SCALE CITY

KET

The Road to Proportional Reasoning: Miniature Land Handouts

TABLE OF CONTENTS

Click on a title to go directly to the handout.

MINIATURE LAND: HANDOUT 1

Are Toys Proportional?

Name: **Date:**

1. Select a toy and some accessories that go with the toy. Choose a toy that directly represents a person or a real object.

2. Measure several dimensions of the toy and accessories. Record the measurements.

3. Compare the items to the objects' actual sizes. You may need to research to find the standard sizes for items like refrigerators, cars, etc.

4. Present your findings to the class. Use the following presentation template:

The toy examined is a _____.

The appearance of the object does or does not look proportional in these details. (Describe at least two observations.)
A.

B.

In comparing the object's measurements with the actual object, I (we) discovered that …

We think that proportional reasoning was used or not used because …

Self-Assessment Checklist:

_____ I completed all four steps of the project.

_____ I carefully measured and recorded several dimensions of the object.

_____ I researched to find measurements of an actual object.

_____ I used mathematics to compare the size of the object to an actual object.

_____ I presented my findings using the presentation template.

_____ My overall work shows good effort and attention to detail.

Group Assessment Checklist:

_____ We quietly and efficiently gathered materials for the project.

_____ We worked well as a team.

_____ We focused on the task and used time efficiently.

_____ We completed all four steps in the process.

_____ We used math to compare this object to an actual object.

_____ We managed materials well as a group and cleaned up quickly.

_____ Our overall work shows good effort and attention to detail.

MINIATURE LAND: HANDOUT 2

Scales from "Greetings from Miniature Land"

Handout 2: Scales from "Greetings from Miniature Land"

Name: _____ Date: _____

There are three scales mentioned in the video "Greetings from Miniature Land." Please record those scales.

1. Kentucky Gateway Museum in Maysville, Kentucky

2. Behringer Crawford Museum in Covington, Kentucky

3. Huntertown Elementary School architectural model

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1. Kentucky Gateway Museum in Maysville, Kentucky

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There are three scales mentioned in the video "Greetings from Miniature Land." Please record those scales.

1. Kentucky Gateway Museum in Maysville, Kentucky

2. Behringer Crawford Museum in Covington, Kentucky

3. Huntertown Elementary School architectural model

MINIATURE LAND: HANDOUT 3

Practice Scaling

Name: **Date:**

1. The Empire State Building continues to be an icon of New York City. Built in 1931, it was the tallest building in the world for many years. Even today, it is still among the tallest buildings in the world. Using an architectural scale of 1:192 and the information in the table below, determine what the measurements of a model of the Empire State Building would be. Calculate in feet and inches (correct to the nearest 1/16 of an inch). Show your work below and then record your answer on the table.

.

Dimension	Metric	English	1:192 scale
Height of roof	381 meters	1250 feet	
Height to top of tower	449 meters	1472 feet	
Maximum length	129 meters	424 feet	
Maximum width	57 meters	187 feet	

A. Determine the model's height from ground level to the roof.

B. Determine the model's height from ground level to the top of the tower.

C. Determine the maximum length of the model.

D. Determine the maximum width of the model.

2. Another way to write the architectural scale is 1/16 of an inch for every foot. Why does it seem that the architectural scale is suited for the English system instead of the metric system?

KEY: MINIATURE LAND: HANDOUT 3

Practice Scaling

Note to Teacher:

There are a variety of ways in which students might make these calculations. For example, they might convert the actual feet to inches and then divide the product by 192. Then they could divide their quotient by 12 to get an answer. Or they might set up equivalent fractions or proportions as outlined below.

Regardless of the approach, to obtain measurements that are exact as possible for the model, students must convert decimal values to inches and fractions of inches (sixteenths). At this point, you may want to encourage them to use a calculator to facilitate converting decimals with several places to inches and fractions of inches.

In the first calculation, you might ask students to estimate what 0.5104 feet would be in inches. They will probably say roughly half a foot or six inches. Ask them if they think this approximate value is accurate enough to create an architectural model or if the extra 1/8 inch makes a significant difference. How much does 1/8 inch represent in the 1/192 scale? (Two feet)

1. The Empire State Building continues to be an icon of New York City. Built in 1931, it was the tallest building in the world for many years. Even today, it is still among the tallest buildings in the world. Using an architectural scale of 1:192 and the information in the table below, determine what the measurements of a model of the Empire State Building would be. Calculate in feet and inches (correct to the nearest 1/16 of an inch). Show your work below and then record your answer on the table.

.

Dimension	Metric	English	1:192 scale
Height of roof	381 meters	1250 feet	*6 feet 6 1/8 inches*
Height to top of tower	449 meters	1472 feet	*7 feet 8 inches*
Maximum length	129 meters	424 feet	*2 feet 2 1/2 inches*
Maximum width	57 meters	187 feet	*11 and 11/16 inches*

A. Determine the model's height from ground level to the roof.

1/192 = x feet/ 1250 feet
1/192 = x/1250
1/192 •1250 = x
1250/192 = x
x = 6.5104 feet

Convert 0.5104 to inches (the most accurate result will be obtained by leaving the entire number in the calculator).
0.5104 • 12 = 6.125 inches 125/1000 = simplifies to 1/8

Height of model at roof in feet and inches = 6 feet 6 1/8 inches

B. Determine the model's height from ground level to the top of the tower.
1/192 = x feet/ 1250 feet
1/192 = x feet/1472 feet
1/192 • 1472 = x
1472/192 = x
x = 7.6667 feet

Convert 0.6667 feet to inches.
2/3 • 12 = 8 inches

Height of model at top of tower in feet and inches = 7 feet 8 inches

C. Determine the maximum length of the model.
1/192 = x feet/424 feet
1/192 = x/424
1/192 • 424 = x
424/192 = x
x = 2.2083 feet

Convert 0.2083 to inches.
0.2083 • 12 = 2.5 or 2 1/2 inches

Maximum length of model = 2 feet 2 1/2 inches

D. Determine the maximum width of the model.
1/192 = x feet/424 feet
1/192 = x/187
1/192 • 187 = x
187/192 = x
x = 0. 9734

Convert 0.9734 to inches.
0.9734 • 12 = 11.6875 inches 6875/10000 = 11/16 inches

Maximum width of model = 11 and 11/16 inches

2. Another way to write the architectural scale is 1/16 of an inch for every foot. Why does it seem that the architectural scale is suited for the English system instead of the metric system?
Ask your students to discuss different theories. Students may realize that 192 is the product of 12 times 16. There are 12 inches in a foot, and inches are measured in sixteenths. With metric measurements it would be easier to use a scale divisible by 10 or 100 so that conversion to different metric units is easily accomplished.

