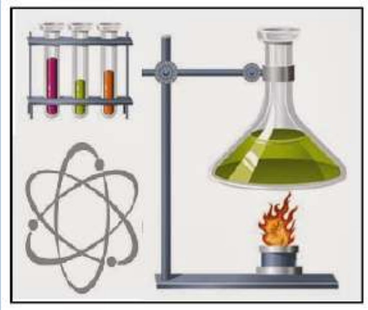
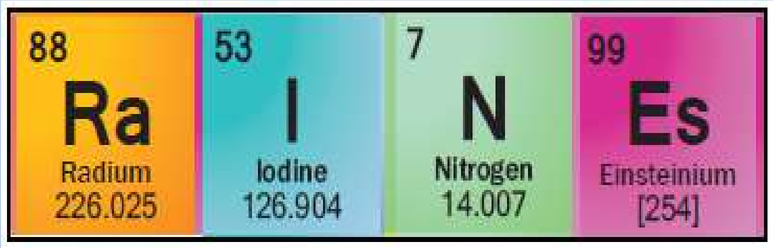
Welcome to Ms. Raines Class

1st day opener

- Sign up for class remind
  - with the app find Honors Chemistry with code: @h-chemsem1
  - Or text @h-chemsem1 to 81010





Day 1 - Agenda

- Opener: Sign up for remind (see dry erase board)
- Receive/Review:
  - Syllabus,
  - Student information sheet, [MUST be signed and returned]
  - book request form, [optional]
  - week 1 element list, [home work make 15 flash cards]
  - periodic table,
  - Finn Safety contract
  - Supply list
  - Science Fair info [Honors]

Day 2 Opener

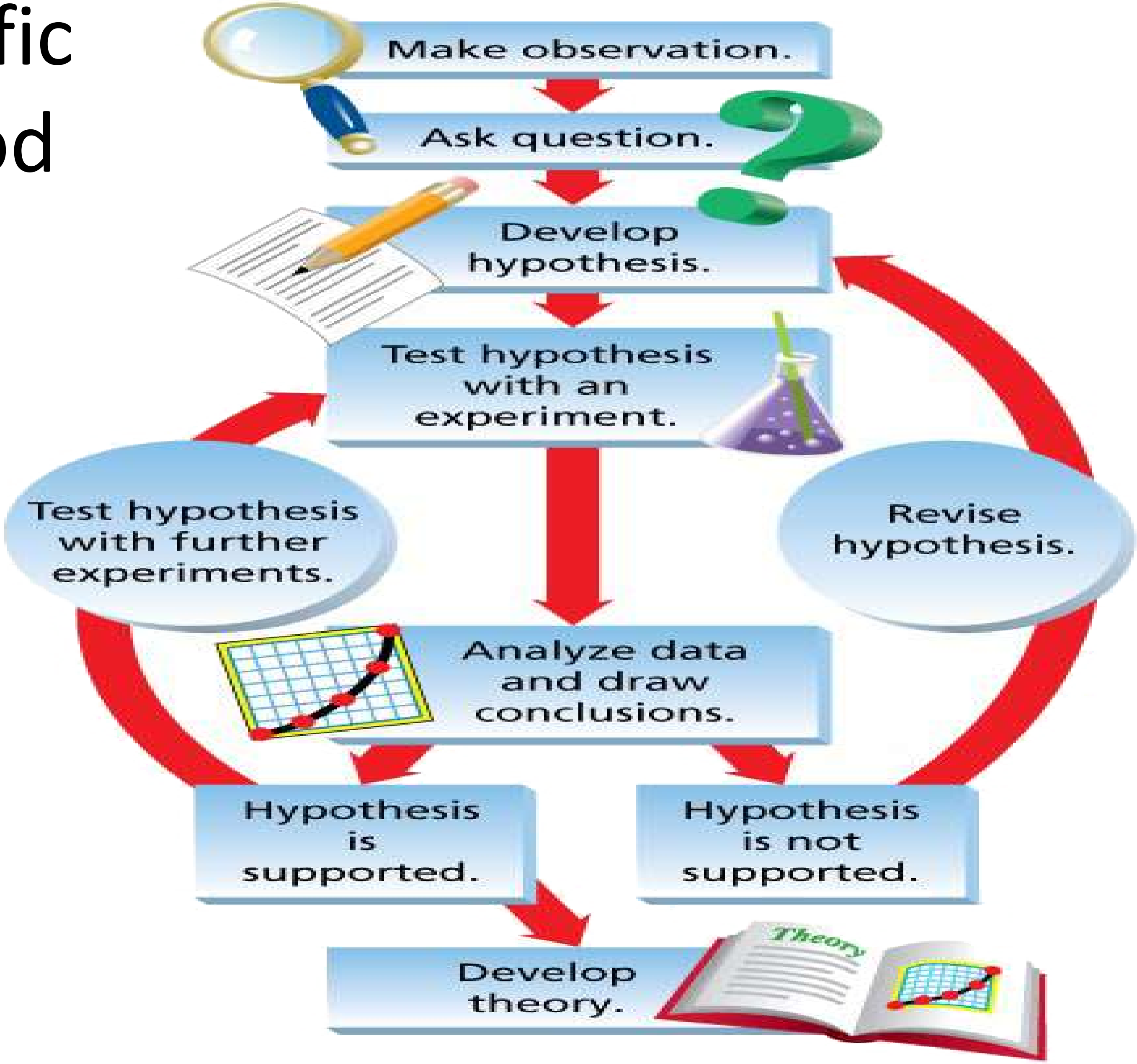
- Observe the beakers at the front of the room
- Record color, phase, odor, or other identifying features

