{1}{4}$ discount, what is the fraction part of the original price that the customer will pay?

e. Mark bought an electronic tablet on sale for $\frac{1}{4}$ off its original price of $825.00. He also wanted to use a coupon for a $\frac{1}{5}$

off the sales price. Before taxes, how much did Mark pay for the tablet?

f. A car dealer paid a certain price for a car and marked it up by $\frac{7}{5}$ of the price he paid. Later he sold it for \$24,000 what is the original price?

g. Joanna ran a mile in physical education class. After resting for one hour, her heart rate was 60 beats per minute. If her heart rate decreased by $\frac{2}{5}$, what was her heart rate immediately after she ran the mile?

Lesson 15: Equations of Graphs of Proportional Relationships Involving Fractions

Classwork

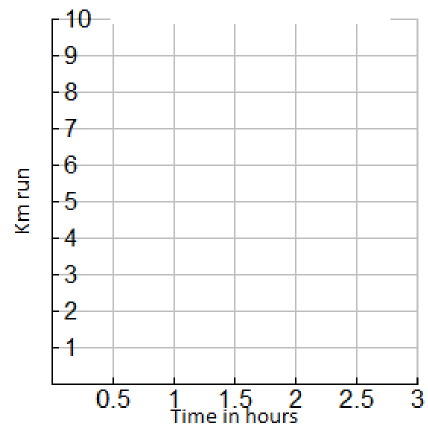
Example 1: Mother's 10K Race

Sam's mother has entered a 10 K race. Sam and his family want to show their support of their mother but they need to figure out where they should go along the race course. They also need to determine how long it will take her to run the race so that they will know when to meet her at the finish line. Previously, his mother ran a 5K race with a time of 1 ½ hours. Assume Sam's mother ran the same rate as the previous race in order to complete the chart.

Create a chart that will show how far Sam's mother has run after each half hour from the start of the race and graph it on the grid at the right.

Hours (H)	Km run (D)

Mother's 10K Race



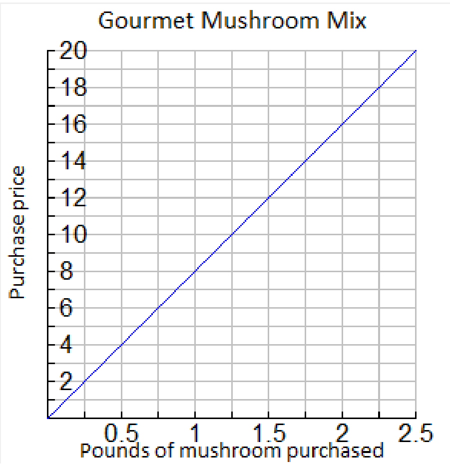
a. What are some specific things you notice about this graph?

b. What is the connection between the table and the graph?

c. What does the ordered pair (2, 6 ⅔) represent in the context of this problem?

Example 2: Organic Cooking

After taking a cooking class, you decide to try out your new cooking skills by preparing a meal for your family. You have chosen a recipe that uses an organic mushroom mix as the main ingredient. Using the graph below, complete the table of values and answer the following questions.



Weight in pounds	cost
0	0
½	4
1	
1 ½	12
	16
2 ¼	18

1. Is this relationship proportional? How do you know from examining the graph?

2. What is the unit rate for cost per pound?

3. Write an equation to model this data.

4. What ordered pair represents the unit rate and what does it mean?

5. What does the ordered pair (2, 16) mean in the context of this problem?

6. If you could spend $10.00 on mushrooms, how many pounds could you buy?

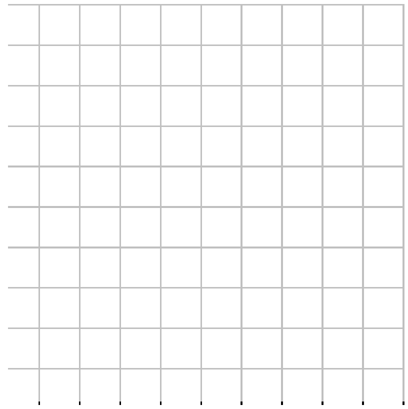
7. What would be the cost of 30 pounds of mushrooms?

Problem Set

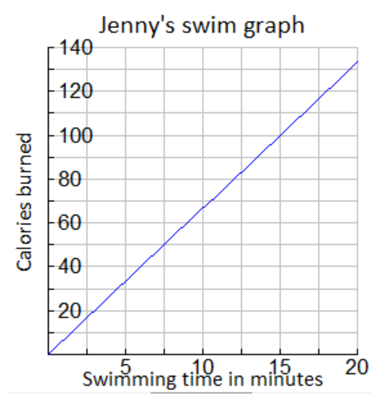
1. Students are responsible for providing snacks and drinks for the Junior Beta Club Induction Reception. Susan and Myra were asked to provide the punch for the 100 students and family members who will attend the event. The chart below will help

Susan and Myra determine the proportion of cranberry juice to sparkling water that will be needed to make the punch. Complete the chart, graph the data, and write the equation that models this proportional relationship.

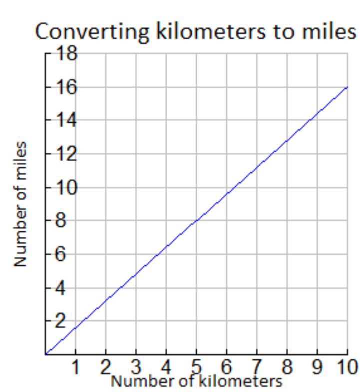
Sparkling water (cups)	Cranberry juice (cups)
1	4/5
5	4
8	
12	9 3/5
	40
100	



2. Jenny is a member of a summer swim team.
   a. How many calories does she burn in one minute?
   b. Use the graph below to determine the equation that models how many calories Jenny burns within a certain number of minutes.
   c. How long will it take her to burn off a 480 calorie smoothie that she had for breakfast?



3. Students in a World Geography Class want to determine the distances between cities in Europe. The map has a European Publisher which gives all distances in kilometers. These students want to determine the number of miles between towns so that they can compare distances with a unit of measure that they are already familiar with. The graph below shows the relationship between a given number of kilometers and the corresponding number of miles.
   a. Find the constant of proportionality or the rate of miles per kilometer for this



problem and write the equation that models this relationship

b. What is the distance in kilometers between towns that are 5 miles apart?

c. Describe the steps you would take to determine the distance in miles between two towns that are 200 kilometers apart?

4. During summer vacation, Lydie spent time with her grandmother picking blackberries. They decided to make blackberry jam for their family. Her grandmother said that to make jam, you must cook the berries until they become juice and then combine the juice with the other ingredients to make the jam.

   a. Use the table below to determine the constant of proportionality of cups of juice to cups of blackberries?

   b. Write an equation that will model the relationship between the number of cups of blackberries and the number of cups of juice?

   c. How many cups of juice were made from 12 cups of berries? How many cups of berries are needed to make 8 cups of juice?

Blackberries	Juice
0	0
4	1 ⅓
8	2 ⅔
12	
	8

Lesson 16: Relating Scale Drawings to Ratios and Rates

Classwork

Intro Activity: Can You Guess the Image?

8.

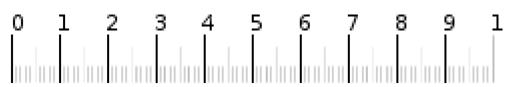
9.

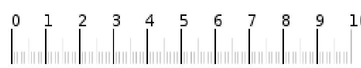
Example 1

For the following problems, (a) is the actual picture and (b) is the scale drawing. Is the scale drawing an enlargement or a reduction of the actual picture?

