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# What is Measurement? [8th grade]

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# UNDERSTANDING BY DESIGN

## Unit Cover Page

**Unit Title: What is Measurement?**

**Grade Level: 8th**

**Subject/Topic Area(s): Math**

**Designed By: Catherine Risinger**

**Time Frame: 11 days (45 minute periods)**

**School District (One Designer): North East Independent School District**

**School: Frank Tejada Middle School**

**School Address and Phone:**

**2909 East Evans Rd.  
San Antonio, TX 78259  
(210)482-2260**

### Brief Summary of Unit (Including curricular context and unit goals):

In this 8<sup>th</sup> grade unit, students will bridge their understanding of measurement from 7<sup>th</sup> grade Math to a new level which is required for the further development of Mathematical Skills. Students will gain a better understanding on the needed skills when solving for both direct and indirect measurement.

Through the performance assessment students will design in small groups a 4,000 square foot home. Not only will students complete a scale drawing of their design they will also be building their design as well. This allows students to appreciate the amount of details that are required in the buildings that we look at and go into on a daily basis.

Overall, students will understand that there are multiple ways to represent measurement and that measurement is standardized. With measurement being standardized, students will come to appreciate that multiple professions use measurement. This is why we are able to appreciate many of the luxuries we engage ourselves in on a daily basis. This unit on measurement allows students to demonstrate their ability to set up proportional relationships, convert from one set of units to another and to both find and make comparisons of directly and indirectly measured objects.

# Unit: What is Measurement?

## Grade: 8<sup>th</sup> Grade

### Stage 1: Desired Results

#### Understandings

*Students will understand that...*

- *There are multiple ways to represent measurement*
- *Measurement is standardized*
- *The use of measurement is not confined to the math classroom it extends into other professions*

*Students will know...*

- *Key Terms – conversion factor, cross products, dilation, indirect measurement, measurement, proportions, similar, similar figures, similar solids, simplify, substitute, unit rate, unit conversion, variable*
- *Scale models and/or drawings are constructed through dilations*

*Students will be able to...*

- *Appropriately convert from one set of units to another*
- *Appropriately set up proportional relationships*
- *Make comparisons and find dimensions of scale drawings, models, and actual objects*

#### Essential Questions

- Why is measurement standard?
- What is the value of measurement?
- Metric system or customary system?
- How does what we measure influence how we measure?

#### Knowledge & Skill

*(NEISD scope & sequence; TEKS; Core; etc.)*

- All students will use appropriate operations to solve problems involving rational numbers in problem situations (TEK 8.2B)
- All students will use multiplication by a constant factor (unit rate) to represent proportional relationships (TEK 8.2D)
- All students will generate similar figures using dilations including enlargements and reductions (TEK 8.6A)
- Students will use geometric concepts and properties to solve problems in fields such as art and architecture (TEK 8.7B)
- All students use indirect measurement to solve problems (TEK 8.9)

### Stage 2: Assessment Evidence

Performance Task:

- You are an architect and your company has just been contacted by a famous couple that they want to build a home in the Stone Oak area. They contacted you because rumor has it that your company is the best architect firm in San Antonio. They would like your company to design a 4,000 square foot home that can be used as a summer home.
- In small groups your job is to design a home that must include at least a kitchen, 2.5 bathrooms, 2 car garage, 3 bedrooms, and a living room. If you wish to add more rooms then you are able to do so. (You may add additional bedrooms, bathrooms, a game room, a 3<sup>rd</sup> garage door, family room, dining room, breakfast nook, loft, library, closets, etc.)
- The group has just finished the design of the house and your clients love the current floor plan. They like the floor plan so much that they now want to see it as a scale model. Your groups' task is to now create a scale model of the design and present it to them when they come in to town in the upcoming month.

