

## **WAMC Lab Template**

Math Concept(s): Imperial vs Metric Conversions Lab

Source / Text:

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### **Attach the following documents:**

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

### **Short Description (Be sure to include where in your instruction this lab takes place):**

- In this activity, we will explore the fundamental concept of measurement and unit conversion, bridging the gap between U.S. imperial and metric systems. Understanding how to convert between different units of length and weight is not only a crucial mathematical skill but also essential in various real-world applications. Through hands-on measurement exercises and calculations, you will investigate conversion factors and unit conversion ratios, enabling you to apply mathematical reasoning to practical scenarios. By the end of this activity, you will gain a deeper appreciation for the precision and accuracy required when working with different measurement systems, preparing you for future mathematical challenges and real-world problem-solving.

### **Lab Plan**

Lab Title: Imperial vs Metric Conversions

Prerequisite skills:

Basic Measurement Skills: Understanding how to measure length and weight using common tools such as rulers, tape measures, and scales.

Familiarity with Units of Measurement: Knowing the common units of length (feet, meters, inches, centimeters) and weight (pounds, kilograms, grams).

Basic Mathematical Operations: Proficiency in performing multiplication, division, addition, and subtraction, which are essential for calculating conversion factors and performing unit conversions.

Understanding of Ratios and Proportions: Knowledge of how to work with ratios and proportions, which is crucial for calculating and applying conversion factors between different units.

Lab objective:

The objective of this lab is to enhance students' understanding and proficiency in measuring lengths and weights using both U.S. customary and metric units. Students will calculate conversion factors between these systems, applying mathematical operations such as

multiplication and division. By the end of the lab, students will be able to accurately convert units, understand ratios and proportions, and apply these skills to real-world scenarios.

**Standards:** *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

- CCSS.Math.Content.HSA-CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- CCSS.Math.Content.HSA-REI.A.1: Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- CCSS.Math.Content.HSA-REI.B.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Standards for Mathematical Practice:

- MP.2 - Reason abstractly and quantitatively: Students convert between different units (feet to meters, pounds to kilograms) and compare conversion factors, requiring them to reason about quantities and their relationships.
- MP.4 - Model with mathematics: By measuring real-world objects and converting units, students create and use models to represent and solve practical problems involving measurement.
- MP.6 - Attend to precision: Precision is crucial in measurement and unit conversion tasks. Students must use accurate measurements and perform calculations precisely to obtain correct conversion factors and ratios.

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- CCSS.ELA-LITERACY.RST.9-10.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
- CCSS.ELA-LITERACY.RST.9-10.7: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- CCSS.ELA-LITERACY.RST.9-10.9: Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

K-12 Science Standards

- HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
- HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

## Technology

ISTE Standards for Students - Knowledge Constructor:

- Students critically curate a variety of resources using digital tools to construct knowledge, synthesize information, and create new understandings. This lesson encourages students to use digital resources and tools to research and understand different measurement systems and conversion factors.

ISTE Standards for Students - Creative Communicator:

- Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats, and digital media appropriate to their goals. This lesson involves students communicating their findings, calculations, and conclusions using digital tools and platforms effectively.

## Engineering

Engineering Design (HS-ETS1-3):

- This standard involves evaluating a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics. Understanding and applying accurate unit conversions are essential in engineering design to ensure that designs meet specifications and regulatory standards.

International Technology and Engineering Educators Association (ITEEA) - Technological Systems (Standard 10):

- Students will develop an understanding of the characteristics and scope of technology systems, including identification of potential sources of measurement error, in this lesson.

