

1.5 MEASURING WITH METRICS



FOCUS QUESTION:

- How do people measure distance, mass, and volume?

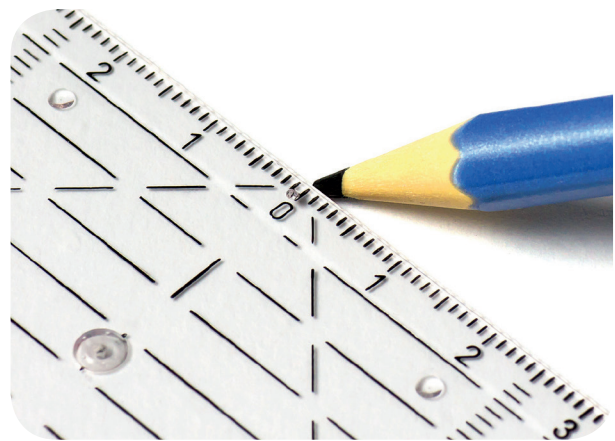
STANDARD #8 SCIENCE, TECHNOLOGY AND SOCIETY.

LESSON OVERVIEW:

This lesson integrates the core disciplines of social studies, math, science, and English. [It presupposes that the students have an introductory knowledge of the metric system.] The lesson provides students with the opportunity to apply their understanding of metrics in situations they may encounter when traveling throughout Germany. Students will engage in activities that require making conversions between the United States customary system and the metric system.

TEACHER BACKGROUND INFORMATION:

The United States is one of the few countries that continues to use the customary measurement system rather than the metric system that is used more commonly in countries such as Germany. It is the measurement system used in all of the sciences. Provided is a Measurement Comparison Chart: Germany – USA (**Handout 1.5 A on Resource Disc**) with example equivalent measures.



TIME:

3 (45-minute Class Periods)

INSTRUCTIONAL RESOURCES:

- Tape measures
- Calculators
- Measurement Comparison Chart: Germany – USA (**Handout 1.5 A on Resource Disc**)
- Measurement Conversion Cards (and answers) (**Handout 1.5 B on Resource Disc**)
- Measurement Game: Brandenburg Gate Outline (**Handout 1.5 C on Resource Disc**)

PROCEDURE:

DAY 1:

Anticipatory Set:

- To determine students' background knowledge of basic US customary measurement, ask students to think about the following questions. As students share their answers, the teacher should write the values on the board in 3 columns (shown on next page). After answering the questions the remainder of the terms should be filled in.

- You are in a grocery store to pick up a large container of milk. What form of measurement does milk come in? (Gallons)
- You are in a grocery store to buy a large bag of sugar. In what form of measurement is sugar sold? (Pounds)
- You are at the doctor's and asked to stand on the scale. What might you weigh? (Pounds)
- What is the measurement for how tall you are? (Feet/Inches)
- You are in the kitchen making a cake. How much flour will you use? (Cups)
- You are riding a bike to meet a friend. How do you measure your distance? (Miles)
- You are in a grocery store and need to buy one large bottle of soda. How much will you buy? (2 liters!) This is another measurement system. What is it called? A student may know that this is the metric system. This shows the influence of globalization. It is much easier and more profitable for a company that produces all around the world to use one measurement system.

US Customary Units		
Liquid (Volume)	Length, Height and Distance	Weight (Mass)
Cups-Pints-Quarts-Gallons	Inches-Feet-Yards-Miles	Ounces-Pounds-Tons
Metric Units		
Liquid (Volume)	Length, Height and Distance	Weight (Mass)
Liters	Centimeters-Meters-Kilometers	Grams-Kilograms

- Ask students to list the metric units. The teacher may fill in their answers as shown above.