MINIATURE LAND: HANDOUT 4

Scaling Miniatures

Name: **Date:**

1. In her job for the Toyland Wonder Company, Sela is proposing a line of action figures modeled after law enforcement officers and their equipment. She chooses to use a scale of 1:12. Estimate to determine if the numbers are reasonable. Determine how large the clipboard and flashlight should be. Answer with fractions in simplest terms. **Correct any proposed measurements that are not reasonable.**

	Actual Measurements	Proposed Toy Measurements
Height of Police Officer (Male)	6 feet or 72 inches	6 inches
Height of Police Officer (Female)	5 feet 6 inches or 66 inches	6 1/2 inches
Length of Squad Car	15 feet long or 180 inches	15 inches
Clipboard	9 inches by 12 inches	
Length of Cell Phone	3 1/5 inches	1/4 inch
Length of Flashlight	20 inches	

2. The Builder's Club is creating a display of favorite structures. Using the architectural scale of 1:192 or 1/16 of an inch for every foot, how tall would the models of the following structures be? Answer in feet and inches, and round to the nearest 1/16 of an inch. Do the calculations on the bottom and back of the paper. Show your work.

Structure	Height in Feet	Model Height 1:192
Big Ben	316 feet	
Eiffel Tower	1052 feet	
Statue of Liberty	305 feet 1 inch	
Gateway Arch	630 feet	
Seattle Space Needle	555 feet 5 1/8 inches	
Washington Monument	605 feet	

3. How can you show the following scales are equal? Explain and show all your work.

A. 1 inch for every 16 feet is equal to 1/16 of an inch for every foot

B. 1/16 of an inch for every foot is equal to 1:192

KEY: MINIATURE LAND: HANDOUT 4

Scaling Miniatures

1. In her job for the Toyland Wonder Company, Sela is proposing a line of action figures modeled after law enforcement officers and their equipment. She chooses to use a scale of 1:12. Estimate to determine if the numbers are reasonable. Determine how large the clipboard and flashlight should be. Answer with fractions in simplest terms.
Correct any proposed measurements that are not reasonable.

	Actual Measurements	Proposed Toy Measurements
Height of Police Officer (Male)	6 feet or 72 inches	6 inches
Height of Police Officer (Female)	5 feet 6 inches or 66 inches	***5 1/2 inches***
Length of Squad Car	15 feet long or 180 inches	15 inches
Clipboard	9 inches by 12 inches	***3/4 inch x 1 inch***
Length of Cell Phone	3 1/5 inches	1/4 inch
Length of Flashlight	20 inches	***1 2/3 inches***

2. The Builder's Club is creating a display of favorite structures. Using the architectural scale of 1:192 or 1/16 of an inch for every foot, how tall would the models of the following structures be? Answer in feet and inches, and round to the nearest 1/16 of an inch. Do the calculations on the bottom and back. Show your work.

Structure	Height in Feet	Model Height 1:192
Big Ben	316 feet	***1 foot 7 3/4 inches***
Eiffel Tower	1052 feet	***5 feet 5 3/4 inches***
Statue of Liberty	305 feet 1 inch	***1 foot 7 1/16 inches***
Gateway Arch	630 feet	***3 feet 3 3/8 inches***
Seattle Space Needle	555 feet 5 1/8 inches	***2 feet 10 11/16 inches***
Washington Monument	605 feet	***3 feet 1 13/16 inches***

Note to Teacher:
Here are two possible approaches that students might use to complete the table.
1) Use the 1:192 scale to set up equivalent ratios and solve for the unknown value (1/192 = model height/actual height). 2) Use the 1/16 inch = 1 foot scale. Divide the height in feet by 16 to get the total number of inches in the model and then convert to feet and inches. (For example, 316 divided by 16 equals 19 3/4 or 1 foot 7 3/4 inches).

Encourage students to share their reasoning and methods for solving the problems. Students will still need to convert decimal remainders from feet to inches and inch remainders from decimals to 1/16 inches.

Big Ben
1/192 = x feet/316 feet 192 • 316 x = 316/192 x = 1.6458
Convert the decimal remainder to inches.
0.6458 • 12 = 7 3/4 inches

Eiffel Tower
1/192 = x feet/1052 feet 192x = 1052 x = 1052/192 x = 5.4791 inches
Convert decimal remainder to inches.
0.4791 x 12 = 5 3/4 inches

Statue of Liberty
305 feet 1 inch
Set up equivalent fractions and convert feet to inches.
1/192 = x feet/(305 feet x 12)+1
192x = 3661 inches
x = 3661/192
x = 19.0677 or 1 foot 7 1/16 inches

Gateway Arch
1/192 = x/630 feet 192x = 630 x = 630/192 x = 3.28125 inches
Convert decimal remainder to inches.
0.28125 x 12 = 3 3/8 inches

Seattle Space Needle
555 feet 5 1/8 inches
Set up equivalent fractions and convert feet to inches.
1/192 = x feet/[(555 feet x 12) +5 inches +(1/8) inch]
1/192 = x/6665 1/8 inches
6665.125/192 = x
x = 34 11/16 inches

Washington Monument
605 feet
1/192 = x feet/605 feet
192x = 605
x = 605/192
x = 3 13/16 inches

3. How can you show the following scales are equal? Explain and show all your work.

A. 1 inch for every 16 feet is equal to 1/16 of an inch for every foot

Here are a few possible ways students might demonstrate that the scales are equal.

Convert both ratios to inches
1/(16 • 12) = (1/16)/12 inches
1/192 = 1/16 ÷12
1/192 = 1/16 • 1/12
1/192 = 1/192

Narrow the measurement by counting backwards and dividing by 2 each time.
1 inch for every 16 feet
1/2 inch for every 8 feet
1/4 inch for every 4 feet
1/8 inch for every 2 feet
1/16 inch for every foot

B. 1/16 of an inch for every foot is equal to 1:192

Here are a few ways to examine these values. You or your students may have other good ways of checking these values by using models or symbols.

Follow the definition for a proportion and test it. If a/b = c/d then ad = b.,
1: 192 is the same as 1/192, a = 1/16, b = 12(12 inches in a foot), c = 1, d = 192
(1/16)/12 = 1/192
1/16 • 192 = 12 • 1
12 = 12
These are equivalent ratios, so the scales are the same.

Simplify the most complicated fraction.
Write the problem out in symbols.
1/16 of an inch for every foot
(1/16)/12 = (1/16) ÷ 12 = 1/16 ÷ 12/1 = 1/16 • 1/12 = 1/192
1/192 is another method of writing 1:192

Set up the two values as equivalent ratios leaving one unknown value to determine if they are equal.
1:192 can be written as 1/192
1/192 = (1/16)/x solve for x
x = 192 • 1/16
x = 12 so the two ratios are equal or proportional.

MINIATURE LAND: HANDOUT 5

Scale Challenge

Name: **Date:**

1. For a family reunion, one of the activities is a board game for a homemade Family Heritage Trivia Game. To construct a board game three times the dimensions of most board games, compute the following dimensions and enter them in the chart.