## Leadership/21st Century Skills:

<u>21st Century Interdisciplinary themes</u> (Check those that apply to the above activity.)			
<input type="checkbox"/> Global Awareness	<input type="checkbox"/> Financial/Economic/Business/Entrepreneurial Literacy	<input type="checkbox"/> Civic Literacy	
<input type="checkbox"/> Health/Safety Literacy	<input type="checkbox"/> Environmental Literacy		
<u>21st Century Skills</u> (Check those that students will demonstrate in the above activity.)			
<b>LEARNING AND INNOVATION</b>	<b>INFORMATION, MEDIA &amp; TECHNOLOGY SKILLS</b>	<b>LIFE &amp; CAREER SKILLS</b>	<b>Productivity and Accountability</b>
<u>Creativity and Innovation</u>	<u>Information Literacy</u>	<u>Flexibility and Adaptability</u>	<input type="checkbox"/> Manage Projects
<input type="checkbox"/> Think Creatively	<input checked="" type="checkbox"/> Access and Evaluate Information	<input type="checkbox"/> Adapt to Change	<input type="checkbox"/> Produce Results
<input type="checkbox"/> Work Creatively with Others	<input type="checkbox"/> Use and manage Information	<input type="checkbox"/> Be Flexible	<input type="checkbox"/> Guide and Lead
<input type="checkbox"/> Implement Innovations	<u>Media Literacy</u>	<u>Initiative and Self-Direction</u>	<input type="checkbox"/> Responsibility
<u>Critical Thinking and Problem Solving</u>	<input type="checkbox"/> Analyze Media	<input type="checkbox"/> Manage Goals and Time	<input type="checkbox"/> Guide and Lead Others
<input checked="" type="checkbox"/> Reason Effectively	<input type="checkbox"/> Create Media Products	<input type="checkbox"/> Work Independently	<input type="checkbox"/> Be Responsible to Others
<input type="checkbox"/> Use Systems Thinking	<u>Information, Communications and Technology (ICT Literacy)</u>	<u>Social and Cross-Cultural</u>	<input type="checkbox"/> Interact Effectively with Others
<input type="checkbox"/> Make Judgments and Decisions	<input type="checkbox"/> Apply Technology Effectively	<input type="checkbox"/> Work Effectively in Diverse Teams	
<input type="checkbox"/> Solve Problems			
<u>Communication and Collaboration</u>			
<input type="checkbox"/> Communicate Clearly			
<input type="checkbox"/> Collaborate with Others			

**Teacher Preparation: (What materials and set-up are required for this lab?)**

## Materials

- Tape Measure
- Scale
- Graph Paper
- Writing utensil
- calculator

## Set-Up Required:

- **Measurement Tools:** Ensure each group of students has access to rulers or tape measures marked in both feet and meters, as well as bathroom scales marked in pounds and kilograms.
- **Calculators:** Provide calculators for each group to perform mathematical operations such as multiplication and division, which are essential for calculating conversion factors.
- **Reference Materials:** Make available textbooks, reference guides, or digital resources that list standard conversion factors between U.S. customary and metric units for length and weight.

## Lab Organization Strategies:

### Leadership (Connect to 21<sup>st</sup> Century Skills selected):

- This activity prompts students to access and evaluate information by using measurement tools and reference materials to perform accurate unit conversions. They reason effectively by applying mathematical operations to calculate conversion factors and verify their results through multiple measurements. Interacting effectively with peers, students collaborate to discuss strategies, share findings, and communicate their calculations and interpretations, fostering teamwork and enhancing communication skills crucial for academic and practical applications.

### Cooperative Learning:

- This lab utilizes cooperative learning by requiring students to work together in groups to measure lengths and weights, calculate conversion factors, and verify their calculations. Students collaborate to discuss strategies, share data, and ensure accuracy in their measurements and conversions. This collaborative approach not only encourages peer teaching and learning but also develops teamwork skills and fosters a supportive learning environment where students can collectively problem-solve and achieve common goals.

### Expectations:

- The lab expectations include accurately measuring lengths and weights using provided tools, applying mathematical operations to calculate conversion factors between U.S. customary and metric units, and documenting findings clearly and precisely. Students are expected to collaborate effectively within their groups, communicate their calculations and interpretations, and demonstrate understanding of unit conversions through practical applications and real-world examples. Additionally, adherence to

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safety protocols when using measurement tools and scales is paramount to ensure a safe and productive learning environment.

