Take notes while watching the following video tutorials to prepare for the "Matter & Measurement Activity".

Measurement Part 1:

Significant Figures are used to communicate measurement uncertainty.

Rules for Significant Figures (Sig Figs)

Significant Figures

The digits in a measurement known with certainty plus one estimated digit.

Nonzero Digits

The digits 1, 2, 3, 4, 5, 6, 7 ,8 & 9 are always significant.

The Digit Zero

Zeros may or may not be significant.

Leading Zeros

Zeros located at the beginning of a number are NEVER significant.

Confined Zeros

Zeros located between nonzero digits are ALWAYS significant.

Trailing Zeros

Zeros located at the end of a number are significant if the number has a decimal point or the zeros carry overbars.

0.0032005700

Round each of the following numbers to the number of sig figs indicated in ( ).

6,478 (two)

0.000793 (two)

456,924 (three)

0.05307 (three)

4000 (two)

Important Distinction!
Zeros are important place holders to preserve the overall value of the measurement. Sig figs are about the accuracy and precision of the measurement.

Round 689,532 to the indicated number of sig figs

Four:

Two:

Round 0.0027869 to the indicated number of sig figs

Four:

Two:

Significant Figures in Calculations

1. For multiplication and division, the result is limited by the term with the smallest number of significant figures.

$$7.05 \text{ ft} \times 2.6 \text{ ft} =$$

$$5.0 \text{ mL} \times \frac{13.9 \text{ g}}{\text{mL}} =$$

2. For addition and subtraction, the result is limited by the term with the least precision. Look at what digit place has the uncertainty – the hundreds, tens, ones, tenths, hundredths, . . . ?

$$\begin{array}{rl} & 7.05 \text{ ft} \\ + & \underline{2.6 \quad \text{ft}} \end{array}$$

$$\begin{array}{rr} & 63{,}200 \text{ g} \\ + & \underline{365 \text{ g}} \end{array}$$

Measurement Part 2:

Scientific Notation

Exponents – a very brief review

Exponents > 1

Exponents < 1

Converting from Decimal to Scientific Notation

Learn to use your calculator to toggle back and forth between decimal and scientific notation.

Learn how to enter numbers in scientific notation into your calculator.

Convert the following numbers from decimal to scientific notation or vice versa.

3.500×10^{-3}

238,000

2.021×10^{5}

0.000167

Mathematical Operations with Scientific Notation

Multiplication

Division

Be Aware of the Order of Operations

Practice Problems – solve the following

$(2.340 \times 10^{-3}) \times (2.6 \times 10^{6}) =$

$$\frac{3.506 \times 10^{3}}{(5.7 \times 10^{7})\ (2.61 \times 10^{-2})} =$$

$$\frac{7.4 \times 10^{-2}}{(3.248 \times 10^{6})\ (6.50 \times 10^{-3})} =$$

Measurement Part 3: Converting Between Units

Converting between Metric Units – 2 Approaches

1) Unit Conversion Factors

How many mg are in 0.53 g?

2) Shifting Decimals by adding/subtracting exponential terms

How many dg are in 3,475,892 μg?

How many mL are in 0.375 kL?

Converting Between Metric and English Units - 3 important bridges

What is the kilogram weight of a 210 lb patient?

A typical member of the species *Vibrio cholerae* is 8.8×10^{-6}m long. How long is this in inches?

Using Multiple Conversion Factors

Horse racing uses the distance of furlongs. If a mile is defined as 8 furlongs, how many kilometers is a 22 furlong race?

There are 42 gallons in one barrel of crude oil. How many mL of crude oil are contained in one barrel?

Dosage Calculations

An antibiotic is prepared in 3.0 mL ampoules that contain 60.0 mg of drug. How many mL of the solution should be administered to a patient prescribed 45 mg per injection?

Ivermectine is used to treat dogs that have intestinal parasites. The effective dosage of this drug is 1.5 μg/kg of body weight. How much invermectine should be given to a 17 lb dog?