A. Determine the larger sizes.

	Smaller Size	Larger Size
Height of Player Piece	1.5 inches	
Dimensions of Board	19 1/2 inches by 19 1/2 inches	
Dice	1 inch x 1 inch x 1 inch	

B. What would the dimensions of the large board be in feet and inches?

C. If the paint used to cover the board requires four ounces per square foot, how much paint is needed to cover one side of the larger board? Round your answer to the nearest tenth place. (Hint: First determine the area.)

D. Use the computation from "c" to determine how many bottles of paint you'll need to buy to paint the large board if the paint comes in 16-ounce bottles.

2. Randy thinks the wheelchair ramp at the old community center is too steep. He and his parents looked into the guidelines of the Americans with Disabilities Act. The chart below indicates that for existing structures a slope steeper than 1:8 is not acceptable. This slope ratio is calculated as the rise (height) of the ramp to the run (length) of the ramp. For every three inches of rise at least a two-foot run is required. Since two feet equals 24 inches, the ratio is 3:24 or 1:8.

Allowable Ramp Dimensions for Construction in Existing Sites, Buildings, and Facilities

Slope*	Maximum Rise	Maximum Run
Steeper than 1:10 but no steeper than 1:8	3 in or 75 mm	2 ft or 0.6 m
Steeper than 1:12 but no steeper than 1:10	6 in or 150 mm	5 ft or 1.5 m

* A slope steeper than 1:8 not allowed.

The rise of the wheelchair ramp at the community center is seven inches. The run of the ramp is 58 inches. Is this slope steeper than 1:8?

3. The Americans with Disabilities Act requires ramps in new buildings to have a slope of 1:12 or less. This means that for every inch of height (rise) of the ramp, there needs to be 12 inches of length (run). The recommended ramp slope is 1:16.

A. For a rise of five inches, how long should the ramp be if it meets the 1:12 requirements?

B. For a rise of five inches, how long should the ramp be if it meets the 1:16 recommendations?

4. Here are the heights of some of the world's tallest buildings in meters.

Building	Country	Top of Spire	Top of Building
Taipei 101	Taiwan	508 meters	448 meters
Shanghair World Financial Center	China		492 meters
Petronas Towers	Malaysia	452 meters	
Sears Tower	U.S.A.		442.3 meters
Jin Mao Tower	China	420.5 meters	

A. To create a scale drawing comparing the heights of these buildings, the class chose to use a scale of 1 cm for every 100 meters. Fill in the chart with the values they would use for their drawing.

Building	Country	Top of Spire	Top of Building
Taipei 101	Taiwan		
Shanghai World Financial Center	China		
Petronas Towers	Malaysia		
Sears Tower	U.S.A.		
Jin Mao Tower	China		

B. How would you express a scale or ratio of 1 cm for every one hundred meters as a ratio in which you only use centimeters? (Hint: You need to convert meters to centimeters.)

5. Using the scale of 1:192, determine what the dimensions would be for a model of your school or a model of your classroom.

KEY: MINIATURE LAND: HANDOUT 5

Scale Challenge

1. For a family reunion, one of the activities is a board game for a homemade Family Heritage Trivia Game. To construct a board game three times the dimensions of most board games, compute the following dimensions and enter them in the chart.

A. Determine the larger sizes.

	Smaller Size	Larger Size
Height of Player Piece	1.5 inches	***4.5 inches***
Dimensions of Board	19 1/2 inches by 19 1/2 inches	***58.5 inches by 58.5 inches***
Dice	1 inch x 1 inch x 1 inch	***3 inches x 3 inches x 3 inches***

B. What would the dimensions of the large board be in feet and inches?

58.5/12 = 4.875 feet or 4 feet 10 1/2 inches

C. If the paint used to cover the board requires four ounces per square foot, how much paint is needed to cover one side of the larger board? Round your answer to the nearest tenth place. (Hint: First determine the area.)

4.875 • 4.875 = 23.765625 square feet
23.765625 square feet • 4 oz/square foot= 95.0625 ounces or 95.1 ounces

D. Use the computation from "c" to determine how many bottles of paint you'll need to buy to paint the large board if the paint comes in 16-ounce bottles.

95.1/16 = 5.94375, so you will need six bottles of paint.

Teaching Tip:

You might ask students to estimate how much paint it would take to paint the smaller board, which is on a scale of 1:3 with the larger board. If they have done the Mural Math lesson and interactive, they'll know that it's much less than one-third the amount (actually one-ninth).

2. Randy thinks the wheelchair ramp at the old community center is too steep. He and his parents looked into the guidelines of the Americans with Disabilities Act. The chart below indicates that for existing structures a slope steeper than 1:8 is not acceptable. This slope ratio is calculated as the rise (height) of the ramp to the run (length) of the ramp. For every three inches of rise at least a two-foot run is required. Since two feet equals 24 inches, the ratio is 3:24 or 1:8.

Allowable Ramp Dimensions for Construction in Existing Sites, Buildings, and Facilities

Slope*	Maximum Rise	Maximum Run
Steeper than 1:10 but no steeper than 1:8	3 in or 75 mm	2 ft or 0.6 m
Steeper than 1:12 but no steeper than 1:10	6 in or 150 mm	5 ft or 1.5 m

* A slope steeper than 1:8 not allowed.

The rise of the wheelchair ramp at the community center is seven inches. The run of the ramp is 58 inches. Is this slope steeper than 1:8?
7/58=1/x 7x=58 x = 58/7 x= 8.2857

No, the slope is not steeper than 1:8. (This problem is tricky since a higher number in the ratio means a less steep slope. It's a great opportunity to review what a ratio means and how larger and smaller numbers would change the proportion.) For more information about these requirements, visit ***www.access-board.gov/ufas/ufas-html/ufas.htm#3.2.***

3. The Americans with Disabilities Act requires ramps in new building to have a slope of 1:12 or less. This means that for every inch of height (rise) of the ramp, there needs to be 12 inches of length (run). The recommended ramp slope is 1:16.

A. For a rise of five inches, how long should the ramp be if it meets the 1:12 requirements?
5/x= 1/12 5/60 = 1/12 The answer is 60 inches or 5 feet.

B. For a rise of five inches, how long should the ramp be if it meets the 1:16 recommendations?
5/x = 1/16 5/80 = 1/16 The answer is 80 inches or 6 feet 8 inches.

4. Here is a chart of the heights of some of the world's tallest structures in meters:

Building	Country	Top of Spire	Top of Building
Taipei 101	Taiwan	508 meters	448 meters
Shanghair World Financial Center	China		492 meters
Petronas Towers	Malaysia	452 meters	
Sears Tower	U.S.A.		442.3 meters
Jin Mao Tower	China	420.5 meters	

A. To create a scale drawing comparing the heights of these buildings, the class chose to use a scale of 1 cm for every 100 meters. Fill in the chart with the values they would use for their drawing.