Timeline:

- 60 Minutes

### **Post Lab Follow-Up/Conclusions:**

Discuss real world application of learning from lab

- The learning from this lab on measurement and unit conversion applies directly to real-world scenarios where accurate measurements and conversions are critical. For instance, in engineering, professionals must convert measurements between different systems to ensure designs meet specifications and safety standards. In healthcare, precise unit conversions are necessary for administering medications and interpreting patient data correctly, highlighting the practical relevance of these skills beyond the classroom.

Career Applications

- **Engineering:** Engineers regularly convert measurements between U.S. customary and metric units when designing structures, systems, and machinery to ensure compliance with international standards and specifications.
- **Healthcare:** Medical professionals use unit conversions to administer medications accurately based on patient weight and convert lab results between different measurement systems for diagnosis and treatment.
- **Science and Research:** Scientists rely on precise measurements and conversions in experiments, data analysis, and reporting findings across various fields such as environmental science, chemistry, and physics.

Optional or Extension Activities

- **Real-World Problem Solving:** Present students with real-world problems where unit conversions are crucial, such as environmental sustainability projects or global health initiatives, encouraging them to propose solutions using their newfound skills.
- **Technology Integration:** Explore digital tools and apps that automate unit conversions or simulate real-world scenarios where accurate measurements and conversions are essential, enhancing students' technological literacy and problem-solving abilities.
- **Peer Teaching and Presentations:** Assign groups to research and teach their classmates about historical or current applications of unit conversions in specific industries, fostering peer learning and presentation skills.

### **Lab Instructions:**

Introduction:

In this activity, we will explore the fundamental concept of measurement and unit conversion, bridging the gap between U.S. imperial and metric systems. Understanding how to convert between different units of length and weight is not only a crucial mathematical skill but also essential in various real-world applications. Through hands-on measurement exercises and calculations, you will investigate conversion factors and unit conversion ratios, enabling you to apply mathematical reasoning to practical scenarios. By the end of this activity, you will gain a deeper appreciation for the precision and accuracy required when working with

different measurement systems, preparing you for future mathematical challenges and real-world problem-solving.

Explore:

In this activity, you will measure length and weight in the U.S. and metric system. You will use your measurement to calculate the conversion factor from one system to the other.

a. Measure the length of your teacher' desk in feet and in meters. Divide the Measurement in feet by the Measurement in meters. This is the conversion factor from meters to feet. Now, divide the Measurement in meters by the Measurement in feet. This is the conversion factor from feet to meters. Write the conversion factor on a sheet of paper. Measure the width of the desk in feet and meters. Let 1 inch equal 1 foot and make a scale drawing of the teacher' desk. Label the drawing with the Measurement in feet and in meters.

b. Weigh a chromebook (or a laptop) in pounds and in kilograms. Divide the weight in pounds by the weight in kilograms. This is the conversion factor from kilograms to pounds. Now, divide the weight in kilograms by the weight in pounds. This is the conversion factor from pounds to kilograms. Write the conversion factor on a sheet of paper. What is your chromebook's weight in grams? What is your chromebook's weight in milligrams?

c. Compare the conversion factors you calculated from your Measurement to the conversion factor listed in Figure 7 of your text (see below). How close are they?

d. Based on the conversion factor you calculated in part A and B above, write the unit conversion ratios for:

- Changing from meters to feet
- Changing from feet to meters
- Changing from kilograms to pounds
- Changing from pounds to kilograms

e. Use the unit conversion ratios from part d to change a Measurement of 0.473 kg/M to its equivalent in lb/FT.

When I observe students:

Monitor Accuracy: Ensure that students are measuring lengths and weights accurately and using the correct units for each measurement. I will check that they apply conversion factors correctly and use appropriate mathematical operations.

Assess Understanding: Observe how well students understand and explain the reasoning behind their calculations. I will listen for their ability to articulate the process of converting units and the significance of the conversion factors they use.