- Test each with pH strips
- Add pipette of each to sample of baking soda
- Dip currency in substance and place in Bunsen burner flame.

Scientific Method (3 beaker demo)

- Scientific method is a logical, systematic approach to the solution of a scientific problem
  1. Make observation
  2. Ask a question
  3. Form a hypothesis
  4. Experiment
  5. Analyze data
  6. Draw Conclusion
  7. Develop Theory /law or re-evaluate hypothesis

Scientific Method



Day 3 Opener

Answer the following questions on note book paper OR the bottom of you equipment activity. You should use a complete sentence and NOT copy the question

1. When must safety goggles be worn? (3 specific items)
2. What device do you use to get chemicals out of your eyes?
3. What should be done if clothing catches on fire? [3 possible answers]
4. What precautions are necessary for the use of volatile solvents?
5. What precautions are needed with long hair, loose clothing and neckties in the laboratory?

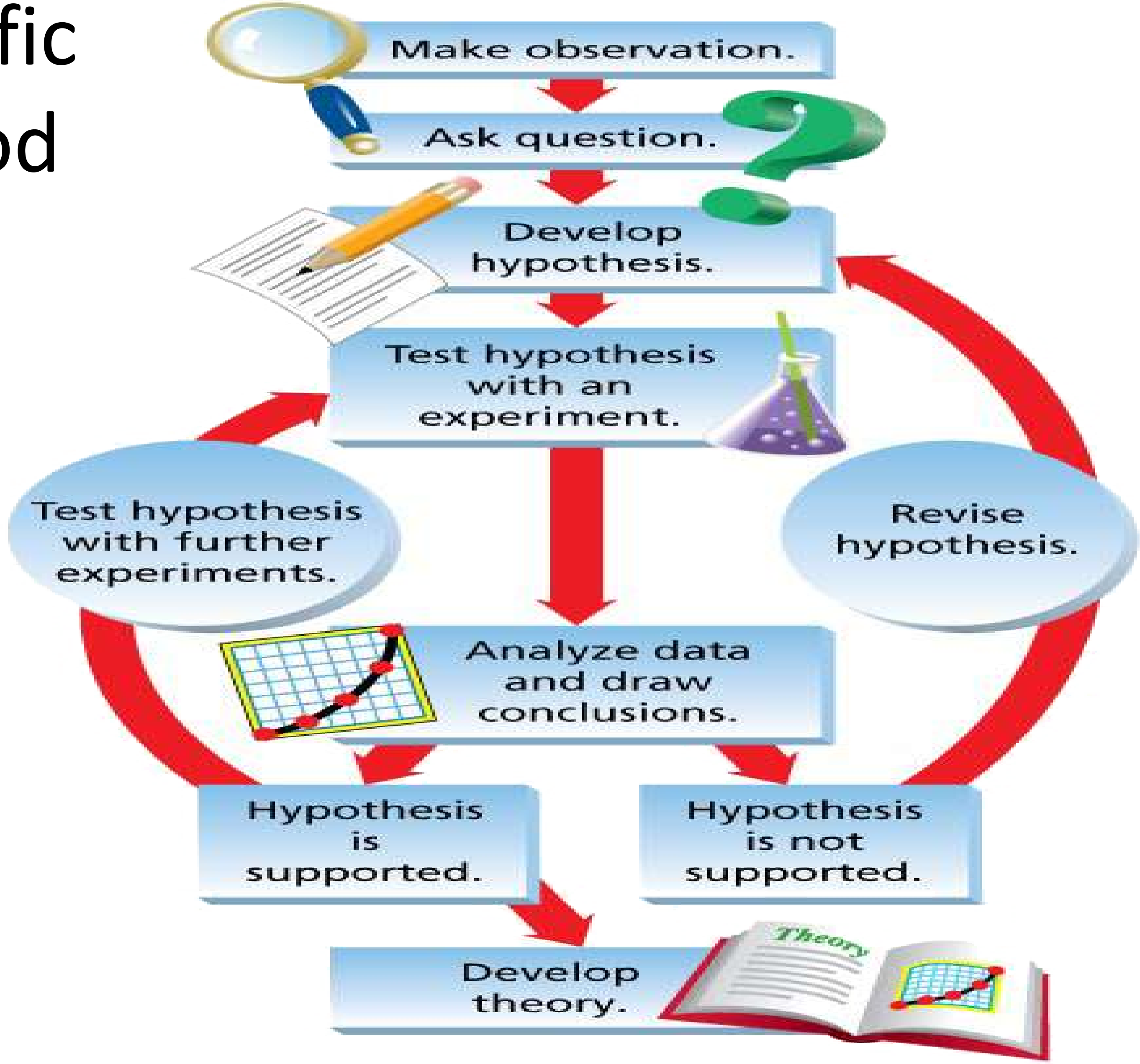
Non-approved Science Fair topics

- Things to consider when developing topic
- Must be testable experiment
  - Example: what temperature of water will grow plants the best in darkness? Can NOT be tested, MOST plants need light for photosynthesis
- Can't test growing (or killing) bacteria at home. This MUST be done in a supervised lab
- Any experiment that involves people, EVERY person tested MUST sign a consent for testing form.
  - If <18 their parent MUST sign form prior to doing test (this includes surveys)
- Can NOT do product comparison

Non-approved Science Fair topics

- what beverage evaporate the fastest?
- what color candle burns fastest?
- do ants prefer sugar vs. artificial sweeteners
- can lemon/oranges/other fruit light an LED bulb
- how does talking on cell phone influence reaction time