Building	Country	Top of Spire	Top of Building
Taipei 101	Taiwan	*5.08 cm*	*4.48 cm*
Shanghai World Financial Center	China		*4.92 cm*
Petronas Towers	Malaysia	*4.52 cm*	
Sears Tower	U.S.A.		*4.423 cm*
Jin Mao Tower	China	*4.205 cm*	

B. How would you express a scale or ratio of 1 cm for every one hundred meters as a ratio in which you only use centimeters? (Hint: You need to convert meters to centimeters.)
1 cm for every 100 meters
100 cm in a meter
100 x 100 = 10,000 cm in 100 meters
1 cm for every 10,000 cm
1:10,000

5. Using the scale of 1:192, determine what the dimensions would be for a model of your school or a model of your classroom. *(various answers)*

MINIATURE LAND: HANDOUT 6

Surface Area and Volume Practice Problems

Name: **Date:**

Formulas:

Surface Area (SA) of a Cube
s = side
$SA = 6s^2$

Surface Area (SA) of a Rectangular Prism
l = length, w = width, h = height
SA = 2lw + 2lh + 2wh

Volume (V) of a Cube
$V = s^3$

Volume (V) of a Rectangular Prism
V = lwh

1. You sometimes need to know the area of the interior walls of a house or a room, for example, when you're trying to determine the amount of paint or wallpaper you need to cover the walls. To calculate this area you need to first determine the area of the four walls, the area of the doors, and area of the windows. Next, you subtract the areas of the doors and windows from the walls. Using the chart from the interactive, determine the areas of the interior walls of the little house (LH) and big house (BH). (Remember, both houses have five windows.)

House of Scales

Measurement	LH	BH
Length (in)	3.0	30
Width (in)	3.0	30
Height (in)	3.0	30
Floor Area (in^2)	9.0	900
Door Width (in)	0.5	5
Door Height (in)	2.0	20
Door Area (in^2)	1.0	100
Window Width (in)	0.75	7.5
Window Height (in)	1.0	10
Window Area (in^2)	7.5	75
House Volume (in^3)	27	27000

2. Increase the dimensions of a 2-inch cube by four times.

Step 1: Find the length of the new sides.

Step 2: Find the surface area of the new cube.

Step 3: Find the volume of the new cube.

3. Decrease by 1/2 the dimensions of a rectangular box that has a length of 30 cm, a width of 12 cm, and a height of 8 cm.

Step 1: Find the new length, width, and height of the box.

Step 2: Find the surface area of the new box.

Step 3: Find the volume of the new box.

KEY: MINIATURE LAND: HANDOUT 6

Surface Area and Volume Practice Problems

Formulas:

Surface Area (SA) of a Cube
s = side
$SA = 6s^2$

Surface Area (SA) of a Rectangular Prism
l = length, w = width, h = height
$SA = 2lw + 2lh + 2wh$

Volume (V) of a Cube
$V = s^3$

Volume (V) of a Rectangular Prism
$V = lwh$

1. You sometimes need to know the area of the interior walls of a house or a room, for example, when you're trying to determine the amount of paint or wallpaper you need to cover the walls. To calculate this area you need to first determine the area of the four walls, the area of the doors, and area of the windows. Next, you subtract the areas of the doors and windows from the walls. Using the chart from the interactive, determine the areas of the interior walls of the little house (LH) and big house (BH). (Remember, both houses have five windows.)

House of Scales

Measurement	LH	BH
Length (in)	3.0	30
Width (in)	3.0	30
Height (in)	3.0	30
Floor Area (in^2)	9.0	900
Door Width (in)	0.5	5
Door Height (in)	2.0	20
Door Area (in^2)	1.0	100
Window Width (in)	0.75	7.5
Window Height (in)	1.0	10
Window Area (in^2)	7.5	75
House Volume (in^3)	27	27000

Little House

Area of 4 walls – Area of Door – Area of Window = Area of interior walls for painting

Area of 4 walls = 2(Height • Width) +2(Height • Length) = 2 (3 • 3) + 2 (3 • 3) = 18 + 18 = 36 in^2

Area of 4 walls – Area of Door – (Area of Window • 5) = Area of interior walls for painting
36 in^2 - 1 in^2 - (5 • 0.75 in^2) = 31.25 in^2

Big House

Area of 4 walls – Area of Door – Area of Window = Area of interior walls for painting

Area of 4 walls = 2(Height • Width) +2(Height • Length) = 2 (30 • 30) + 2 (30 • 30) = 18 + 18 = 1800 + 1800 = 3600 in^2

Area of 4 walls – Area of Door – (Area of Window • 5) = Area of interior walls for painting
3600 in^2 - 100 in^2 - 375 in^2 = 3125^2

2. Increase the dimensions of a 2-inch cube by four times.

Step 1: Find the length of the new sides.
Sides = 8 inches

Step 2: Find the surface area of the new cube.
SA = 384 in^2

Step 3: Find the volume of the new cube.
V = 512 in^3

3. Decrease by 1/2 the dimensions of a rectangular box that has a length of 30 cm, a width of 12 cm, and a height of 8 cm.

Step 1: Find the new length, width, and height of the box.
1 = 15 cm, w = 6 cm, and h = 4 cm

Step 2: Find the surface area of the new box.
SA = 348 cm^2

Step 3: Find the volume of the new box.
V = 360 cm^3

MINIATURE LAND: HANDOUT 7

Surface Area and Volume Homework Problems

Name: **Date:**

Formulas:

Surface Area (SA) of a Cube
s = side
$SA = 6s^2$

Surface Area (SA) of a Rectangular Prism
l = length, w = width, h = height
SA = 2lw + 2lh + 2wh

Volume (V) of a Cube
$V = s^3$

Volume (V) of a Rectangular Prism
V = lwh

1. A cube has sides that measure 4 cm. Complete the chart. Please show work on a separate sheet of paper.

	Side length	Surface area	Volume
Original cube	4 cm		
1/2 sides of original	2 cm		
1/4 sides of original	1 cm		
Increase sides 2 times	8 cm		
Increase sides 3 times	12 cm		
Increase sides 4 times	16 mm		

2. A rectangular prism has the following measurements: l = 15 inches, w = 9 inches, h = 6 inches. Complete the chart. Please show work on a separate sheet of paper.

	Length	Width	Height	Surface Area	Volume
Original figure	15 in	9 in	6 in		
1/3 each side	5 in	3 in	2 in		
2/3 each side	10 in	6 in	4 in		
2 times each side	30 in	18 in	12 in		
4 times each side	60 in	36 in	24 in		
6 times each side	90 in	54 in	36 in		

3. A miniature house has the following dimensions: l = 18 inches, w = 12 inches, and h = 14 inches. The windows in the house have a length of three inches and a width of two inches (the house has five windows). The doors in the house have a height of 10 inches and a width of 3 inches (the house has two doors). Using the dimensions, calculate the area of the interior walls of the house.