1. a. 

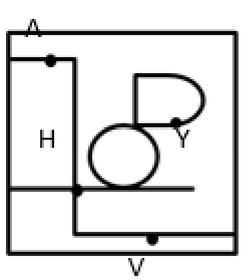
   b. 

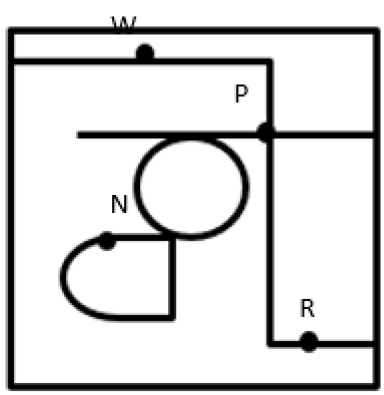
2. a. 

   b. 

Example 2

Derek's family took a day trip to a modern public garden. Derek looked at his map of the park that was a reduction of the map located at the garden entrance. The dots represent the placement of rare plants. The diagram below is the top-view as Derek held his map while looking at the posted map.



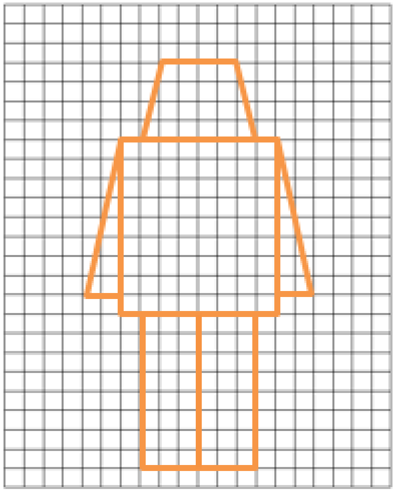


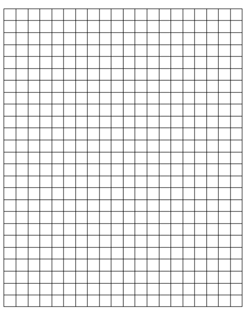
What are the corresponding points of the scale drawings of the maps?

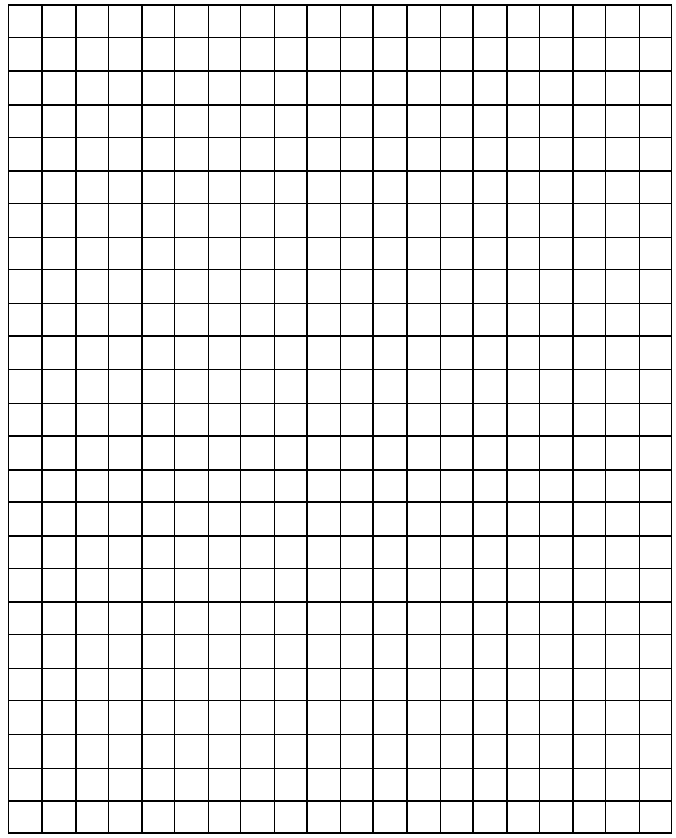
Point A to _________ Point V to ____________ Point H to ____________ Point Y to ____________

Exercise 1

Create scale drawings of your own modern nesting robots using the grids provided.

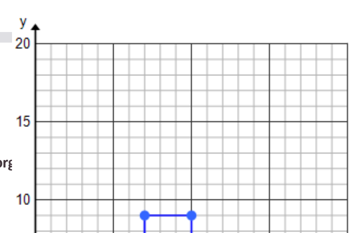


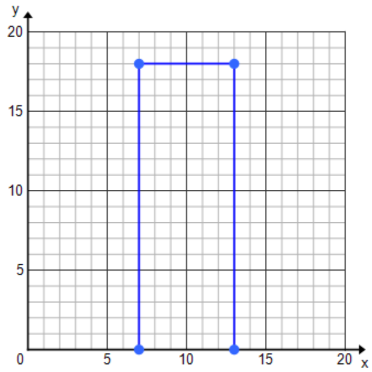




Example 3

Celeste drew an outline of a building for a diagram she was making and then drew a second one mimicking her original drawing. State the coordinates of the vertices and fill in the table.



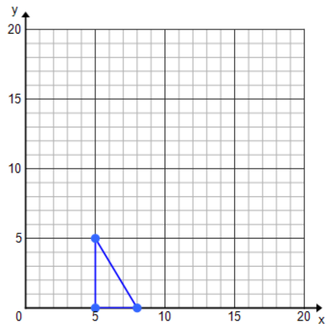


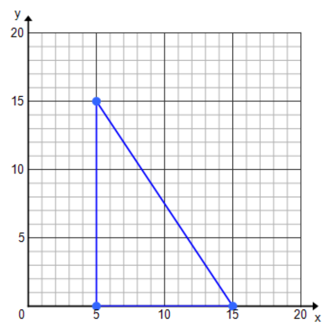
	Height	Length
Original Drawing		
Second Drawing		

Notes:

Exercise 2

Luca drew and cut out small right triangle for a mosaic piece he was creating for art class. His mother really took a liking and asked if he could create a larger one for their living room and Luca made a second template for his triangle pieces.





Lengths of the original image		
Lengths of the second image		

a. Does a constant of proportionality exist? If so, what is it? If not, explain.

b. Is Luca's enlarged mosaic a scale drawing of the first image? Explain why or why not.

Problem Set

For Problems 1–3, identify if the scale drawing is a reduction or enlargement of the actual picture.

