

Math by Design
Lesson Plan: Proportional Reasoning

National Standard: <u>Measurement</u> : Apply appropriate techniques, tools, and formulas.../solve problems involving scale factors, using ratio and proportion
MD Standard 2: <u>Knowledge of Measurement</u>
MD Topic C: Applications in Measurement
MD Indicator 2: Analyze measurement relationships
MD Objective a: Use proportional reasoning to solve measurement problems
Materials and/or Set Up: Equipment to project several clip art pictures and manipulate their sizes, graph paper, several examples of pairs of proportional rectangles
Relevant Vocabulary: Ratio, proportion, cross products
Note to Teacher: This lesson is designed to be used in conjunction with the online interactive activity at http://mathbydesign.thinkport.org .
Suggested Activities: <ul style="list-style-type: none">▪ Most students are familiar with resizing pictures on a computer. Use a clip art picture to demonstrate stretching from side to side or from top to bottom and compare those results with stretching from the corner so the both dimensions change together. (<i>See examples below.</i>) Facilitate a discussion about which demonstration maintains the characteristics of the original picture and introduce the concept of proportions.  ▪ Transition to the use of a geometric figure such as a rectangle. Draw rectangles on graph paper making several pairs of proportional ones and several extras. Ask the students to identify the pairs of rectangles that are proportional to one another. Compare the measures of the lengths and widths of the proportional rectangles by writing ratios. Lead students to the conclusion that the ratios of the widths to the lengths of the sides of proportional rectangles are equal and introduce the definition of a proportion.

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- Demonstrate finding the cross products to determine whether or not a proportion is true or correct. Provide the students with practice in identifying true or correct proportions.
- Pose the following problem: Suppose you have a rectangle that has dimensions of 5 inches by 8 inches. You want to make a larger rectangle that maintains the proportion. If the larger rectangle needs to be 25 inches wide, how long should it be? Facilitate a discussion about how to use the cross products to determine the missing measurement. Be sure that the students understand that there are several equivalent proportions that will produce the correct results. (See the examples below.)

$\frac{W_1}{L_1} = \frac{W_2}{L_2}$	$\frac{L_1}{W_1} = \frac{L_2}{W_2}$	$\frac{W_1}{W_2} = \frac{L_1}{L_2}$	$\frac{W_2}{W_1} = \frac{L_2}{L_1}$
$\frac{5 \text{ in}}{8 \text{ in}} = \frac{25 \text{ in}}{n \text{ in}}$	$\frac{8 \text{ in}}{5 \text{ in}} = \frac{n \text{ in}}{25 \text{ in}}$	$\frac{5 \text{ in}}{25 \text{ in}} = \frac{8 \text{ in}}{n \text{ in}}$	$\frac{25 \text{ in}}{5 \text{ in}} = \frac{n \text{ in}}{8 \text{ in}}$
$5n = 8(25)$	$8(25) = 5n$	$5n = 25(8)$	$25(8) = 5n$
$5n = 200$	$200 = 5n$	$5n = 200$	$200 = 5n$
$n = 40$	$40 = n$	$n = 40$	$40 = n$

- Provide the students with practice in determining missing measurements in a proportion.

Differentiation Suggestions:

- Draw segments connecting the numbers being multiplied to find the cross products.
- Write ratios in words to identify the numbers being used in the ratios as in the examples above.
- Use the explanation and practice at:
<http://www.321know.com/rat-prop-crossx.htm#section3>

Assessment:

- The flag pole casts a shadow 12 feet long at the same time as a 5-foot tall student casts a 3-foot shadow. What is the height of the flag pole?
Answer: 19.2 feet

Follow Up:

- Ask students to make scale drawings of the classroom, the cafeteria, or a room in their home.
- Provide examples of scale drawings and ask students to determine actual measurements of the objects in the scale drawings.