A. Determine the area of the walls.

Area of walls = 2 (length • height) + 2 (width • height)

2 (_____• _____) + 2 (_____• _____) = _____

B. Determine the area of the windows.

Length of window • width of window = area of window

_____ • _____ = _____ Number of windows is _____

Number of windows x area of window = total area of windows

_____ • _____ = _____

C. Determine the area of the doors.

Height of door • width of door = area of door

_____ • _____ = _____ Number of doors is _____

Number of doors • area of door = total area of doors

_____ • _____ = _____

D. Determine the area of the interior walls.

Area of walls – Area of windows – Area of doors = Area of interior walls

_____ - _____- _____= _____

KEY: MINIATURE LAND: HANDOUT 7

Surface Area and Volume Homework Problems

1. A cube has sides that measure 4 cm. Complete the chart. Please show work on a separate sheet of paper.

	Side length	Surface area	Volume
Original cube	4 cm	***96 cm^2***	***64 cm^3***
1/2 sides of original	2 cm	***24 cm^2***	***8 cm^3***
1/4 sides of original	1 cm	***6 cm^2***	***1 cm^3***
Increase sides 2 times	8 cm	***384 cm^2***	***512 cm^3***
Increase sides 3 times	12 cm	***864 cm^2***	***1,728 cm^3***
Increase sides 4 times	16 mm	***1,536 cm^2***	***4,096 cm^3***

2. A rectangular prism has the following measurements: l = 15 inches, w = 9 inches, h = 6 inches. Complete the chart. Please show work on a separate sheet of paper.

	Length	Width	Height	Surface Area	Volume
Original figure	15 in	9 in	6 in	***558 in^2***	***810 in^3***
1/3 each side	5 in	3 in	2 in	***62 in^2***	***30 in^3***
2/3 each side	10 in	6 in	4 in	***248 in^2***	***240 in^3***
2 times each side	30 in	18 in	12 in	***2,232 in^2***	***6,480 in^3***
4 times each side	60 in	36 in	24 in	***8,928 in^2***	***51,840 in^3***
6 times each side	90 in	54 in	36 in	***20,088 in^2***	***174,960 in^3***

3. A miniature house has the following dimensions: l = 18 inches, w = 12 inches and h = 14 inches. The windows in the house have a length of 3 inches and a width of 2 inches (the house has 5 windows). The doors in the house have length of 10 inches and a width of 3 inches (the house has 2 doors). Using the dimensions, calculate the area of the interior walls of the house.

A. Determine the area of the walls.
$2 (18 \cdot 14) + 2 (12 \cdot 14) = 504 + 336 = 840\ in^2$

B. Determine the area of the windows.
$3 \cdot 2 = 6$ Number of windows is *5* *$5 \cdot 6 = 30$* *$30\ in^2$ is total area of windows*

C. Determine the area of the doors.
$10 \cdot 3 = 30\ in^2$ Number of doors is *2* *$2 \cdot 30 = 60$* *$60\ in^2$ is total area of doors*

D. Determine the area of the interior walls.
$840\ in^2 - 30\ in^2 - 60\ in^2 = 750\ in^2$

MINIATURE LAND: HANDOUT 8

Scale of Planets

Name: **Date:**

In this worksheet, we'll be using data from our solar system to compare scale.

The sun's mean equatorial radius (the distance from its geometric center to the surface) is 695,500 km. The earth's mean equatorial radius is 6,378.14 kilometers.

1. How many times bigger is the sun than the earth? (Answer to four decimal places.)

2. The moon's equatorial radius is 1,737.4 kilometers. What is the decimal value of the ratio of the earth's radius to the moon's radius?

3. Determine the scale comparison of the planets given the following information and fill in the chart below. (Answer to four decimal places.)

Planet	Radius (km)	Scale Comparison to Earth	Ratio of Planet to Earth
Mercury	2,439.7	0.3825 • Earth	0.3825 to 1
Venus	6,051.8		
Earth	6,378.14		
Mars	3,397		
Jupiter	71,492		
Saturn	60,268		
Uranus	25,559		
Neptune	24,764		

4. How could you use the scale comparison to determine the size for models of planets in the solar system? Provide an example of how you could do the calculations.

Scale of Planets: Ball Models

Using your scale comparisons and rounding them to the nearest tenth place, choose one ball to represent Earth and select at least three other balls to represent three other planets on the same scale. You will not be able to provide exact models, but you should choose balls that represent the dimensional differences as well as possible.

Object	Diameter
Gumball	1 inch
Baseball	3 inches
Softball	4 inches
Tennis Ball	2.5 inches
Racquet Ball	2 1/4 inches
Ping Pong Ball	1.5 inches
Soccer Ball	8 inches
Basketball	9 inches
Beach Ball	12 inches, 16 inches
Exercise Ball	18 inches, 21 inches, 25 inches, 29 inches
Volleyball	8 inches
Marble	5/8 inch
Beads	3/16 inch, 1/2 inch
Playground Ball	6 inches, 10 inches, 8.5 inches
Giant Balls	36 inches, 40 inches

Object	Planet	Scale to Earth	Diameter
1.			
2.			
3.			
4.			

Scale of Planets: One to One Hundred Million

To create a two-dimensional scale model of the solar system in 1/100,000,000 scale:

First, determine how big the sun would be.

The sun's mean equatorial radius is 695,500 km.

695,500/100,000,000 = 0.006955 km

1 km = 1000 meters

0.006955 • 1000 = 6.955 meters

1 meter = 100 centimeters

6.955 • 100 = 695.5 centimeters

Diameter is twice the radius.

695.5 • 2 = 1391 centimeters

Size of Model Planets on a 1:100,000,000 Scale

(Fill in the chart below.)

Planet	Radius (km)	Radius (m)	Radius (cm)	Diameter (cm)
Mercury	0.000024397			
Venus	0.000060518			
Earth	0.00006378.14			
Mars	0.00003397			
Jupiter	0.00071492			
Saturn	0.00060268			
Uranus	0.00025559			
Neptune	0.00024764			

Based on the scale of 1/100,000,000, which model planets have a diameter that is less than the length of a pencil?

Which two planets are the closest in size?

Planets' Distances from the Sun on a 1:100,000,000 Scale

(Fill in the chart below.)

Planet	Distance from Sun (km)	1 to 100 million scale (km)	Miles km • 0.6214 (rounded to 4 decimal places)
Mercury	57,909,175		
Venus	108,208,930		
Earth	149,597,890		
Mars	227,936,640		
Jupiter	778,412,020		
Saturn	1,426,725,400		
Uranus	2,870,972,200		
Neptune	4,498,252,900		

What is the difficulty in setting up a scale model of the solar system that includes both distance from the sun and the diameters of planets on a 1 to 100 million scale?

Source: **solarsystem.nasa.gov/planets/charchart.cfm**

KEY: MINIATURE LAND: HANDOUT 8

Scale of Planets

In this worksheet, we'll be using data from our solar system to compare scale.