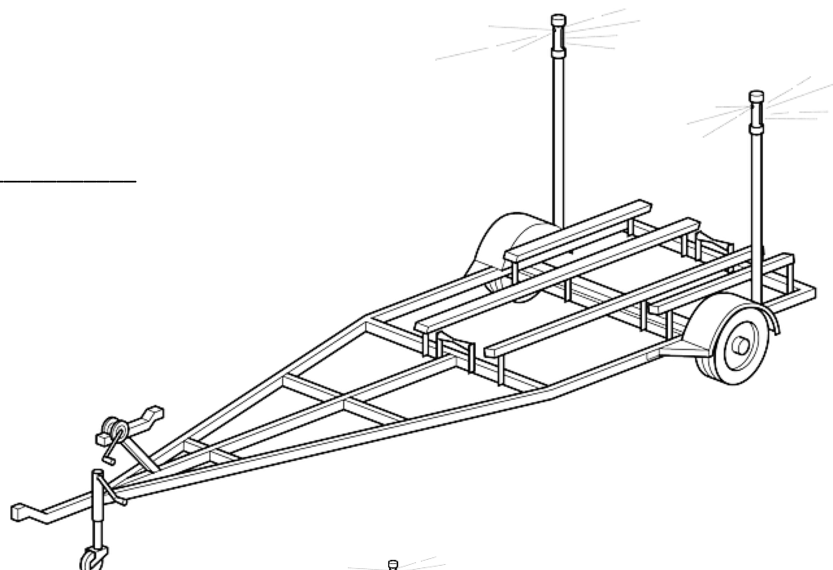
1. ____________________________

a. Actual Picture

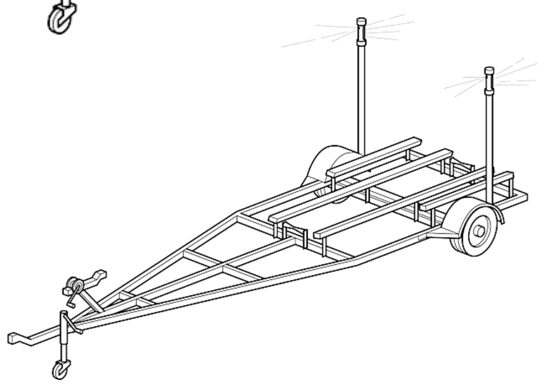
b. Scale Drawing

2. _____________________________

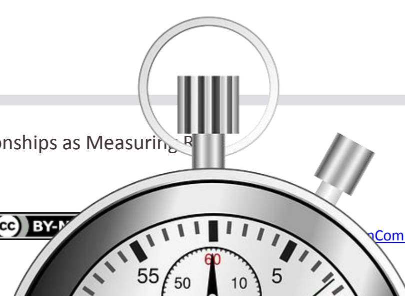
a. Actual Picture



b. Scale Drawing



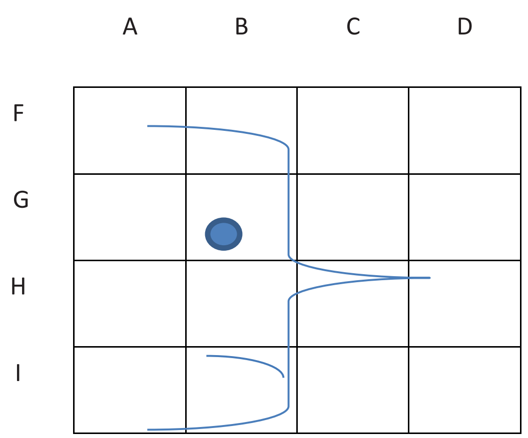
3. ___________________________

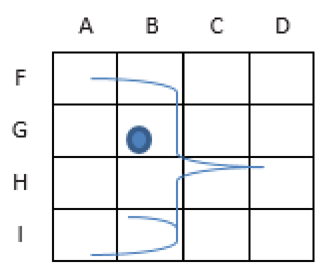


a. Actual Picture

b. Scale Drawing

4. Using the grid and the abstract picture of a face, answer the following questions:





a. On the grid, where is the eye?

b. What is located in DH?

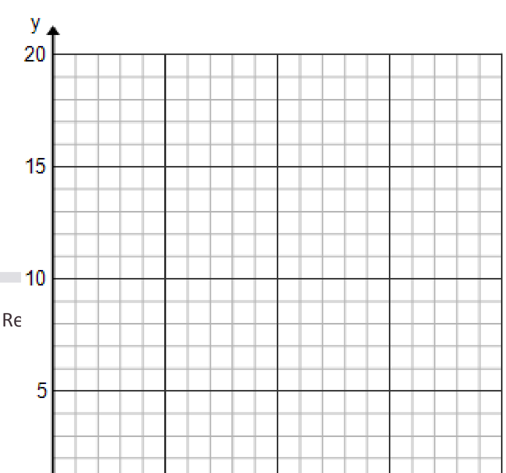
c. In what part of the square BI is the chin located?

5. Use the graph provided to decide if the rectangular cakes are scale drawings of each other.

Cake 1: (5,3), (5,5), (11,3), (11, 5)

Cake 2: (1,6), (1, 12),(13,12), (13, 6)

How do you know?



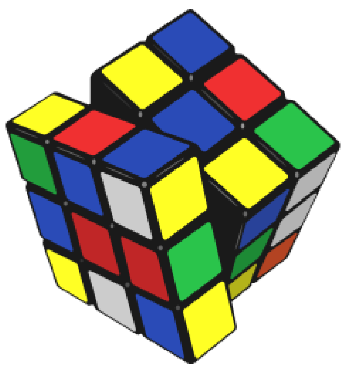
Lesson 17: The Unit Rate as the Scale Factor

Classwork

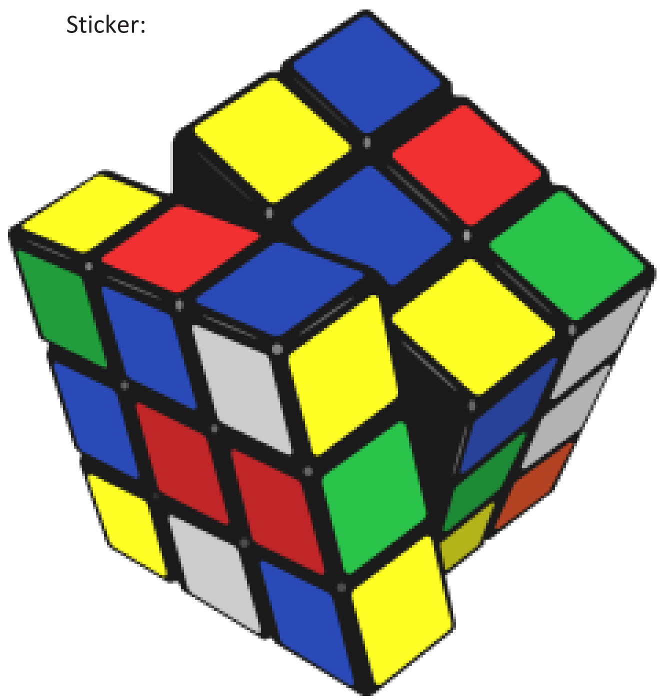
Example 1: Rubin's Icon

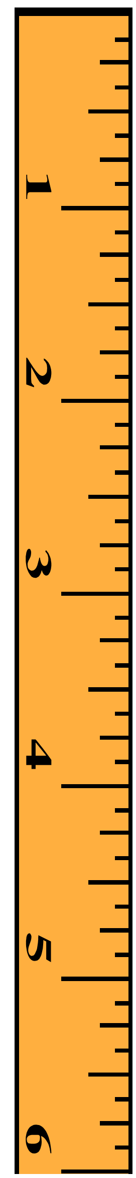
Rubin created a simple game on his computer and shared it with his friends to play. They were instantly hooked and the popularity of his game spread so quickly that Rubin wanted to create a distinctive icon, so players could easily identify his game. He drew a simple sketch. From the sketch, he created stickers to promote his game, but Rubin wasn't quite sure if the stickers were proportional to his original sketch.

Original Sketch:



Sticker:





Steps to check for proportionality for scale drawing and original picture:

1.

2.

3.

Exercise 1: App Icon

Example 2

Use a Scale Factor of 3 to create a scale drawing of the picture below.

Picture of the Flag of Columbia:

Exercise 2

Scale Factor= ___________________________

Picture of the Flag of Columbia:

Sketch and notes:

Example 3

Your family recently had a family portrait taken. Your aunt asked you to take a picture of the portrait using your cell phone and send it to her. If the original portrait is 3 feet by 3 feet and the scale factor is $\frac{1}{18}$, draw the scale drawing that would be the size of the portrait on your phone.