Evaluate Problem-Solving Skills: Watch for students' problem-solving strategies and their ability to overcome any difficulties or misconceptions. I will note how they approach tasks, check their work, and make corrections when necessary.

Encourage Collaboration: Observe how students work together, share ideas, and support each other in completing the tasks. I will look for effective communication and teamwork, ensuring that all group members are engaged and contributing.

Provide Feedback: Give timely and constructive feedback to guide students' learning. I will address any misconceptions, reinforce correct methods, and encourage deeper thinking and reflection on the activity's concepts and real-world applications.

Questions to Develop Mathematical Thinking as you observe:

- How did you determine the conversion factor from meters to feet? Can you explain your reasoning and the steps you took?
- How confident are you in the accuracy of your measurements? What steps did you take to ensure precision?
- Can you think of a real-world situation where converting units accurately is crucial? How would errors in conversion impact that scenario?
- How does the conversion factor you calculated compare to the standard conversion factor listed in the text? What might account for any differences you found?

Answers to Questions Above:

- To ensure precision, I used tools correctly and carefully read the measurements. I also double-checked my measurements to verify consistency and minimize errors.
- Accurate unit conversion is crucial in fields like engineering, construction, and healthcare. For example, in construction, incorrect unit conversions can lead to structural issues, resulting in safety hazards or costly repairs. Accurate conversions ensure the integrity and safety of buildings and infrastructure.
- Any differences might be due to slight measurement inaccuracies, rounding during calculations, or variations in measurement tools. These small discrepancies highlight the importance of precision in measurements and conversions.

Summarize:

In this activity, students measure lengths and weights in both U.S. customary and metric units and then calculate the conversion factors between these systems. By applying mathematical operations and reasoning, they gain practical experience in unit conversion and understand its importance in real-world contexts. This hands-on approach enhances their precision, accuracy, and problem-solving skills, preparing them for future mathematical and practical applications.

## Conversion Chart

Measurement Conversions	
Customary to Metric	Metric to Customary
<b>Length</b>	
1 in. $\approx$ 2.54 cm	1 cm $\approx$ 0.394 in.
1 ft $\approx$ 0.305 m	1 m $\approx$ 3.279 ft
1 yd $\approx$ 0.914 m	1 m $\approx$ 1.094 yd
1 mi $\approx$ 1.609 km	1 km $\approx$ 0.621 mi
<b>Capacity</b>	
1 fl oz $\approx$ 29.574 mL	1 mL $\approx$ 0.034 fl oz
1 pt $\approx$ 0.473 L	1 L $\approx$ 2.119 pt
1 qt $\approx$ 0.946 L	1 L $\approx$ 1.057 qt
1 gal $\approx$ 3.785 L	1 L $\approx$ 0.264 gal
<b>Weight/Mass</b>	
1 oz $\approx$ 28.35 g	1 g $\approx$ 0.035 oz
1 lb $\approx$ 0.454 kg	1 kg $\approx$ 2.203 lb

### Quiz:

- Question 1\*\*:** What is the conversion factor from meters to feet?
  - A) 0.3048
  - B) 3.2790
  - C) 1.6093
  - D) 0.6214
- Question 2\*\*:** If a desk measures 2 meters in length, how many feet is that approximately?
  - A) 4 feet
  - B) 6 feet
  - C) 8 feet
  - D) 10 feet
- Question 3\*\*:** What is the conversion factor from kilograms to pounds?
  - A) 0.4536
  - B) 2.2030
  - C) 0.6214
  - D) 1.6093
- Question 4\*\*:** If a person weighs 150 pounds, approximately how many kilograms is that?
  - A) 50 kg
  - B) 65 kg
  - C) 75 kg
  - D) 90 kg
- Question 5\*\*:** Which of the following units is used for measuring length in the metric system?
  - A) Inches



- B) Feet
- C) Centimeters
- D) Yards

**\*\*Answer Key\*\*:**

1. B) 3.2790
2. B) 6 feet
3. B) 2.2030
4. C) 75 kg
5. C) Centimeters

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