The doctor ordered 20. mg/kg of a medication for a patient who weighs 36 lbs. The medication is available as 100. mg/mL. How many mL should be given to the patient?

A young child is being treated for a severe ear infection. The pediatrician prescribes amoxicillin at a daily dose of 40 mg/kg to be given in three injections 8 hours apart. If the amoxicillin is supplied as a solution that contains 125 mg amoxicillin per 5 mL of liquid, then how many mL should the child receive in each injection? The child weighs 7.64 kg.

Dosage of IV Solutions – administering drugs gradually over time to allow for different metabolism rates

Flow rate = dosage per unit time

A medication is given intravenously at the rate of 250 drops per min. The medication's concentration is 450 ng/μL (450 ng/mcL). What is the weight, in grams, of the medication delivered to the patient in 24 hours? (15 drops = 1.0 mL)

A patient is given intravenous morphine at a rate of 0.35 mg per hour. At this rate, how many minutes will it take to give the patient 1.5 mg of morphine?

Measurement Part 5: Energy & Specific Heat

Energy – the capacity to do work

Heat – a form of energy

Temperature – a measure of the hotness or coldness of an object

Heat vs Temperature

The units for heat:

Specific Heat (SH)

The heat needed to raise 1.00 g of any substance by 1°C.

The units of specific heat:

Specific Heats for Some common Substances

Substance	SH (cal/g•°C)	Substance	SH (cal/g•°C)
Water	1.00	Wood – average	0.42
Ice	0.48	Glass – average	0.22
Steam	0.48	Rock - average	0.20
Iron	0.11	Ethanol	0.59
Aluminum	0.22	Methanol	0.61
Copper	0.092	Ether	0.56

Specific Heat calculations use the following equation:

Calculate the number of calories of heat energy required to heat 25.0 g of copper from 23.0°C to 34.7 °C.

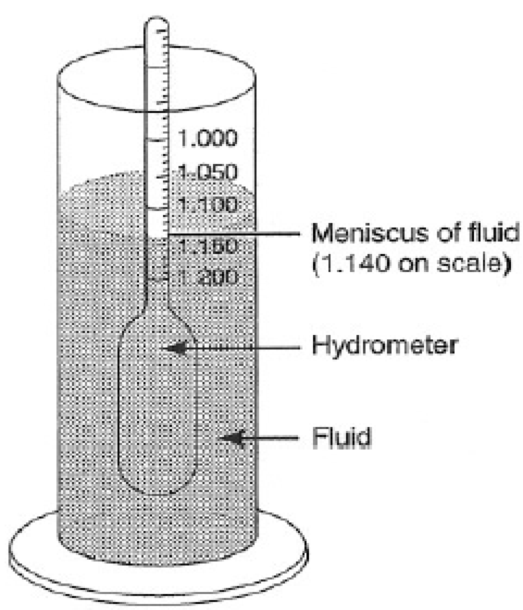
Calculate the final temperature after 175 cal of heat energy is added to 7.73 g of water at 43.2°C.

What is the mass, in grams, of a piece of aluminum if its temperature changes from 30.0°C to 315 °C when it absorbs 1770 cal?

Specific gravity is the density of a substance relative to water (1.00 g/mL)

The specific gravity of urine can be used diagnostically.

Normal urine has a specific gravity between 1.010 and 1.030.



Solids, Liquids, and Gases Part 1: Temperature

Temperature – a measure of the hotness or coldness of an object

	Fahrenheit (°F)	Celsius (°C)	Kelvin (K)
bp of water	212	100	373
body temp	98.6	37	310
fp of water	32	0	273
absolute zero	-459.6	-273	0

When converting between temperature units we must consider

1)

2)

$$°F = 9/5\,(°C) + 32 \qquad K = °C + 273.2$$

The hottest temperate ever recorded in the US was 56.7 °C in Death Valley, California. Convert this temperature into °C and K.