The sun's mean equatorial radius (the distance from its geometric center to the surface) is 695,500 km. The earth's mean equatorial radius is 6,378.14 kilometers.

1. How many times bigger is the sun's equatorial radius than the earth's? (Answer to four decimal places).
109.0443

2. The moon's equatorial radius is 1,737.4 kilometers. What is the decimal value of the ratio of the earth's radius to the moon's radius?
3.6711

3. Determine the scale comparison of the planets given the following information and fill in the chart below. (Answer to four decimal places.)

Size of Model Planets on a 1:100,000,000 Scale

Planet	Radius (km)	Scale Comparison to Earth	Ratio of Planet to Earth
Mercury	2,439.7	0.3825 • Earth	0.3825 to 1
Venus	6,051.8	*0.9488 • Earth*	*0.9488 to 1*
Earth	6,378.14	*1 • Earth*	*1 to 1*
Mars	3,397	*0.5326 • Earth*	*0.5326 to 1*
Jupiter	71,492	*11.2089 • Earth*	*11.2089 to 1*
Saturn	60,268	*9.4491 • Earth*	*9.4491 to 1*
Uranus	25,559	*4.0073 • Earth*	*4.0073 to 1*
Neptune	24,764	*3.8826 • Earth*	*3.8826 to 1*

4. How could you use the scale comparison to determine the size for models in the solar system? Provide an example of how you could do the calculations. *(various answers)*

Scale of Planets: Ball Models

Using your scale comparisons and rounding them to the nearest tenth place, choose one ball to represent Earth and select at least three other balls to represent three other planets on the same scale. You will not be able to provide exact models, but you should choose balls that represent the dimensional differences as well as possible.

Object	Diameter	Object	Diameter
Gumball	1 inch	Baseball	3 inches
Softball	4 inches	Tennis Ball	2.5 inches
Racquetball	2 1/4 inches	Ping Pong Ball	1.5 inches
Soccer Ball	8 inches	Basketball	9 inches
Beach Ball	12 inches, 16 inches	Exercise Ball	18 inches, 21 inches, 25 inches, 29 inches
Volleyball	8 inches	Marble	5/8 inch
Beads	3 1/6 inch, 1/2 inch	Playground Ball	6 inches, 10 inches, 8.5 inches
Giant Balls	36 inches, 40 inches		

Sample Answers:
Here are just a few possibilities. Many different answers are possible. If you would like to simplify this activity, you might tell students which ball to use for Earth, and then ask them to decide which balls might represent the other planets and why.

Object	Planet	Scale to Earth	Diameter
Gumball	*Earth*	*1 • 1*	*1 inch*
Bead	*Mars*	*1 • 1/2*	*1/2 inch*
Basketball	*Saturn*	*1 • 9*	*9 inches*
Softball	*Uranus*	*1 • 4*	*4 inches*

Object	Planet	Scale to Earth	Diameter
Baseball	*Earth*	*1 • 3*	*3 inches*
Ping Pong Ball	*Mars*	*0.5 • 3*	*1 1/2 inches*
Exercise Ball	*Saturn*	*9.5 • 3*	*29 inches*
Beach Ball	*Neptune*	*3.9 • 3*	*12 inches*

Object	Planet	Scale to Earth	Diameter
Playground Ball	*Earth*	*1 • 10*	*10 inches*
Softball	*Mercury*	*0.4 • 10*	*4 inches*
Basketball	*Venus*	*0.9 • 10*	*9 inches*
Giant Ball	*Neptune*	*3.9 • 10*	*40 inches*

Object	Planet	Scale to Earth	Diameter
Marble	*Earth*	*1 • 5/8*	*5/8 inches*
Bead	*Venus*	*0.9 • 5/8*	*1/2 inch*
Tennis Ball	*Uranus*	*4 • 5/8*	*2 1/2 inches*
Bead	*Mars*	*0.5 • 5/8*	*1/4 inch*

Object	Planet	Scale to Earth	Diameter
Softball	*Earth*	*1 • 4*	*4 inches*
Giant Ball	*Saturn*	*9 • 4*	*36 inches*
Rackquetball	*Mars*	*1/2 • 4*	*2 1/4 inches*
Beach Ball	*Uranus*	*4 • 4*	*16 inches*

Scale of Planets: One to One Hundred Million

To create a two-dimensional scale model of the solar system in 1/100,000,000 scale:
First, determine how big the sun would be.
The sun's mean equatorial radius is 695,500 km.
695,500/100,000,000 = 0.006955 km
1 km = 1000 meters
0.006955 • 1000 = 6.955 meters
1 meter = 100 centimeters
6.955 • 100 = 695.5 centimeters
Diameter is twice the radius.
695.5 • 2 = 1391 centimeters

Size of Model Planets on a 1:100,000,000 Scale

Planet	Radius (km)	Radius (m)	Radius (cm)	Diameter (cm)
Mercury	*0.000024397*	*0.024397*	*2.4397*	*4.8794*
Venus	*0.000060518*	*0.060518*	*6.0518*	*12.1036*
Earth	*0.00006378.14*	*0.0637814*	*6.37814*	*12.75628*
Mars	*0.00003397*	*0.03397*	*3.397*	*6.794*
Jupiter	*0.00071492*	*0.71492*	*71.492*	*142.984*
Saturn	*0.00060268*	*0.60268*	*60.268*	*120.536*
Uranus	*0.00025559*	*0.25559*	*25.559*	*51.118*
Neptune	*0.00024764*	*0.24764*	*24.764*	*49.528*

Based on the scale of 1/100,000,000, which model planets are smaller than the length of a pencil?
Mercury, Mars, Venus, and Earth

Which two planets are the closest in size?
Venus and Earth

Planets' Distances from the Sun on a 1:100,000,000 Scale

Planet	Distance from Sun (km)	1 to 100 million scale (km)	miles (km x .6214)
Mercury	57,909,175	*0.57909175*	*0.3598*
Venus	108,208,930	*1.08208930*	*0.6762*
Earth	149,597,890	*1.49597890*	*0.9296*
Mars	227,936,640	*2.27936640*	*1.4164*
Jupiter	778,412,020	*7.78412020*	*4.8371*
Saturn	1,426,725,400	*14.26725400*	*8.8657*
Uranus	2,870,972,200	*28.7097220*	*17.8402*
Neptune	4,498,252,900	*44.98252900*	*27.9521*

What is the difficulty in setting up scale models of the solar system using distance from the sun and the diameters of planets on a 1 to 100 million scale?

While the planet models are easy to create and view, the distance between the models makes it impossible to look at them all at once.

Source: **solarsystem.nasa.gov/planets/charchart.cfm**

MINIATURE LAND: HANDOUT 9

Game: Race to the Top of the Washington Monument

Note to teacher:
There are three sets of problems here: multiple choice, short answer, and true/false. There are 10 problems in each set. They have been written to use in the game or as additional assessment.

