

# CHAPTER 3: MEASUREMENTS



## Tape Measure

### INTRODUCTION

**M**easurement is an essential part of this as well as any other nanoscience module because understanding how to measure the macroscale is essential to understanding how to research and work at the nanoscale.

This section begins with units. The first section of the module works to elaborate about the Imperial System while at the same time teaching SI units, such as meters, liters, grams, and Celsius. The activity stresses the benefits of both systems of measurement and the importance of being able to convert between those systems. It also explains why having units is essential. By having a standard system of measurement, scientists and others around the world can share each other's work, and more importantly, they can understand it.

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This module also stresses the ability to convert between the Imperial System of Measurement and SI. This is important because conversions between units help scientists and others understand the work of their international colleagues. In fact, in a recent conversion mishap, NASA lost a multimillion dollar satellite because of some conversion errors between SI and Imperial units.

Another important idea this section explains is the proper use of ideal tools. This teaches how to choose a specific tool to measure a certain object and how to understand why other tools would be less ideal. In order to understand the importance of choosing ideal tools, this chapter of the module also covers the definitions of both “Accuracy” and “Precision”, and more importantly it explains the difference between them and their importance to the world of measurement.

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## GOALS

By the end of this chapter, students should be able to:

### CONVERT BETWEEN COMMON SI AND ENGLISH UNITS AND WITHIN SI

Given a value for length, area, or volume in SI or English units, students correctly convert to the other system and choose appropriate SI prefix or English unit for the expression of the number.

Students correctly convert within both SI and English systems (mm to km, ft to mi, etc) and recognize the ease of the SI prefix system over the English system.

Students define the requirements of a valid system of measurement, and recognize both the SI and the English systems as valid.

### REGOGNIZE WHEN AND HOW TO ROUND NUMBERS IN A SCIENTIFIC CONTEXT (SIGNIFICANT FIGURES)

Given results of a calculation, students make appropriate rounding choices.

Students explain their rounding choice with reference to the precision of the measurements going into the calculation.

### RECOGNIZE THE NEED FOR APPROPRIATE TOOLS FOR USE AT DIFFERENT SCALES