Sketch and notes:

Exercise 3

John is building his daughter doll house that is a miniature model of their house. The front of their house has a circular window with a diameter of 5 feet. If the scale factor for the model house is 1/30, make a sketch of the circular doll house window.

Problem Set

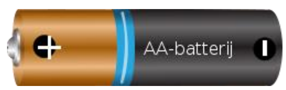
1. Giovanni went to Los Angeles, California for the summer to visit his cousins. He used a map of bus routes to get from the airport to the nearest bus station from his cousin's house. The distance from the airport to the bus station is 56 km. On his map, the distance was 4 cm. What is the scale factor?

2. Nicole is running for school president and her best friend designed her campaign poster which measured 3 feet by 2 feet. Nicole liked the poster so much she reproduced the artwork on rectangular buttons measuring 2 inches by $1\frac{1}{3}$ inches. What is the scale factor?

3. Use a ruler to measure and find the scale factor.

   Scale Factor: ___________________________

   Actual Picture

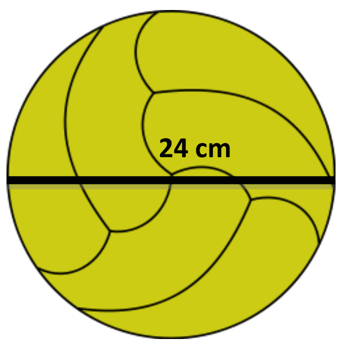


   Scale Drawing

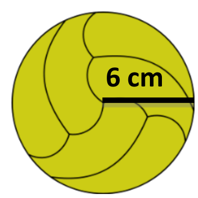
4. Find the scale factor using the given scale drawings and measurements below.

   Scale Factor: ___________________________

   Actual Picture

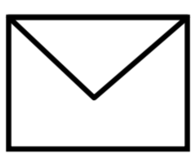


   Scale Drawing



5. Using the given scale factor, create a scale drawing from the actual pictures in centimeters:

   a. Scale factor: 3



   b. Scale factor: $\frac{3}{5}$

6. Hayden likes building radio-controlled sailboats with her father. One of the sails, shaped like a right triangle, has side lengths measuring 6 inches, 8 inches and 10 inches. To log her activity, Hayden creates and collects drawings of all the boats she and her father built together. Using the scale factor of $\frac{1}{4}$, draw a scale drawing of sail.

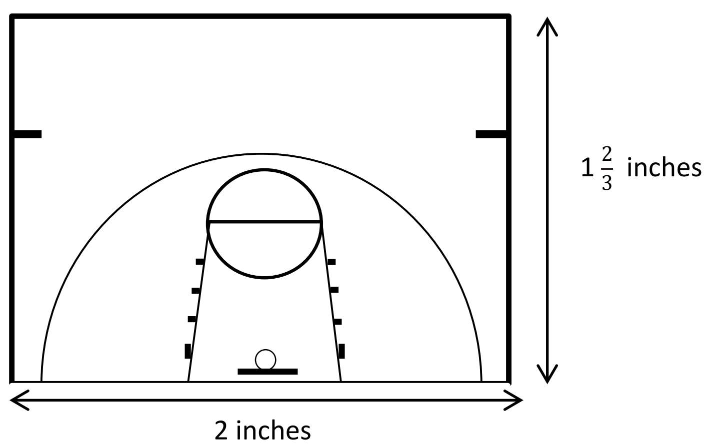
Lesson 18: Computing Actual Lengths from a Scale Drawing

Classwork

Example 1: Basketball at Recess?

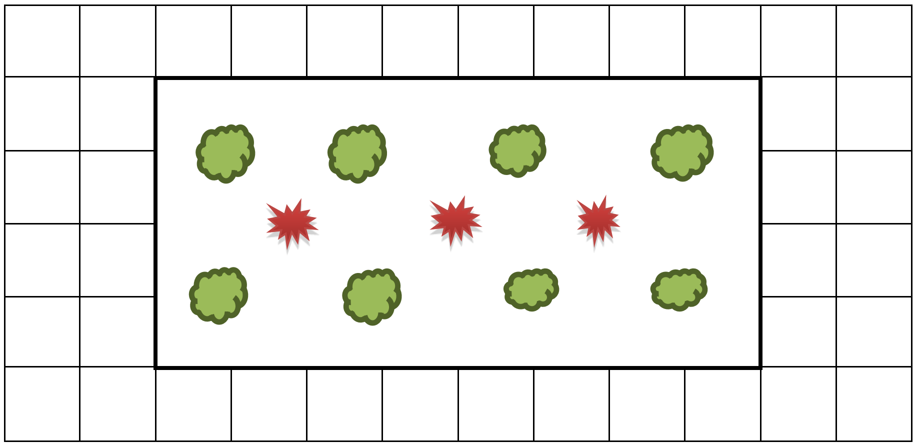
Vincent proposes an idea to the Student Government to install a basketball hoop along with a court marked with all the shooting lines and boundary lines at his school for students to use at recess. He presents a plan to install a half- court design as shown below. After checking with school administration, he is told it will be approved if it will fit on the empty lot that measures 25 feet by 75 feet on the school property. Will the lot be big enough for the court he planned? Explain.

Scale Drawing: 1 inch on drawing corresponds to 15 feet of actual length



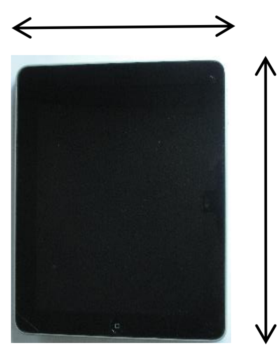
Example 2

The diagram shown represents a garden. The scale is 1 cm for every 20 meters of actual length. Find the actual length and width of the garden based upon the given drawing. Each square in the drawing measures 1 cm by 1 cm.



Example 3

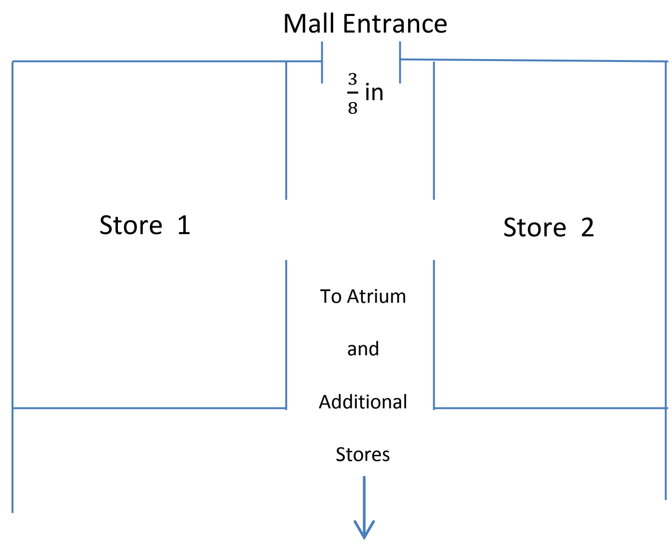
A graphic designer is creating an advertisement for a tablet. She needs to enlarge the picture given here so that 0.25 inches on the scale picture will correspond to 1 inch on the actual advertisement. What will be the length and width of the tablet on the advertisement?