Other evidence:

(quizzes, tests, academic prompts, etc. note – these are usually included where appropriate in Stage 3 as well)

- Quiz
- Vocabulary quiz
- Exit slips
- Test

## Stage 3: Learning Activities

(Steps taken to get students to answer Stage 1 questions and complete performance task)

*Class Schedule: Everyday with 45 minute classes*

### Day 1: Introduction

- Provide a large piece of butcher paper posted to the board. In the center of the paper write “What is *measurement*?”
- Explain to students that they will be doing a silent chalk talk as a class. Give students about 5-10 minutes to engage in the chalk talk.
- Once completed come back as a class and begin a discussion on what students have written on the butcher paper.
- Begin an introduction of the concept of similar figures. Explain the definition of *similar*, *similar figures*, and *similar solids*.
- On an overhead begin displaying figures, shapes, and solids.
- Discuss with students “What makes these figures and shapes similar or not similar?”
- The teacher will pick out a comic strip or poster. Divide the comic strip into appropriately sized squares. (This must be completed prior to the beginning of class)
- Do not show the students the comic strip as a whole simply explain the activity and goal of their work.
- Pass out to each student a blank 2x2 *inch* square which is labeled with its location of where it will be when it is pieced back together.
- Now give each student a 1x1 *inch* square (make it an appropriate size that fits your class size).
- Explain to students that it is their job to recreate the piece they were given fully colored. If time permits, have students begin to recreate the smaller square on the provided 2x2 inch square in class. Students will be given tonight and the following night to complete their 2x2 inch square.

### Day 2: Proportions

- Check in with students on their progression from the previous days work.
- Using the same shapes, figures, and solids from the previous day, now have numbers and missing numbers attached to each of the shapes, figures, and solids.
- Explain to students that they can determine if figures are truly similar or not, through the use of proportions.
- Go over with students “What are *proportions*?” and incorporate the definition in so that students can associate and understand the meaning.
- As a teacher directed lesson begin having students practice the process of setting up proportions based on the provided examples from yesterday’s class.
- Once students display the ability to set up proportions with all the information provided, display an example that is now missing a number.
- Using what students know from setting up proportions when all the information is

provided, ask students to try to set up a proportion when there is a missing number.

- Based on how students set up the proportion, introduce the term “*variable*” and how it can be placed where there is a missing number. Explain to students what a variable is and its use in math.
- Continue to practice setting up proportions. Once students are able to set up proportions correctly, now show students how to solve the proportion by *substituting* a variable in for the missing number, *cross products* and *simplifying*.
- Give each student a worksheet with practice problems. Guide students and work as a whole group for the first couple of problems, and then slowly let students begin to solve the proportions with variables on their own.
- Before students will be dismissed from class they will complete an exit slip of what they learned today.
- Homework: Finish enlarged picture. The 2x2 inch square needs to be completed (Drawn out and colored)

### Day 3: Unit Conversions

- Begin class by having students turn in their completed square piece. As students turn in their piece, begin piecing each square together in order to reveal the hidden picture.
- Once the picture is complete, discuss with students what happened and reveal at the same time the original comic strip. Discuss with students that they dilated a picture.
- Have students come up with their own explanation of what dilation is.
- Explain and define to students what *dilation* is and give a concrete example of dilation that they can relate to, for example going to the eye doctor and getting your eye dilated with drops or looking at a cat’s eye, etc.
- After the discussion, take the pieced together comic strip and ask students to measure both the original comic strip and the newly dilated comic strip.
- After both comic strips have been measured, ask students to individually set up a proportion. Once the proportion is set up ask students to take an estimated guess, “How many times bigger is the new comic strip?”
- When students have guessed, ask students, “What are *conversion factors*?”
- Have students respond and then explain and define what conversions are.
- Ask students, “Can we determine how many times bigger the larger comic strip is?” Explain to students that in order to find out how many times larger the comic strip is, we must convert because of the *units* (inches versus feet)
- Pass out a worksheet and have students begin to fill in an equivalency table that they will use and keep for further use throughout the school year. (It would be helpful to copy this worksheet on colored cardstock/paper, in order to prevent student loss.)
- Go over with student’s their Units of Measurement Worksheet of basics they should know and will know. (Examples: 12 inches=1 foot, 1 yard=3 feet, 2.54 centimeters = 1 inch, etc.) Make sure to distinguish between metric and customary since your worksheet will distinguish between the two.
- For the rest of the measurements that students do not already know, explain to them that you can convert from one unit to another by multiplying a given measure by the corresponding conversion factor or essentially setting up several proportions. Fill in the rest of the Units of Measurement worksheet.
- Show students and explain the process of converting units.
- Pass out the teacher created unit conversion worksheet and guide students through steps to solve these problems. Include several examples in order to help students understand conversions.