- which metal is better at conducing electricity
- which liquid corrodes a rock/nail/(other object) the fastest?
- does eye color impact vison
- what food provides most energy
- what brand of paper towel will work the best
- what brand of contact solution kills bacteria the best?

Scientific Method



Experimentation

- Variables are things that change during an experiment
- Independent variable is the one changed by the scientist [I control, I change]
- Dependent variable is the one that changes because of what the scientist did. [It depends on what I do]
- Both can be measured and both can be changed.
- Constants are things that do NOT change between trails

Scientific Method in the real world

- Teacher Example:
  - Observation: Hairdryer is not working
  - Question: Why is the hairdryer not working?
  - Hypothesis: not plugged in
  - Experiment: check to see if plugged completely in
  - Data: turns on
  - Conclusion: hairdryer was not plugged
- Group Example:

Scientific Theory vs Scientific Law

- Scientific Theory: a well tested explanation for observations and/or experimental result
  - Attempts to explain why or how
  - Can not be proven only can get stronger
  - Kinetic Theory of matter stated atoms are in constant motion and explains how they move
- Scientific law: a statement that summarizes the results of many observations and experiment
  - Does NOT try to explain why/how
  - Gravity

Measurement

Types of measurement
Units of measure
12 metric prefixes
Significant Figures

Types of measurement

- Qualitative measurement based on some quality or characteristic
  - Deals with descriptions.
  - Data can be observed but not measured.
    - Colors, textures, smells, tastes, appearance, beauty, etc.
- **Qualit**ative → **Qualit**y
    - Blue liquid, soft fabric, cold room