Scale Picture of Tablet

Exercises

1. Students from the high school are going to perform one of the acts from their upcoming musical at the atrium in the mall. The students want to bring some of the set with them so that the audience can get a better feel of the whole production. The backdrop that they want to bring has panels that measure 10 feet by 10 feet. The students are not sure if they will be able to fit these panels through the entrance of the mall since the panels need to be transported flat (horizontal). They obtain a copy of the mall floor plan, shown below, from the city planning office. Use this diagram to decide if the panels will fit through the entrance. Use a ruler to measure.



Scale:

$\frac{1}{8}$ inch on drawing represents $4\frac{1}{2}$ feet of actual length

Answer the following questions.

a. Find the actual distance of the mall entrance and determine whether the set panels will fit.

b. What is the scale factor? What does it tell us?

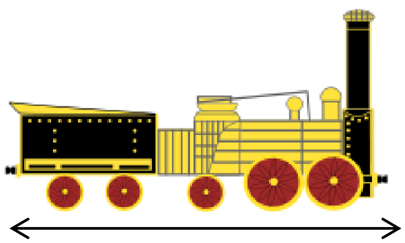
Problem Set

1. A toy company is redesigning their packaging for model cars. The graphic design team needs to take the old image shown below and resize it so that $\frac{1}{2}$ inch on the old packaging represents $\frac{1}{3}$ inch on the new package. Find the length of the image on the new package.

Car image length on old packaging measures 2 inches

2. The city of St. Louis is creating a welcome sign on a billboard for visitors to see as they enter the city. T he following picture needs to be enlarged so that $\frac{1}{2}$ inch represents 7 feet on the actual billboard. Will it fit on a billboard that measures 14 feet in height?

3. Your mom is repainting your younger brother's room. She is going to project the image shown below onto his wall so that she can paint an enlarged version as a mural. How long wiill the mural be if the projector uses a scale where 1 inch of the image represents $2\frac{1}{2}$ feet on the wall?



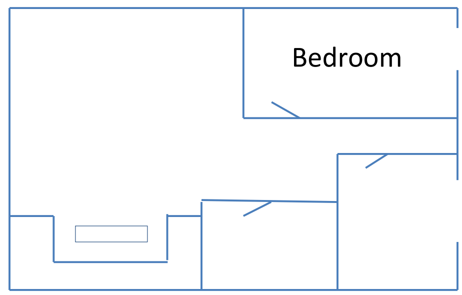
4. A model of a skyscraper is made so that 1 inch represents 75 feet. What is the height of the actual building if the height if the model is $18\frac{3}{5}$ inches?

5. The portrait company that takes little league baseball team photos is offering an option where a portrait of your baseball pose can be enlarged to be used as a wall decal (sticker). Your height in the portrait measures $3\frac{1}{2}$ inches. If the company uses a scale where 1 inch on the portrait represents 20 inches on the wall decal, find the height on the wall decal. Your actual height is 55 inches. If you stand next to the wall decal, will it be larger or smaller than you?

6. The sponsor of a 5K run/walk for charity wishes to create a stamp of its billboard to commemorate the event. If the sponsor uses a scale where 1 inch represents 4 feet and the billboard is a rectangle with a width of 14 feet and a length of 48 feet, what will be the shape and size of the stamp?

7. Danielle is creating a scale drawing of her room. The rectangular room measures $20\frac{1}{2}$ feet by 25 ft. If her drawing uses the scale 1 inch represents 2 feet of the actual room, will her drawing fit on an $8\frac{1}{2}$ in. by 11 in. piece of paper?

8. A model of an apartment is shown below where $\frac{1}{4}$ inch represents 4 feet in the actual apartment. Use a ruler to measure the drawing and find the actual length and width of the bedroom.



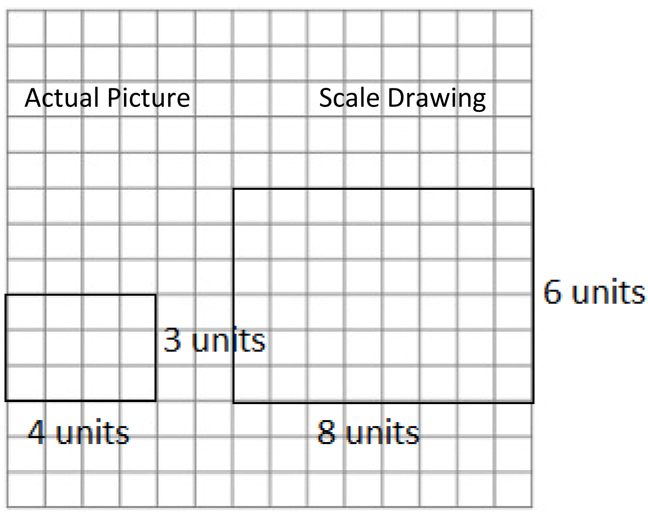
Lesson 19: Computing Actual Areas from a Scale Drawing

Classwork

Examples 1–3: Exploring Area Relationships

Use the diagrams below to find the scale factor and then find the area of each figure.

Example 1



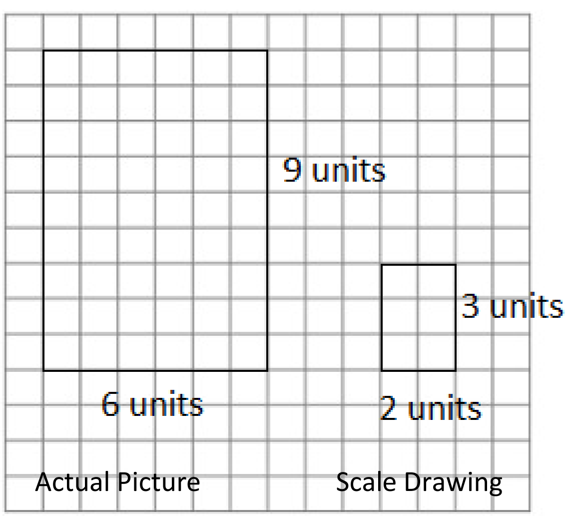
Scale factor: _________

Actual Area = ______________

Scale Drawing Area = ________________

Ratio of Scale Drawing Area to Actual Area: _________

Example 2



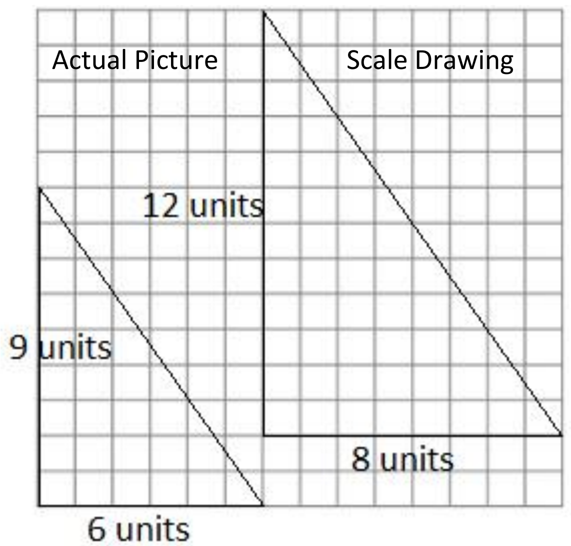
Scale factor: _________

Actual Area = ______________

Scale Drawing Area = ________________

Ratio of Scale Drawing Area to Actual Area: _________

Example 3



Scale factor: _________

Actual Area = ______________

Scale Drawing Area = ________________

Ratio of Scale Drawing Area to Actual Area: _________

Results: What do you notice about the ratio of the areas in Examples 1-3? Complete the statements below.