- Check in with students and have them ask questions when clarification is needed.
- When students feel comfortable with this idea inform students that they are now to measure in small groups the dimensions of the classroom they are currently in.
- When the classroom is measured, have students convert the room dimensions from feet to yards and from feet to inches.
- Assign the homework assignment for the evening in order to prepare for upcoming performance assessment. The homework assignment is for students to design their ideal/coolest bedroom. The teacher will provide the grid paper in order to aid in the planning of their ideal bedroom. Students are expected to draw out their room.

#### **Day 4: Indirect Measurement**

- Begin class by asking a few students to volunteer and share their ideal/coolest bedroom design with the class. (\*\*If you have an Elmo projector then display student work and have students explain their work.) Once students have finished sharing steer the conversation back to the comic strip dilation.
- \*\*Prior to class you will have placed both comic strips side by side so that you will be able to create two triangles.
- Have two students come up and measure the triangle created. Students will call out the measurements using feet.
- Pose the following question to students: “Have you ever wondered how tall a tree is based upon the length of your shadow?” Ask students if there is any way you can figure out how tall it is.
- List student’s suggestions on the board in order to organize their thought process.
- Walk students through the process of setting up these situation problems. Being that the set up will simply be another proportion there should not be much needed extra practice.
- Give students 1 or 2 more examples that involve application problems and solve. When that is complete proceed to the activity.
- Activity A: As a class proceed outside and have students measure you and a flagpole/tree. The student’s goal is to figure out the height of the flagpole. Once that has been completed, allow students to get into small groups and figure out the height to other objects that are around the school grounds.

*Or*

- Activity B: As a class try to determine the height of the ceiling in the classroom based on your teachers shadow. Once the height has been determined, then checks to see if you will get the same result by using student’s heights. This will prove to students the usefulness of proportions to application problems.
- Explain to students that tomorrow they will be going to the computer lab in order to prepare them for their performance assessment. In the meantime for homework students will solve application problems using proportions with the provided worksheet.

#### **Day 5: Scale Drawings & Models**

- Have students meet the teacher at the computer lab.
- Begin the lesson by showing students a model airplane and an image of a Boeing 747 airplane (or some other airplane). Ask students, “Is it better to build an airplane its actual size first or a downsized version?” Hold a brief discussion with students on their thoughts.
- Explain to students why objects are scaled when they are built and that proportions can be used in order to solve problems that deal with real objects.
- Solve some examples and talk about mapmaking as well. Give an example of a map and show students a map of the southwest and San Antonio. Hold a short discussion on maps

versus the real thing.

- When the discussion has finished hand out the performance assessment and rubric to students.
- Explain to students that they will be given the remaining class time to search and look at floor plans by different home builders; websites will be provided in order to eliminate the time used to search and find floor plans. (If able to do so, attach the website list to your teacher web page.)
- Once they have completed their floor plan search, students will get into their small groups and begin to use the rest of the class period to design the floor plan.

#### **Day 6: Performance Assessment: Floor Plan**

- Students will come to class and get into their small groups and begin working on their design.
- Teacher will walk around and monitor student progress.
- By the end of today students should be finished or almost finished with the floor plan of their home. If time permits, they may begin working on building their scale model.

#### **Day 7: Performance Assessment**

- Students will come to class, get in their groups, and begin working on their scaled model.
- Teacher will provide poster board, giant grid paper, construction paper, etc. Students are more than welcomed to bring in their own supplies as well.
- Teacher will continue to monitor student progress throughout the class period.

