## Proportions and Scale Factor for Measurement

Summary
Solve problems using simple proportions

## Materials

TI-73's, ruler and map for each small group
Gummi Bear for each student
Map from Google Maps or Map Quest showing area around school
Worksheets: Solving Distance Problems Using Proportions, Cookie Conversions, Gummi Bear
Basketball
Journal page: Defining Scale Factor

## Background for Teachers

Enduring Understanding (Big Ideas):
Proportional relationships can help us find missing information and solve problems
Essential Questions:
How can a proportion help solve distance problems
How can a scale factor be used in solving problems?
Skill Focus:
Students will use proportions and scale factors to solve problems.
Vocabulary Focus:
Ratio, proportion, scale factor
Ways to Gain/Maintain Attention (Primacy):
Read book and have students relate to themselves. Students measure heights. Measuring on maps.
Instructional Procedures
Starter:
Which of these comparisons is a proportion:

$$
6 / 9=8 / 12
$$

$$
5 / 15=4 / 12
$$

$$
5-3=10--8
$$

Explain how you determined your answers.
Write two more ratios that compare the same way these ratios compare.
$3 / 5,6 / 10,9 / 15$, $\qquad$ , $\qquad$
What would the tax be on a $\$ 25.00$ shirt, if the tax rate was $6.25 \%$
Lesson Segment 1 (Launch): How can a proportion be used to solve problems involving distance?
Three Step Interview Question:
Students talk with a partner for 30 seconds, then listen to their partner for 30 seconds, and finally tell their team what their partner had to say.
Q. We often hear people talk about very high objects. For example, we may hear that the Sears Tower in Chicago is 1,100 feet high or that a mountain, like Mt. Everest, is 35,000 feet high, or that a plane is traveling at 40,000 feet above the earth. How do you think the measurements for those heights are found?
Work with the class member to use proportions for Solving Distance Problems Using Proportions. For the worksheet have student teams choose roles: Place Selector, Measurer, Scribe, and Encourager, to cooperate in finding distances. Make sure they locate the scale first. Explain that the scale is usually a rate (miles per inch or km per cm )

You may want to have students use the Smart Pals or whiteboards with a proportion template to set up a few of the problems, so you can have them show the class.
Using Google Maps found at www.google.com, or maps from www.MapQuest.com, you can use the address of your school, to get a map the kids can see to look for the distance from the school to their homes or other significant places. These maps help you model measuring the scale line or using the given scale as a ratio.
Lesson Segment 2: How can a scale factor be used in solving problems.
Point out that students have been using a proportion for finding distance. Q. Is there another way to find the distances without setting up a proportion? (Since the scale factor is often 1 inch or 1 centimeter, students will naturally want to multiply by the scale factor.) Multiplying by a scale factor can help us solve problems.
If we divide a ratio inches/miles, meters/kilometers, or cm/meters, we will find the scale factor.
Mix --Freeze-Pair: Have students mingle around the room until you call, "Freeze". They choose the person closest to them to be their partner. Partners decide which of them will be \# 1 and which will be \# 2. Ask a question. Give them time to think for themselves, then select either \# 1 or \# 2 to explain what they think and why to their partner.

If 3 inches represent 15 miles, the scale factor is $\qquad$ .
If I want to double a recipe, I would multiply by a scale factor of $\qquad$ .
If I am selling Girl Scout Cookies and I want to earn four times what they cost me, I must use a scale factor of $\qquad$ to determine what to charge for each box.
If 4 cm represents 12 kilometers. I should multiply each centimeter on a map by a scale factor of to find the kilometers.
How Far Is My House From The School?
Objective: Use scale factor to determine actual distance from a map.
Materials needed. Overhead projector, a map of your school and surrounding area with a measurable scale in meters and feet for each student and an overhead of that map. Go to www.MapQuest.com or www.google.com (select Maps) and type in the address of your school, then print a map. Meter stick. Rulers. Calculators.

## Procedure:

Give students a copy of the map. Have the student measure the scale on their maps and determine a scale factor. This is easier for them if you have them use centimeters and meters rather than feet. Tell them that rather than write a ratio for the scale, they will use the scale factor or the number of meters/feet the scale represents. That factor will be used to multiply measurements taken from the map.
Ask the students to try to locate about where their home is on their map. Project the map on the whiteboard and ask if the students can see where their houses are located. Ask a student to come up to show where his/her house is. Next, ask the student to measure the map distance to his/her house. Help the class find the actual distance by multiplying by the scale factor. Do this with two or three students to model using the scale factor.
Then have them measure the distance to their own homes on their maps and find the actual distance by multiplying by the scale factor. Ask them to locate a friend's home, a church or business or any other four places on the map. Have them find the distances from their home to those other places. Questions: How is a scale factor similar to a ratio? How are they different? Would the scale factor or map distance ratio be the same or different if we used a different system of measurement (Metric or Customary), if we used yards instead of inches or meters instead of centimeters?
Scale factors can also be used for enlarging or shrinking.
Q. If a box of macaroni serves 4 people and you have 8 people to feed, what would you do? Q If a whole package of mix serves 25 people, and you only want to serve 5 people, what would you do?

Help students work to complete the Cookie Conversions worksheet. Invite them to bring their cookies to class.
Give each student a Gummi Bear and ruler. Work with students to complete the Gummi Bear Basketball worksheet.
Lesson Segment 3: Summarize and Practice
Journal: Work with students to complete the Scale Factor Frayer Model for their journals Assign appropriate practice as needed.

Assessment Plan
Starter questions, Student performance
Bibliography
This lesson plan was created by Linda Bolin.
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