**LESSON TITLE: Unit Conversion with Spreadsheets**

**OVERVIEW:** This activity uses spreadsheets to tackle unit conversion problems. Through various scenarios, students will learn to carefully read word problems, extract and organize the given information and use Microsoft Excel to solve the problems. The lesson is intended to be given after students have already had an introduction to basic unit conversion problems.

**PREREQUESITE IDEAS AND SKILLS**

- Students should be familiar with basic notions of units (units for length, time, volume, speed, etc.)
- Students should understand unit conversion factors and how to use them to convert from one unit of measurement to another. (Note: This activity is NOT intended as an introduction to unit conversions. That topic is a prerequisite.)
- Ideally, students will have some previous experience with Excel, though this is not absolutely necessary.

**MATERIALS NEEDED TO CARRY OUT THE LESSON**

- Activity Worksheet
- Computer/laptop access for each student (or small group of students)
- Microsoft Excel software

**CONCEPTS TO BE LEARNED/APPLIED**

- Students will learn that a unit conversion involves viewing the numbers involved as measurements in a certain unit of the same amount of a quantity. For example, when converting between feet and miles, the numbers 1 and 5280 are both different measurements of the same underlying amount of the quantity in question (in this case, distance).
- Students will learn basic table formatting for organizing information.
- Students will learn how to use the CONVERT function in Microsoft Excel to convert from one unit of measurement to another.
- Students will solve unit conversion problems that involve more than one type of unit conversion.
- Students will learn the importance of cataloging descriptive information.

**INSTRUCTIONAL PLAN**

**Part 0: Review of Unit Conversion Concept**

Begin by handing out the worksheet, and walking students through the first example. Make sure to emphasize that the idea of unit conversions is that the same quantity can be measured numerically in different ways (i.e., with different units). Then let students do the second example on their own.

**<u>Part 1</u>: Introducing Excel**

Begin the main part of the lesson by introducing students to the basic capabilities of Excel, particularly those that are useful for unit conversions (such as the CONVERT function). To do this, have each student

(and the instructor) open the "Unit Conversions Template" Excel document. Work through the first example (the one involving converting inches to centimeters) as a way of introducing the CONVERT function. Have students enter various values for the number of inches and observe how Excel automatically changes the resulting number of centimeters. Then present the following scenario to the class:

**Road Trip:** "Suppose you are planning a long road trip. Your car's fuel efficiency is 25 miles per gallon, and you plan to drive a total distance of 2,300 kilometers. The average price of gasoline is $3.25 per gallon. How much will you spend on gasoline for the trip?"

Ask the class for ideas about how this type of problem could be solved by hand. Then solve the problem as a class using the Excel template. After solving the problem, ask students to plug in different values for the various inputs, such as total distance, price of gasoline, etc. The cells in are color-coded: the green cells contain values that can be changed, the pink cells contain conversion factors, and the blue cells contain formulas (i.e., calculated values). Students should see how quickly Excel gives the solutions compared to re-doing the problem by hand every time an input is changed.

**Part 2: Solving Unit Conversion Problems (in Groups)**

Next, hand out the student worksheets, and have the students form groups of 3 to 4 students per group. (Also, hand out the Unit Abbreviations sheet, which lists the various abbreviations that Excel uses, such as "kn" for knots, etc.). Let each group pick one of the 6 unit-conversion problems. (Alternatively, the instructor could assign each group a problem.) Students should solve their problems using a table in Excel. The table should have a similar format to the table in the template (i.e., columns for "Description," "Quantity," and "Units"). The cells do not need to be color-coded, although this is encouraged.

Have each group pick a representative to explain their problem and solution to the class. Encourage students to explain how the unit conversion that is performed in their particular problem involves a measurement (in two different ways) of the same underlying quantity.

**Part 3: Design your own Unit Conversion Problem**

The final part of the activity asks students to design their own unit conversion problem. The instructor can decide whether this should be done in groups or done individually, and whether this should be done in class or as homework (likely depending on time). The unit conversion problems should each involve multiple unit conversions, not just one.

**MIP COMPONENTS OF INQUIRY**

Active Learning: In this activity, students select, perform, and evaluate actions in various unit conversion problems using Excel spreadsheets. In the review section (Part 0), students actively work through the underlying concept of unit conversions by considering how unit conversions involve viewing the numbers involved as measurements of the same amount of a quantity, and they come up with their own creatively defined units for the quantity in question (such as bicycle wheel rotations for distance or coffee cups of volume). Students begin Part 2 by selecting one of several real-world problems, such as calculating the cost of filling a swimming pool with Jell-O or estimating the distance of a lightning strike, which engages them in the material and allows for personalized learning experiences. As they work

through their chosen problems, students actively select different inputs and use Excel's CONVERT function to perform the necessary unit conversions, observing how their selections affect the outcomes. This process not only reinforces their understanding of unit conversions but also demonstrates the practical applications of these skills. Furthermore, students are encouraged to design their own unit conversion problems, selecting relevant units and conversions, which fosters creativity and deeper engagement. Students work in groups to discuss their problems and evaluate their methods and results, and communicate their problems and solutions to the class. This approach to learning ensures that students are not passively receiving information but are actively involved in the process.

Meaningful Applications: The activity incorporates meaningful applications by enabling students to identify mathematical relationships, make and justify claims, and generalize across contexts to extract common mathematical structures. For example, students generalize the underlying concept of unit conversion from Part 0 (i.e., that unit conversions may be thought of as treating the numbers involved as measuring the same quantity in different ways) to more complex scenarios. Through real-world problems such as calculating the distance to the nearest star or comparing the reacting time for a hitter in baseball versus softball, students learn to apply unit conversions in practical situations. They identify the relationships between different units and use Excel to perform and verify conversions. This process helps students understand the underlying mathematical principles and see the relevance of these principles in real contexts. By designing their own unit conversion problems, students further deepen their understanding and ability to generalize the concepts across various situations. This approach supports students in recognizing patterns, making informed decisions based on their findings, and justifying their solutions through clear and logical reasoning.

Academic Success Skills: This activity promotes academic success skills in several ways. Students work in groups to solve the unit conversion problems, which encourages collaboration and communication, which are key skills for academic success. Students build confidence in their ability to use technology (Excel software) to solve complex problems. And designing their own problems further enhances their ability to take ownership of their learning and apply their knowledge creatively.