#### **Day 8: Performance Assessment**

- Students will come to class, get in their groups, and begin working on their scaled model.
- Teacher will continue to monitor student progress.

#### **Day 9: Performance Assessment**

- Students will come to class, get in their groups, and begin working on their scaled model.
- Notify students that tomorrow will be their final day to build their scale models in class
- Teacher will continue to monitor student progress

#### **Day 10: Performance Assessment**

- Groups will ask a team member to pick a number out of a hat. The number will represent the order in which their groups will present tomorrow.
- Groups will continue to work on projects the remainder of class and prepare for their presentation tomorrow.
- Teacher will continue to monitor group progress.

#### **Day 11: Presentations**

- Students will sit together as groups in preparation for their presentation.
- After each group presents students will provide positive comments on their provided comment sheet.
- Groups will turn in their scale model and original scale drawing which will be reviewed by the teacher.
- When all groups have finished and comment sheets have been turned in the class will complete another chalk talk with the same question, "What is measurement?"

## Home Design Performance Assessment

### **Background Information:**

- You are an architect and your company has just been contacted by a famous couple that they want to build a home in the Stone Oak area. They contacted you because rumor has it that your company is the best architect firm in San Antonio. They would like your company to design a 4,000 square foot home that can be used as a summer home.

### **Task:**

- Your company' job is to design a 4,000sq ft home that must include at least a:
  - Kitchen
  - 2.5 Bathrooms
  - 2 Car Garage
  - 3 Bedrooms
  - Living room.
  - \*\*If you wish to add more rooms then you are able to do so. (You may add additional bedrooms, bathrooms, a game room, a 3<sup>rd</sup> garage door, family room, dining room, breakfast nook, loft, library, closets, etc.)
- The group has just finished the design of the house and your clients love the current floor plan. They like the floor plan so much that they now want to see it as a scale model. Your groups' task is to now create a scale model of the design and present it to them when they come in to town in the upcoming month.

### **You will be assessed on the following:**

- Preparedness
- Scale drawing on graph paper
- Scale model built
- Labeling of rooms and dimensions
- Accuracy of desired square footage
- Group Work
- Group Presentation

### **Time Frame:**

- Day 1 – Go to computer lab and search/look at floor plans
- Day 2 – Design scale drawing/floor plan
- Day 3 – Begin building scale model
- Day 4 – Continue working on scale model
- Day 5 – Continue working on scale model
- Day 6 – Finish building scale model
- Day 7 – Make presentation to clients



# Home Design Rubric

Category	4	3	2	1
<b>Preparedness</b>	Brings needed materials to class and is always ready to work.	Almost always brings needed materials to class and is ready to work.	Almost always brings needed materials but sometimes needs to settle down and get to work	Often forgets needed materials or is rarely ready to get to work
<b>Scale Drawing</b>	Drawing is neat with clear measurements and labeling for all components	Drawing is neat with clear measurements and labeling for most components	Drawing provides clear measurements and labeling for most components	Plan does not show measurements clearly or is otherwise inadequately labeled
<b>Scale Model</b>	Model is neat with clear measurements and labeling for all components	Model is neat with clear measurements and labeling for most components	Model provides clear measurements and labeling for most components	Model does not show measurements clearly or is otherwise inadequately labeled
<b>Labeling of rooms &amp; dimensions</b>	At least 90% of the items are labeled and located correctly.	80-89% of the items are labeled and located correctly.	79-70% of the items are labeled and located correctly.	Less than 70% of the items are labeled and located correctly.
<b>Accuracy of desired square footage</b>	90-100% of the total dimensions equal the desired square footage	Almost all (85-89%) of the total dimensions equal the desired square footage	Most (75-84%) of the total dimensions equal the desired square footage.	Less than 75% of the total dimensions equal the desired square footage
<b>Group Work</b>	Student was an engaged partner, listening to suggestions of others and working cooperatively throughout project.	Student was an engaged partner but had trouble listening to others and/or working cooperatively.	Student cooperated with others, but needed prompting to stay on-task.	Student did not work effectively with others.
<b>Group Presentation</b>	Group is organized and all group members participate	Group is somewhat organized and all members participate	Group is organized except one member does not participate	Group is unorganized and not all members participate
<b>Total Points</b>	_____	_____	_____	_____