When the scale factor of the sides was 2, then the ratio of area was _______________.

When the scale factor of the sides was $\frac{1}{3}$, then the ratio of area was _____________.

When the scale factor of the sides was $\frac{4}{3}$, then the ratio of area was _____________.

Based on these observations, what conclusion can you draw about scale factor and area?

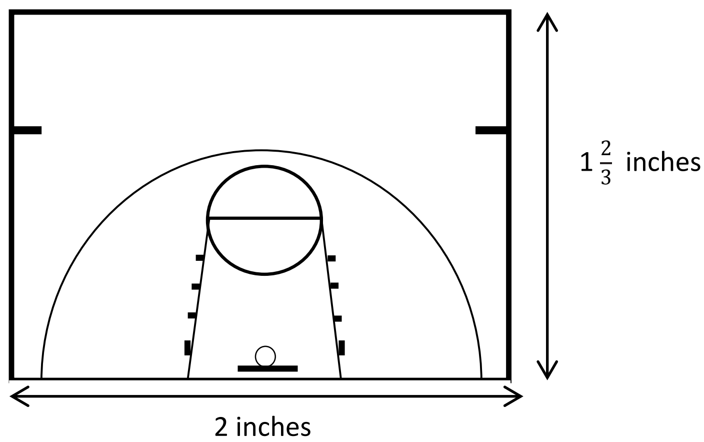
If the scale factor of the sides is r, then the ratio of area will be ___________________.

Example 4: They Said Yes!

The Student Government liked your half-court basketball plan. They have asked you to calculate the actual area of the court so that they can estimate the cost of the project.

Based on your drawing below, what is the area of the planned half-court going to be?

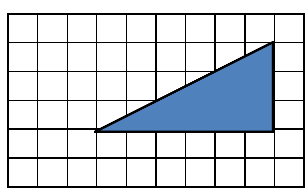
Scale Drawing: 1 inch on drawing corresponds to 15 feet of actual length



Does the actual area you found reflect the results we found from Examples 1–3? Explain how you know.

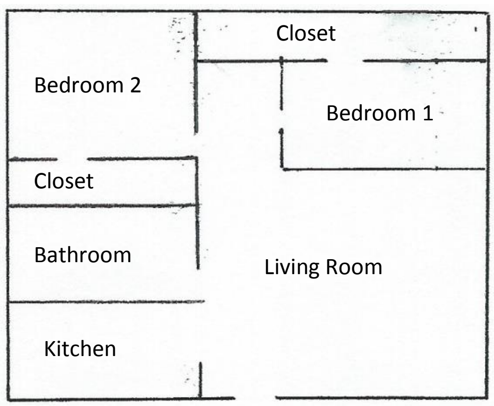
Exercises

1. The triangle depicted by the drawing has an actual area of 36 square units. What is the scale of the drawing? (Note: each square on grid has a length of 1 unit)



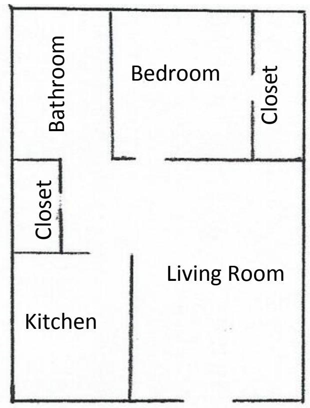
2. Use the scale drawings of two different apartments to answer the questions. Use a ruler to measure.

Suburban Apartment



Scale: 1 inch on scale drawing corresponds to 12 feet in the actual apartment

City Apartment



Scale: 1 inch on scale drawing corresponds to 16 feet in the actual city apartment

a. Find the scale drawing area for both apartments, and then use it to find the actual area of both apartments.

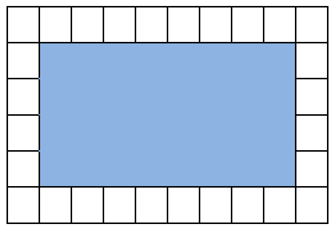
b. Which apartment has the closet floor with more square footage? Justify your thinking.

c. Which apartment has the largest bathroom? Justify your thinking.

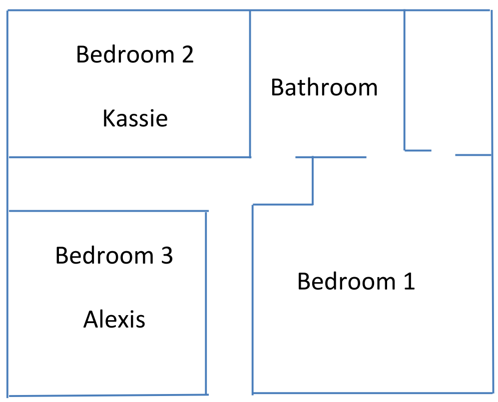
d. A one-year lease for the suburban apartment costs $750 per month. A one-year lease for the city apartment costs $925. Which apartment offers the greater value in terms of the cost per square foot?

Problem Set

1. The shaded rectangle shown below is a scale drawing of a rectangle whose area is 288 square feet. What is the scale factor of the drawing? (Note: each square on grid has a length of 1 unit)



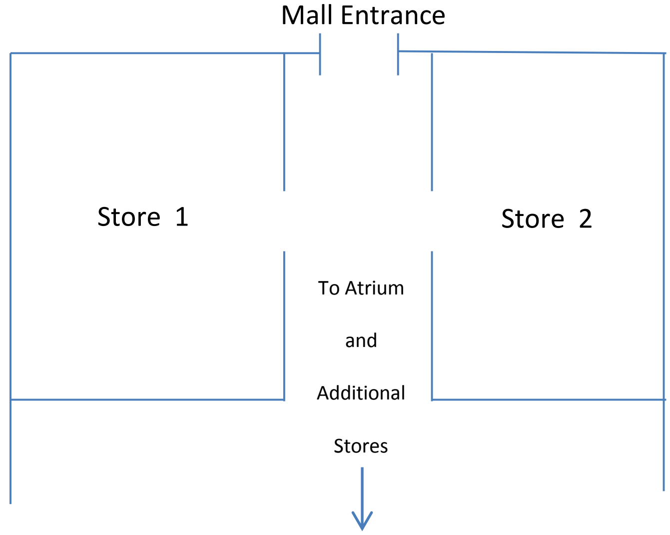
2. A floor plan for a home is shown below where $\frac{1}{2}$ inch corresponds to 6 feet of the actual home. Bedroom 2 belongs to 13-year old Kassie, and bedroom 3 belongs to 9-year old Alexis. Kassie claims that her younger sister, Alexis, got the bigger bedroom, is she right? Explain.



3. On the mall floor plan, $\frac{1}{4}$ inch represents 3 feet in the actual store.

a. Find the actual area of Store 1 and Store 2.

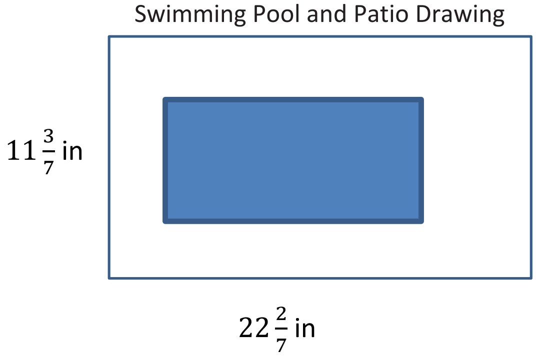
b. In the center of the atrium, there is a large circular water feature that has an area of $\left(\frac{9}{64}\right)\pi$ square inches on the drawing. Find the actual area in square feet.