Object: To inch up the Washington Monument by correctly answering questions. The team that makes it to the top first wins.

Teacher Preparation: Measure a 38-inch area on the chalkboard or white board. Tape a meter stick with inch and metric measurements to the board. Draw a 38-inch tall obelisk beside the meter stick or ask a student to draw the obelisk.

Directions:

1. Divide students into teams of four. Each team will use one white board. If white boards are not available, laminated white paper and a white board marker will work. Each individual on the team will work each problem and compare answers. Each team will submit one answer per problem.

2. The teacher will use the overhead to post problems and allow a fair amount of time per question. Students are expected to quietly discuss answers and discreetly write their answers. The teacher will say "Show Your Answer" when it is time for a team to reveal their answer.

3. The Washington Monument is 605 feet tall. Using the architectural scale of 1:192, a scale model of the Washington Monument would be close to 38 inches tall. On the Washington Monument sketch, place marks for each inch. Each point will represent one inch of the scale model. It will probably be easiest to use tally points to keep up with team scores and compare progress up the monument after several questions.

4. The first team to earn 38 points wins. If you want to continue until all questions are answered, you can give another distinction for most points overall.

5. Allow students to use calculators. Some of the calculations are difficult.

Race to the Top of the Washington Monument
Multiple Choice Questions

1. The giant oak in town was 80 feet tall. The giant oak in the model railroad scene was about 4 5/8 inches tall. The scale used in the railroad scene was the
A. O Scale, 1:48
B. N Scale, 1:160
C. HO Scale, 1:187
D. Z Scale, 1:220

2. A mansion measures 80 by 200 feet. On a scale of 1:24, a model of the mansion would be
A. 4 by 10 feet
B. 3 2/3 by 9 2/3 feet
C. 3 1/3 by 8 1/3 feet
D. 2 1/2 by 6 1/2 feet

3. Lego builders commonly use a minifig scale of 1:48. On this scale, a rural post office building measuring 12 by 12 feet would be
A. 2 by 2 inches
B. 3 by 3 inches
C. 4 by 4 inches
D. 6 by 6 inches

4. One model building was four inches taller than all the other buildings. If the scale used was 1:192, the model building was actually
A. 48 feet taller than the rest
B. 64 feet taller than the rest
C. 192 feet taller than the rest
D. 768 feet taller than the rest

5. When comparing the volume of a 3-cm cube and a 6-cm cube, the volume of the 3-cm cube is
A. half the volume of the 6-cm cube
B. 1/3 the volume of the 6-cm cube
C. 1/4 the volume of the 6-cm cube
D. 1/8 the volume of the 6 cm cube

6. When comparing the surface area of a 3-cm cube and a 6-cm cube, the surface area of the 3-cm cube is
A. 54 cm^2 (the larger cube's surface area is 216 cm^2)
B. 36 cm^2 (the larger cube's surface area is 216 cm^2)
C. 27 cm^2 (the larger cube's surface area is 216 cm^2)
D. 9 cm^2 (the larger cube's surface area is 216 cm^2)

7. The most efficient formula for surface area of a cube is
A. $6s^2$
B. $2lw + 2lh + 2wh$
C. s^2
D. lwh

8. The most efficient formula to find the volume of a cube is
A. $6s^2$
B. $2lw + 2lh + 2wh$
C. s^3
D. lwh

9. The formula to find the surface area of a rectangular prism is
A. $6s^2$
B. $2lw + 2lh + 2wh$
C. s^3
D. lwh

10. The formula to find the volume of a rectangular prism is
A. $6s^2$
B. $2lw + 2lh + 2wh$
C. s^3
D. lwh

Race to the Top of the Washington Monument
Short Answer Questions

1. A school bus is 39.5 feet long. To order one for a model railroad scene on the HO Scale (1:187), how long should the school bus be? Answer to four decimal places.

2. 1/16 of an inch is used to represent each foot. How tall would the model representation of a 6-foot tall person be? Answer in simplest form.

3. A small collector car scale is 1:64. Using this scale, how long would a toy of a 9-foot electric car be? Answer to the nearest 1/16 of an inch.

4. If the ramp has a 14-inch rise and a run of 126 inches, what is the slope ratio, also called the rise over the run, in simplest terms?

5. A ramp with a rise of 15 inches and a run of 210 inches is planned for the new school. What is the ratio of the rise over the run for this ramp?

6. Under the building guidelines, the steepest slope allowed for an access ramp for a new building is 1:12. Would a slope of 1:15 be allowed for a new building?

7. Using the architectural scale of 1:192, how much taller would a model of Toronto's CN Tower be than a model of Shanghai's Oriental Pearl Tower?

Toronto CN Tower	553.33 meters
Shanghai Oriental Pearl Tower	468 meters to the spire

8. Chelsea is donating her dollhouse for a fundraising auction. She wants to add wallpaper to the living room. The living room is 12 inches deep, 10 inches wide, and 14 inches high. There is one door that is 9 inches by 3 inches. Two windows each measure 3 by 5 inches. The dollhouse living room has three walls and is open at the side of the width so you can see inside. What is the total surface area of the walls for wallpaper?

Area of Windows: 3 in × 5 in = _____ • 2 windows = _____

Area of Door: 9 in × 3 in = _____

Total square area of door and windows = _____

Area of wall one = 12 in × 14 in = _____

Area of wall two = 10 in × 14 in = _____

Area of wall three = 12 in × 14 in = _____

Total possible area of walls = _____

Total wall area – total square area of door and windows = _____

9. Sunny and Lena are mailing boxes full of T-shirts and school supplies to children in another country. Sunny's box is 5 inches by 3 inches by 3 inches. Lena's box is 10 inches by 6 inches by 6 inches. How many times greater is the volume of Lena's box than the volume of Sunny's box?

10. Sunny's box is 3 inches by 3 inches by 5 inches. Lena's box is 6 inches by 6 inches by 10 inches. How many times greater is the surface area of Lena's box than the surface area of Sunny's box?

Race to the Top of the Washington Monument
True or False Questions

1. True or False: Calculating volume will tell you how much wrapping paper you need for a box.

2. True or False: The following scales are equal:
1/2 inch for every foot 1:24

3. True or False: Two ratios are proportional if the decimal values of the ratios are equal.

4. True or False: The following are equal:
1/64 1/4 inch for every foot

5. True or False: If you are creating a model of the Empire State Building in limited space, 1:24 is a better scale than 1:192.

6. True or False: On a scale of 1:12, three inches of a model represent two feet of the actual object.

7. True or False: The Great Pyramid stands 449.5 feet high. Using a 1:24 scale, a model of the Great Pyramid would be 18 feet 8 3/4 inches tall.

8. True or False: You can use the formulas for surface area and volume of a rectangular prism for a cube.

9. True or False: If the length, width, and height are three times greater for a larger box, then the volume will be three times the volume of the smaller box.