**Final Score:**      \_\_\_\_\_ / 28 =      \_\_\_\_\_ %

# **Vocabulary List – *What is Measurement?* Unit**

**Conversion factor** –

**Cross products** –

**Dilation** –

**Indirect measurement** –

**Measurement** –

**Proportions** –

**Similar** –

**Similar figures** –

**Similar solids** –

**Simplify** –

**Substitute** –

**Unit rate** –

**Unit conversion** –

**Variable** –

## **Vocabulary List – What is Measurement? Unit**

**Conversion factor** – 1) a numerical factor used to multiply or divide a quantity when converting from one system of units to another; 2) factor by which a quantity that is expressed in one set of units must be multiplied in order to convert it into another set of

**Cross products** – a method used to solve proportions and test whether ratios are equal

**Dilation** – a transformation where the original figure and its image are similar

**Indirect measurement** – the use of proportions and similar triangles to measure distances that would be difficult to measure directly

**Measurement** – the process of assigning a number to a physical property (Measurement includes length, size, area, volume, mass, time, etc.)

**Proportions** – an equation stating that two ratios are equal

**Similar** – figures with the same shape but not necessarily the same size are similar

**Similar figures** – having the same shape but not necessarily the same size

**Similar solids** – two solids are similar if they have the same

**Simplify** – to write a fraction or expression in simplest form

**Substitute** – to replace a variable with a number or another expression in an algebraic expression

**Unit rate** – a rate in which the second quantity in the comparison is one unit (Example: 10cm per minute)

**Unit conversion** – the process of changing one unit of measure to another

**Variable** – a letter or other symbol that represents a number or set of numbers in an expression or equation

## **Designing the Ideal/Coollest Bedroom Homework**

### Assignment:

- 1) Draw the layout of your current bedroom on one side of the provided graph paper. Make sure to include your bed, placement of your closet(s), door(s), window, bathroom (if you have one), desk, television, lamps, etc.
- 2) On the other side of the graph paper, now design what your ideal/coolest room would look like. You are free to include anything you like. Try to keep in mind if you include a pool or something big in your room it should **not** be the same size of your bed unless that is your intention. Have fun with the idea of trying to design the room you want. All details and decisions are left up to you.

\*\*For both layouts you can be as detailed as you wish, and if you choose to design it in color you may do so as well.

### Expectation:

- You are expected to turn this in on the day it is due, include your name, class period, and be ready to present it to the class
- In order to get full credit you must have drawn your current room labeled and the room you would like to have.



## **Designing the Ideal/Coollest Bedroom Homework**

### Assignment:

- 3) Draw the layout of your current bedroom on one side of the provided graph paper. Make sure to include your bed, placement of your closet(s), door(s), window, bathroom (if you have one), desk, television, lamps.
- 4) On the other side of the graph paper, now design what your ideal/coolest room would look like. You are free to include anything you like. Try to keep in mind if you include a pool or something else bigger in your room it should not be the same size of your bed unless that is your intention. Have fun with the idea of trying to design the room you want. All details and decisions are left up to you.

\*\*For both layouts you can be as detailed as you wish, and if you choose to design it in color you may do so as well.

### Expectation:

- You are expected to turn this in on the day it is due, include your name, class period, and be ready to present it to the class

- In order to get full credit you must have drawn your current room labeled and the room you would like to have labeled as well.