4. The greenhouse club is purchasing seed for the lawn in the school courtyard. They need to determine how much to buy. Unfortunately, the club meets after school, and students are unable to find a custodian to unlock the door. Anthony suggests they just use his school map to calculate the amount of area that will need to be covered in seed. He measures the rectangular area on the map and finds the length to be 10 inches and the width to be 6 inches. The map notes the scale of 1 inch representing 7 feet in the actual courtyard. What is the actual area in square feet?

5. The company installing the new in-ground pool in your back yard has provided you with the scale drawing shown below. If the drawing uses a scale of 1 inch to $1\frac{3}{4}$ feet, calculate the total amount of two-dimensional space needed for the pool and it's surrounding patio.

Swimming Pool and Patio Drawing



Lesson 20: An Exercise in Creating a Scale Drawing

Today, you will be applying your knowledge from working with scale drawings to create a floor plan for your idea of the dream classroom.

Classwork: Your Dream Classroom

Guidelines

Take measurements: All pairs will work with the perimeter of the classroom as well as the doors and windows (Perimeter to be given by the teacher). Use the table provided to record measurements. Always double check the measurements.

Create your dream classroom and use the furniture catalog to pick out your furniture: Discuss what your ideal classroom will look like with your partner and start picking out furniture from the catalog. Record the actual measurements on the given table.

Determine scale and calculate scale drawing lengths and widths: With your partner, determine your own scale. The calculations of the scale drawing lengths, widths and area is to be included.

Scale Drawing: Using a ruler and referring back to the calculated scale length, draw the scale drawing including the doors, windows and furniture.

Measurements

	Classroom Perimeter	Windows	Door	Additional Furniture					
Actual : Length									
Width									
Scale Drawing : Length									
Width									

Scale: ___________________

Initial Sketch: Use this space to sketch the classroom perimeter, draw out your ideas and play with the placement of the furniture.

Area

	Classroom						
Actual Area							
Scale Drawing Area							

Lesson Summary:

Scale Drawing Process:

1. Measure lengths and widths carefully with a ruler or tape measure. Record in an organized table.
2. Calculate the scale drawing lengths, widths and areas using what was learned in previous lessons.
3. Calculate the actual areas.
4. Begin by drawing the perimeter, windows and doorways.
5. Continue to draw the pieces of furniture making note of placement of objects (distance from nearest wall).
6. Check for reasonableness of measurements and calculations.

Problem Set

Interior Designer

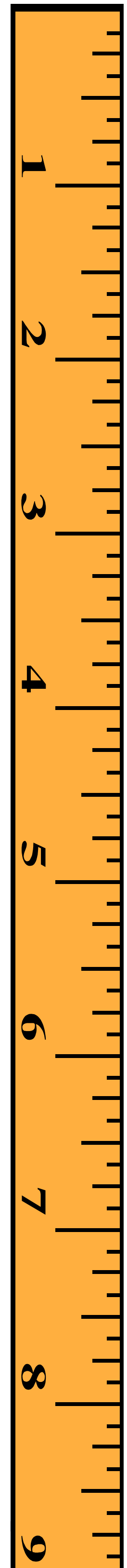
You won a spot on a famous interior designing TV show! The designers will work with you and your existing furniture to redesign a room of your choice. Your job is to create a top-view scale drawing of your room and the furniture within it.

- With the scale factor being $\frac{1}{24}$, create a scale drawing of your room or other favorite room in your home on a sheet of 8.5 x 11 inch graph paper.
- Include the perimeter of the room, windows, doorways, and three or more furniture pieces (such as tables, desks, dressers, chairs, bed, sofa, ottoman, etc.).
- Use the table to record lengths and include calculations of areas.

- Make your furniture “moveable” by duplicating your scale drawing and cutting out the furniture.
- Create a “before” and “after” to help you decide how to rearrange your furniture. Take a photo of your “before.”
- What changed in your furniture plans?
- Why do you like the “after” better than the “before”?

	Entire Room	Windows	Doors	Desk/Tables	Seating	Storage	Bed	
Actual Length								
Actual Width								
Scale Drawing Length								
Scale Drawing Width								

	Entire Room Length	Desk/Tables	Seating	Storage	Bed	
Actual Area						
Scale Drawing Area						


1
2
3
4
5
6
7
8
9

Lesson 21: An Exercise in Changing Scales

How does your scale drawing change when a new scale factor is presented?

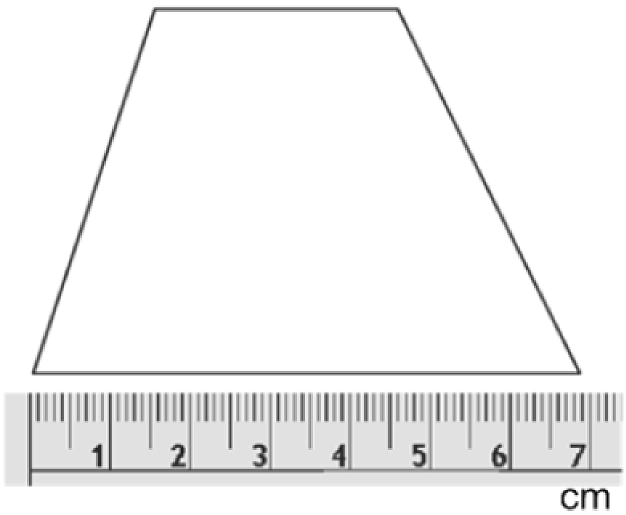
Classwork

Example 1: A New Scale Factor

The school plans to publish your work on the dream classroom in the next newsletter. Unfortunately, in order to fit our drawing on the page, it must be $\frac{1}{4}$ its current length to be published in the magazine. Create a new drawing (SD2) in which all of the lengths are $\frac{1}{4}$ those in the original scale drawing (SD1) from Lesson 20.

Exercise

The picture shows an enlargement or reduction of a scale drawing of a trapezoid.



Using the scale factor written on the card you chose, draw your new scale drawing with correct calculated measurements.

Changing Scale Factors:

- To produce a scale drawing at a different scale, you must determine the new scale factor. The new scale factor is found by dividing the different (new drawing) scale factor by the original scale factor.
- To find each new length, you can multiply each length in the original scale drawing by this new scale factor.

Steps:

- Find each scale factor.
- Divide new scale factor by original scale factor.
- Divide the given length by the new scale factor (the quotient from the prior step)

a. What is the scale factor between the original scale drawing and the one you drew?

b. The longest base length of the actual trapezoid is 10 cm. What is the scale factor between original scale drawing and the actual trapezoid?

c. What is the scale factor between the new scale drawing you drew and the actual trapezoid?

Problem Set

1. Jake reads the following problem: If the original scale factor for a scale drawing of a square swimming pool was $\frac{1}{90}$ and length of the original drawing measured to be 8 inches, what is the length on the new scale drawing if the scale factor of the new scale drawing length to actual length is $\frac{1}{144}$?

   He works out the problem like so:

   $8 \div \frac{1}{90} = 720$ inches.

   $720 \times \frac{1}{144} = 5$ inches.

   Is he correct? Explain why or why not.

2. What is the scale factor of the new scale drawing to the original scale drawing (SD2 to SD1)?

3. If the length of the pool measures 10 cm on the new scale drawing:

   a. What is the actual length of the pool in meters?

   b. What is the surface area of the actual pool?

   c. If the pool has a constant depth of 4 feet, what is the volume of the pool?

   d. If 1 cubic meter of water is equal to 264.2 gallons, how much water will the pool contain when completely filled?