10. True or False: There are two cubes. One cube's edges are four times as long as the edges of the other cube. The surface area of the larger cube will be four times the surface area of the smaller cube.

KEY: MINIATURE LAND: HANDOUT 9

Race to the Top of the Washington Monument

KEY Multiple Choice Questions

Point Value for Game
Questions 1-3: 2 points
Questions 4-5: 3 points
Question 6: 2 points
Questions 7-10: 1 point

Answer Key

1. *D,* **2.***C,* **3.** *B,* **4.** *B,* **5.** *D,* **6.** *A,* **7.** *A,* **8.** *C,* **9.** *B,* **10.** *D*

KEY Short Answer Questions

2 points
1. A school bus is 39.5 feet long. To order one for a model railroad scene on the HO Scale (1:187), how long should the school bus be? Answer to four decimal places.
2.5348 inches

2 points
2. 1/16 of an inch is used to represent each foot. How tall would the model representation of a 6-foot tall person be? Answer in simplest form.
3/8 inch or 0.375 inches

2 points
3. A small collector car scale is 1:64. Using this scale, how long would a toy of a 9-foot electric car be? Answer to the nearest 1/16 of an inch.
1 and 11/16 inches

2 points
4. If a ramp has a 14-inch rise and a run of 126 inches, what is the slope ratio, also called the rise over the run, in simplest terms?
1:9

2 points
5. A ramp with a rise of 15 inches and a run of 210 inches is planned for the new school. What is the ratio of the rise over the run for this ramp?
1/14 or 1:14

KEY Short Answer Questions (continued)

1 point

6. Under the building guidelines, the steepest slope allowed for an access ramp for a new building is 1:12. Would a slope of 1:15 be allowed for a new building?

Yes. 1:12 is the steepest allowable slope in a new building. A less steep slope is acceptable. 1:15 is less steep than 1:12.

3 points

7. Using the architectural scale of 1:192, how much taller would a model of Toronto's CN Tower be than a model of Shanghai's Oriental Pearl Tower?

Toronto CN Tower	553.33 meters	*2.882 meters*
Shanghai Oriental Pearl Tower,	468 meters to the spire	*2.4375 meters*

0.4445 meters

4 points

8. Chelsea is donating her dollhouse for a fundraising auction. She wants to add wallpaper to the living room. The living room is 12 inches deep, 10 inches wide, and 14 inches high. There is one door that is 9 inches by 3 inches. Two windows each measure 3 by 5 inches. The dollhouse living room has three walls open at the side of the width. What is the total surface area of the walls for wallpaper?

Area of Windows: 3 in × 5 in = *15 in^2* × 2 windows = *30 in^2*
Area of Door: 9 in • 3 in = *27 in^2*
Total square area of door and windows = *57 in^2*
Area of wall one = 12 in × 14 in = *168 in^2*
Area of wall two = 10 in × 14 in = *140 in^2*
Area of wall three = 12 in × 14 in = *168 in^2*
Total possible area of walls = *476 in^2*
Total wall area – total square area of door and windows = *476 in^2 – 57 in^2 = 419 in^2*

3 points

9. Sunny and Lena are mailing boxes full of T-shirts and school supplies to children in another country. Sunny's box is 5 inches by 3 inches by 3 inches. Lena's box is 10 inches by 6 inches by 6 inches. How many times greater is the volume of Lena's box than the volume of Sunny's box?

Volume of Sunny's box = 45 in^3
Volume of Lena's box = 360 in^3
360 ÷ 45 = 8
The volume of Lena's box is eight times greater than the volume of Sunny's.

3 points

10. Sunny's box is 3 inches by 3 inches by 5 inches. Lena's box is 6 inches by 6 inches by 10 inches. How much greater is the surface area for Lena's box than the surface area of Sunny's box?

Surface area of Sunny's box = 78 in^2
Surface area of Lena's box = 312 in^2
312 ÷ 78 = 4
The surface area of Lena's box is four times greater than the surface area of Sunny's box.

KEY True or False Questions

1 point

1. True or False: Calculating volume will tell you how much wrapping paper you need for a box.

False. Calculating surface area will tell you how much wrapping paper you need for a box. Calculating volume will tell you how much the box will hold.

2 points

2. True or False: The following scales are equal;

1/2 inch for every foot 1:24

True. Write in all inches (1/2)/[(1 foot) • 12 inches/foot] = 0.5/12
Is 0.5/12 equal to 1:24 or 1/24?
a = 0.5, b = 12, c = 1, d = 24
0.5/12 = 1/24
Test by the definition for a proportion a/b = c/d if ad = bc
(0.5)24 = 12 (1)
12 = 12
Since ad is equal to bc, these scales are equal.

1 point

3. True or False: Two ratios are proportional if the decimal values of the ratios are equal.

True. The decimal value of the ratios is determined by dividing the numerator by the denominator when the ratio is written as a fraction.

2 points

4. True or False: The following are equal:

1/64 1/4 inch for every foot

False. 1/64 is not equal to (1/4 inch or 0.25 inches)/[(1 foot) • (12 inches/foot)]
a = 1, b = 64, c = 0.25, d = 12 inches
1/64 = 0.25/12 inches if ad = bc
1 • 12 = 64 • 0.25
12 is not equal to 16 so these two ratios are not equal.
1/64 is equal to 1/4 inch for every 16 inches.

2 points

5. True or False: If you are creating a model of the Empire State Building in limited space, 1:24 is a better scale than 1:192.

False. 1:24 of the Empire State Building would be very large (1472 feet ÷ 24 or 61.333 feet tall). The 1:192 model would be 7 feet 8 inches tall.

2 points

6. True or False: On a scale of 1:12, three inches of a model represent two feet of the actual object.

False. 24 inches = 2 feet
2 inches/24 inches simplifies to 1:12
3 inches/24 inches simplifies to 1:8

KEY True or False Questions (continued)

2 points

7. True or False: The Great Pyramid stands 449.5 feet high. Using a 1:24 scale, a model of the Great Pyramid would be 18 feet 8 3/4 inches tall.

True. 449.5/24 = 18.729167 Convert 0.729167 to inches by multiplying by 12.

1 point

8. True or False: You can use the formulas for surface area and volume of a rectangular prism for a cube.

True. You will get the correct answer if you use the formulas for surface area and volume for rectangular prisms on a problem with a cube. But your computation will not be as efficient as if you had used the formulas for cubes.

1 point

9. True or False: If the length, width and height are each three times greater for a larger box, then the volume will be three times the volume of the smaller box.

False. The volume will be more than three times greater. It will be 27 times as great.

1 point

10. True or False: There are two cubes. One cube's edges are four times the edges of the other cubes. The surface area of the larger cube will be four times the surface area of the smaller cube.

False. Each edge is multiplied by four, so the larger cube is actually much more than four times larger and has a surface area that is 16 times as large.

Surface Area $= 6s^2$

Surface Area$= 6(4s)^2$