DAY 2:

- The teacher should set up 4 workstations (Distance Station, Length Station, Area Station and Weight Station) around the classroom. Each workstation will have one card with 3 questions requiring students to make conversions between the US customary system and the metric system. Tape measures or meter sticks are needed at the Length station. The teacher should distribute a calculator and the Measurement Comparison Chart: Germany – USA (**Handout 1.5 A on Resource Disc**) to each student. The teacher should divide students into 4 groups. Each student should take a sheet of notebook paper, fold it into fourths and label each section with the title of the station and write their answers in the correct section. The teacher should instruct the students to round their answers to an approximate answer. Students should work together to find the correct conversion. They may rotate to each station as a group or independently depending on teacher direction. The teacher may either go over the answers after all students have gone through the 4 stations or the teacher may leave the answers on a card at each station that may be turned over after students have attempted the conversion.

DAY 3:

- For more practice converting measurements, the teacher may wish to have students play the following game which requires the teacher to prepare different tasks for the students to convert. The teacher divides the class into two or three groups. One student from each group will come to the board and become the artist. The teacher should show the Measurement Game: Brandenburg Gate Outline (**Handout 1.5 C on Resource Disc**) to the artists and explains to them how to draw it. (For each correct answer from their group they are allowed to draw one stroke.) Then the teacher calls out one conversion scenario after another to the students. Each group must rush to answer. The artist of the group that comes up with the correct answer first can draw one stroke of the Gate on the board. The group whose artwork is finished first wins, and the activity is over.

- Afterwards, the teacher should ask the students if they can recognize the art piece as the Brandenburg Gate. Depending on their background knowledge, the students might have difficulties coming up with the correct solution. If this is the case, the teacher might give hints as: it is one of the most well-known monuments of Germany; it's located in Berlin; it's a national symbol of Germany; it's on the back of some of the German euro coins, etc. This can be the starting point for further research on the Brandenburg Gate and its significance in German history.

WHOLE GROUP REFLECTION:

- The teacher will engage the students to reflect upon the measurement activities by leading the students in a discussion with the following questions: What similarities and differences do the students notice between meters and yards, etc. What generalizations can they make about using the customary system versus the metric system?

MODIFICATIONS:

- Depending on the student's math level, a calculator may or may not be allowed.
- The teacher may decide depending on the age and the comprehension of the students if they should do the exact conversion or just the rough estimate. The teacher should explain the different issues with having two sets of standard measurements in the world, so they understand the difference between the exact conversion and the rough estimates. Since the actual conversion can be quite complicated, explain to the students that most of the time a close estimation is good enough when you travel in Germany in order to get around.

Here are some helpful equivalents to use when estimating US Customary units:

- 1 meter is approximately 3 feet, so if a mountain is 2000 meters high it's about 6000 feet.
- 1 kilometer is roughly two thirds of a mile. If a car goes 150 kilometers per hour on the Autobahn (which is often possible and even allowed), it goes 100 miles per hour.
- If the distance between two cities is 300 kilometers, it's approximately 200 miles from city A to city B.
- If 1 meter is approximately 3 feet, 1 square meter is roughly 9 square feet. So if a house has a 150 square meter living space, it has roughly 1350 square feet.
- 100 grams is approximately 4 ounces. In Germany chocolate is usually sold in 100 gram bars, so if you buy one, you buy 4 ounces of chocolate.
- 1 kilogram is approximately 2 pounds. So if you find a price tag telling you 1 kilogram of apples cost 2.00 € and you want to buy it, you buy 2 pounds of apples.
- 1 liter is approximately a quarter gallon. In Germany milk is usually sold in 1 liter cartons, so if you want to buy 1 gallon, you have to buy 4 cartons.

EXTENSIONS:

- The teacher may engage students in higher level math problems such as:
 - If the distance from Berlin to Frankfurt is approximately 560 kilometers and the train takes approximately 4 hours and 45 minutes to travel this distance, how fast is the train traveling? (Compute the answer in kilometers per hour and miles per hour.)
- Additional sample math problems (and their solutions) can be found on the Measurement Conversion Cards handout (**Handout 1.5 B on Resource Disc**).