# Website List

## Home Builders Websites:

- [Armadillo Homes](#)
- [Centex Homes](#)
- [DR Horton](#)
- [Fieldstone Homes](#)
- [KB Homes](#)
- [Legacy Homes](#)
- [Medallion Homes](#)
- [Newmark Homes](#)
- [Perry Homes](#)
- [Pulte Homes](#)
- [Ryland Homes](#)
- [Sitterle Homes](#)
- [Standard Pacific Homes](#)
- [Wilshire Homes](#)

## Measurement Websites:

- [Measure 4 Measure](#) – a collection of interactive websites that measure for you
- [How Many](#) – a dictionary of units of measurement
- [Online Conversion.com](#)
- [Fun Brain](#) – Measurement games for students based on difficulty levels
- [Measurement](#) – a fun interactive website to help students measure

Name: \_\_\_\_\_  
Period: \_\_\_\_\_

## Proportions Worksheet

**Directions:** Tell whether or not the following proportions are equal or not equal to one another through cross products. Be sure to show all steps and box your answers.

*Example:*  $\frac{4}{6} = \frac{10}{14}$   
 $4 \times 14 = 6 \times 10$       *Write the cross products*  
 $56 \neq 60$                       *Simplify*

---

1.  $\frac{6}{9} = \frac{4}{6}$

2.  $\frac{15}{20} = \frac{5}{7}$

3.  $\frac{7}{12} = \frac{17.5}{30}$

---

4.  $\frac{2}{3} = \frac{10}{20}$

5.  $\frac{25}{80} = \frac{5}{16}$

6.  $\frac{4}{7} = \frac{20}{25}$

---

7.  $\frac{2}{3} = \frac{12}{18}$

8.  $\frac{5}{2} = \frac{35}{14}$

9.  $\frac{3}{4} = \frac{12}{15}$

---

10.  $\frac{1}{6} = \frac{9}{56}$

11.  $\frac{4}{5} = \frac{12}{15}$

12.  $\frac{6}{7} = \frac{23}{28}$

Name: \_\_\_\_\_  
Period: \_\_\_\_\_

## Proportions Worksheet (Key)

**Directions:** Tell whether or not the following proportions are equal to or not equal to one another through cross products. Be sure to show all steps and box your answers.

*Example:*  $\frac{4}{6} = \frac{10}{14}$   
 $4 \times 14 = 6 \times 10$   
 $56 \neq 60$       *Write the cross products*  
*Simplify*

---

1.  $\frac{6}{9} = \frac{4}{6}$   
 $6 \times 6 = 9 \times 4$   
 $36 = 36$

YES

2.  $\frac{15}{20} = \frac{5}{7}$   
 $15 \times 7 = 20 \times 5$   
 $105 \neq 100$

NO

3.  $\frac{7}{12} = \frac{17.5}{30}$   
 $7 \times 30 = 12 \times 17.5$   
 $210 = 210$

YES

---

4.  $\frac{2}{3} = \frac{10}{20}$   
 $2 \times 20 = 3 \times 10$   
 $40 \neq 30$

NO

5.  $\frac{25}{80} = \frac{5}{16}$   
 $25 \times 16 = 80 \times 5$   
 $400 = 400$

YES

6.  $\frac{4}{7} = \frac{20}{25}$   
 $4 \times 25 = 7 \times 20$   
 $100 \neq 140$

NO

---

7.  $\frac{2}{3} = \frac{12}{18}$   
 $2 \times 18 = 3 \times 12$   
 $36 = 36$

YES

8.  $\frac{5}{2} = \frac{35}{14}$   
 $5 \times 14 = 2 \times 35$   
 $70 = 70$

YES

9.  $\frac{3}{4} = \frac{12}{15}$   
 $3 \times 15 = 4 \times 12$   
 $45 \neq 48$

NO

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10.  $\frac{1}{6} = \frac{9}{56}$   
 $1 \times 56 = 6 \times 9$   
 $56 \neq 54$

NO

11.  $\frac{4}{5} = \frac{12}{15}$   
 $4 \times 15 = 5 \times 12$   
 $60 = 60$

YES

12.  $\frac{6}{7} = \frac{23}{28}$   
 $6 \times 28 = 7 \times 23$   
 $168 \neq 161$

NO



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