



Overruled! Teacher Guide

The *Overruled!* animation is available on iTunes U (search "Math Snacks") and at MathSnacks.org

Topic: Unit conversion

Time Required: 1–2 days for 50-min classes; 1 day for 90-min classes

Learning Objectives: After watching the animation, completing the activities in the Learner Guide, and completing at least one bonus activity, students will understand that:

- Various mathematical techniques are helpful in finding the missing part of a proportion, including tables, graphs, measurement and equations.
- Graphing proportions on a coordinate plane results in a graph that is linear.
- Proportions are multiplicative situations.
- Given an application problem, using the units can help to set up the correct proportion.

Vocabulary: Proportion, convert, measurement, ordered pairs, plot, graph, line, units

Vocabulary in Spanish: Proporción, convertir, medida, pares ordenados, graficar, gráfica, línea, unidades

Materials and Technology required:

- Computer, LCD Projector, Access to Internet or animation
- Copies of blank survey tables for bonus activity

Common Core State Standards Covered:

Standard	Standard Description
4.MD.1	Know relative sizes of measurement units within one system of units including km, m, cm.... Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table.
5.MD	Convert like measurement units within a given measurement system.
5.MD.1	Convert among different sized standard measurement units within a given measurement systems, and use these conversions in solving multi-step, real world problems.
6.RP	Understand ratio concepts and use ratio reasoning to solve problems.
6.RP.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
6.RP.2	Understand the concept of a unit rate a/b associated with the ratio $a:b$ with b not equal to 0, and use rate language in the context of a ratio relationship.
2.MS.2	Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of unit chosen.
4.MD	Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.
7.G	Draw, construct, & describe geometrical figures & describe relationships between them.
7.G.1	Solve problems involving scale drawings of geometric figures, including computing actual lengths & areas from scale drawing & reproducing a scale drawing at a different scale.

Preliminary Preparation:

1. Watch the "Teaching With *Overruled!*" video.
2. Make copies of learner guides for *Overruled!*.
3. Do all problems in each learner guide and compare with teacher guide answers.
4. Go to mathsnacks.com website and make sure the *Overruled!* animation is working. If you are using iPads to view the animation, make sure to download the animation from iTunes prior to class.
5. Make copies of the "feet" for the bonus activity and have them cut out (in rectangles) prior to class.
6. Create a class table to record measurement results. Make sure to label table properly.
7. Create a class graph to record measurement results. Make sure to label the x and y axis properly.

Animation Viewing and Discussion Questions:

Show *Overruled!* and ask the following questions:

1. What do you think this animation is about?
2. What math words or concepts did you see in the animation? (Hopefully measurement will be mentioned...if not, don't worry.)
3. What were some of the problems the citizens encountered? (Record answers on the board.)

We are going to watch the animation again and I am going to stop this time so we can discuss the math in the animation.

Show *Overruled!* again and ask the following questions. Pause the animation when you feel it is appropriate.

1. Can you think of a situation where measurement is important? (Possible answers: building a house, engineering projects, space travel, building roads, etc.)
2. What tool did the characters in the animation use to explain and solve their problem? (Possible Answer: Graph.)
3. Why was this tool useful? (Possible Answer: They could see the pattern and make the conversions using the graph.)
4. Can you suggest other ways to solve the problem? (Answers will vary; a table or an equation might be possible answers.)
5. Can you think of other situations in which proportions or ratios might be used to convert measurements or solve problems? (Possible answer: Standard to metric, cooking, distance, or money exchanges.)

Bonus Activity

- Divide students into groups of 3.
 - One student to measure objects with large feet.
 - One student to measure objects with small feet.
 - One student to record results of measurements.
- Pass out 5 large feet and 5 small feet to each group.
- Have each group select three objects in the classroom to measure using both the small feet and the large feet, and record their results in a table.
- Have the recorder enter the measurement results on the class table.
- Have the recorder enter the measurement results on the class graph.

Bonus Activity

Ask the following discussion questions:

1. I want everyone to look at the data on the table and on the graph. Write down what you think the ratio is of the big foot to the small foot. (Record answers.)
2. Is the pattern perfect? Why or why not? (Answer: Measurements could be off.)
3. What kind of a pattern do you see on the graph?
4. If we measured the floor of the classroom and it was 100 small feet, how many large feet would that be? How could we figure that out? (Answers: Graph, table, proportions – have students demonstrate different ways.)
5. What if we were trying to measure the school and it was 1000 small feet; how many large feet would that be?

Be on the lookout for different strategies students are using in doing this problem. If there are different ways students are approaching this problem, have them demonstrate their thinking process on the board or explain what they are doing. Some might draw pictures; others will set up a proportion problem; others will add fractions. Try to highlight all of the different methods used on the board.

(Even though the goal is to get students to use a proportion, try not to just show them how to do this using cross multiplication. It will be tempting to say, "Just set up a proportion like this, and then cross multiply," but try to avoid doing this. There are many ways to do this problem. Let students discover them. After the exploration, if one of the students sets up the proportion, have them explain it to the group, but try to first allow them the time to find various ways of doing the problem.)

Learner Guide Discussion:

Pass out the Learner Guide and have students work alone or in groups of two, to solve the problems on it. This Learner Guide is very challenging, and students may need extra assistance in order to complete the questions. When you pass out the Learner Guide, go over each problem as a class and discuss the importance of LABELING tables and graphs.

The Learner Guide covers the following concepts:

1. Recognizing that a ratio will follow a pattern when entered in a table. (1)
2. Plotting points from a table onto a graph. (1c, 3)
3. Recognizing that the graph should be linear. (1d)
4. Using proportions to find missing values when given a ratio. (2, 3)
5. Labeling a table and the axes of a graph (3)

Have students demonstrate on a separate piece of paper how they find their answers. Students may have difficulty with problem 3 and may need extra assistance. Have them demonstrate the various ways they get the answers to number 3. If they are very confused, try to brainstorm different ways for them to approach the problem as a whole class.

- Some students may plot the points that are easy to find and try to use the graph to find the missing points.
- Some students may set up a proportion to solve the problem.
- Some students may figure out the unit rate and use it to find the missing values.

The Bow (Tie it all together to bring out the main ideas):

1. Now that we are finished with the animation, the measurement activity and the learner guide, what do you think *Overruled!* has helped you understand? (Record answers.)
2. What are some of the vocabulary words you learned from this lesson? (Record answers.)
3. What is important to keep in mind when you are measuring?
4. If you have two different measurement systems, is there a way to figure out how to switch from one to the other? What different ways did we learn to do this? (Record answers.)
5. When you create a table and a graph, what is the most important thing to remember? (Answer: Labeling.)
6. This can be followed up with similar problems, questions and activities that deal with proportional reasoning and unit conversions.

FOOT TEMPLATE FOR BONUS ACTIVITY

Here is a template for a set of feet that represent the 3:5 ratio. It takes 3 large feet for every 5 small feet. We are only looking at length, not width. Make enough copies for each group to have at least five of each size of foot.