4. Complete a new scale drawing of your dream room from Lesson 20's problem set by either reducing by $\frac{1}{4}$ or enlarging it by 4.

Lesson 22: An Exercise in Changing Scales

Classwork

Using the new scale drawing of your dream room, list the similarities and differences between this drawing and the original drawing completed for Lesson 20.

Similarities

Differences

Original Scale Factor:___________________ New Scale Factor:_______________________

What is the relationship between these scale factors?

Key Idea:

Two different scale drawings of the same top-view of a room are also scale drawings of each other. In other words, a scale drawing at a different scale can also be considered a scale drawing of the original scale drawing.

Example 1: Building a Bench

To surprise her mother, Taylor helped her father build a bench for the front porch. Taylor's father had the instructions with drawings but Taylor wanted to have her own copy. She enlarged her copy to make it easier to read. Using the following diagram, fill in the missing information.

The pictures below show the diagram of the bench shown on the original instructions and the diagram of the bench shown on Taylor's enlarged copy of the instruction.

Original Drawing of Bench (top view)

2 inches

Taylor's Drawing(top view) Scale Factor to bench: $\frac{1}{12}$

6 inches

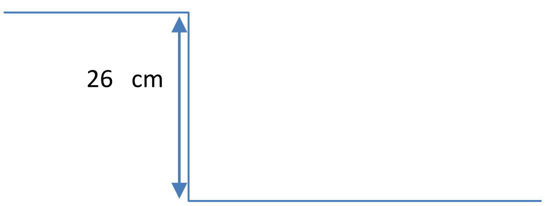
Scale Factors

	Bench	Father's Diagram	Taylor's Diagram
Bench	1		
Father's Diagram		1	
Taylor's Diagram			1

Exercise 1

Carmen and Jackie were driving separately to a concert. Jackie printed a map of the directions on a piece of paper before the drive, and Carmen took a picture of Jackie's map on her phone. Carmen's map had a scale factor to the actual distance of $\frac{1}{563270}$. Using the pictures, what is the scale of Carmen's map to Jackie's map? What was the scale factor of Jackie's printed map to the actual distance?

Jackie's Map



Carmen's Map

Exercise 2

Ronald received a special toy train set for his birthday. In the picture of the train on the package, the box car has the following dimensions: length is $\mathbf{4\frac{5}{16}}$ inches; width is $1\frac{1}{8}$ inches; and height is $1\frac{5}{8}$ inches. The toy box car that Ronald received has dimensions *l* is 17.25 inches; *w* is 4.5 inches; and *h* is 6.5 inches. If the actual boxcar is 50 feet long:

a. Find the scale factor of the picture on the package to the toy set.

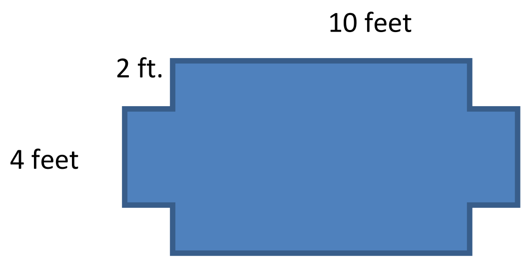
b. Find the scale factor of the picture on the package to the actual boxcar.

c. Use these two scale factors to find the scale factor between the toy set and the actual boxcar.

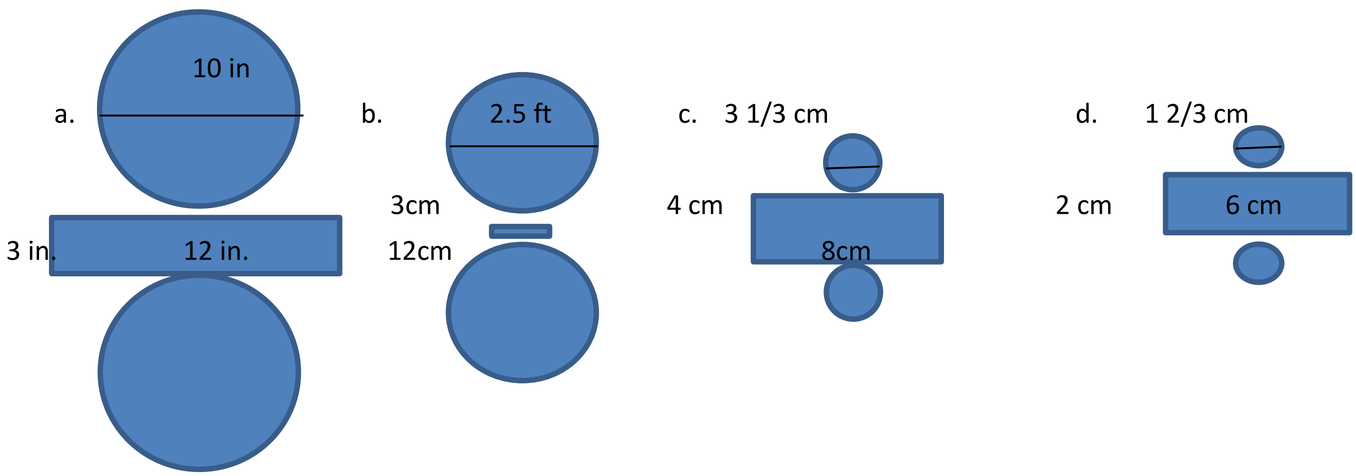
d. What are the width and height of the actual boxcar?

Problem Set

1. For the scale drawing, the actual lengths are labeled onto the scale drawing. Measure the lengths of the scale drawing and draw a new scale drawing with a scale factor (SD2 to SD1) of $\frac{1}{2}$.

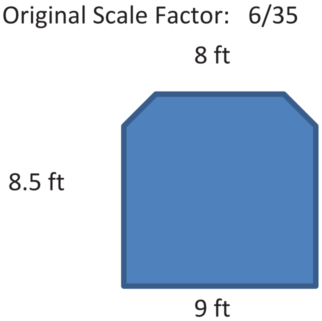


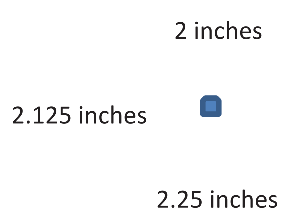
2. Use the measurements on the diagrams below to identify whether each would be scale drawings of a garden. The garden contains a rectangular portion measuring 24 ft by 6 ft and two circular fountains each with a diameter of 5 ft.



3. Compute the scale factor of the new scale drawing (SD2) to original scale drawing (SD1) using information from the given scale drawing.

a. Original Scale Factor: 6/35 New Scale Factor: 1/280





Scale Factor: _____________

b. Original Scale Factor: 1/12

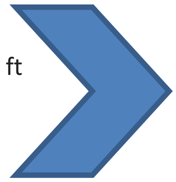
1/2 in

3 in  3 in

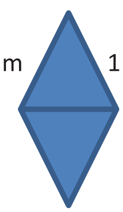
Scale Factor:_______________

New Scale Factor: 3

6 ft

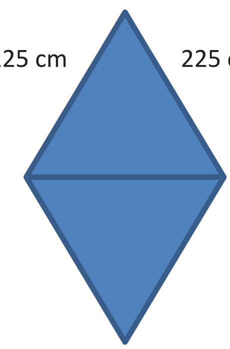
36 ft  36 ft

c. Original Scale Factor: 20

1 m  1 m

Scale Factor:_______________

New Scale Factor: 25

225 cm  225 cm