Types of measurement

- Quantitative measurement is something that is measurable in quantity
  - Deals with numbers.
  - Data which can be measured.
  - distance, volume, mass, speed, time, temperature, cost, ages, etc.
- **Quantit**ative → **Quantit**y
    - 25.0 g, 48 mL, 3 days, 45 miles

Measurement

- Measuring with SI Units
- The metric system units are based on multiples of 10 and can be converted easily
- International System of Units (SI) is a revised version of the metric system
- **The five SI standard units commonly used by chemists are the meter, the kilogram, the Kelvin, the second, and the mole.**

SI Base Unit

Quantity	**SI standard unit**	**Base unit****
length	Meter (m)	Meter (m)
Mass	Kilogram (Kg)	Gram (g)
Temperature	Kelvin (K)	Kelvin (K)
Time	Seconds (s)	Seconds (s)
Volume	Decimeter cubed (dm^3)	Liter (L) or cubic meter (m^3)
Amount of a substance	Mole (mol)	Mole (mol)
Heat and Energy	Joules (J)	Joules (J)
Force and weight	Newton (N)	Newton (N)

Metric Prefixes

- Added to the base unit to make it larger or smaller
- Changes by powers of 10
- Physical science prefix pneumonic: “King henry died by drinking chocolate milk”
- kilo, hecto, deca, base, deci, centi, milli
- Chemistry has 6 more you may see
- Tera, Giga,mega, kilo, hecto, deca, base, deci, centi, milli, micro, nano, pico
- T, G,M, k,h, da, base, d, c, m, μ, n, p

Pneumonic

- The Great Mad king Henry died by drinking chocolate milk under nick’s porch.

Name	Symbol	Meaning
Tera	T	10^{12}
Giga	G	10^{9}
Mega	M	10^{6}
Kilo	k	10^{3}
Hecto	h	10^{2}
Deca	da	10^{1}
Base	(g, l, m, s)	10^{0}
Deci	d	10^{-1}
Centi	c	10^{-2}
Milli	m	10^{-3}
Micro	u	10^{-6}
Nano	n	10^{-9}
Pico	P	10^{-12}

Metric Prefix meanings

When looking at metric units a unit with only 1 letter is a BASE unit, and units with 2 or 3 letters is a prefix unit

Example:

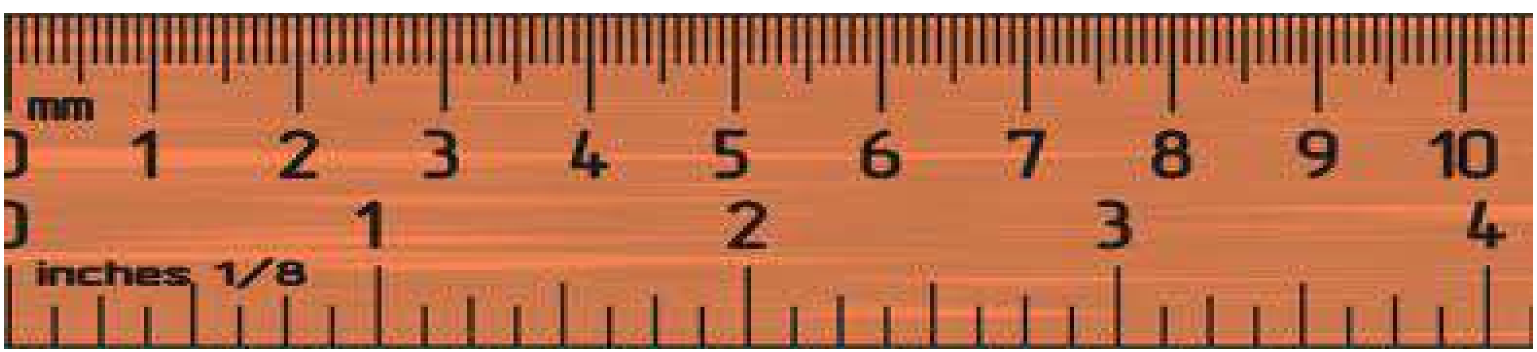
Mm is megameters

m is meters

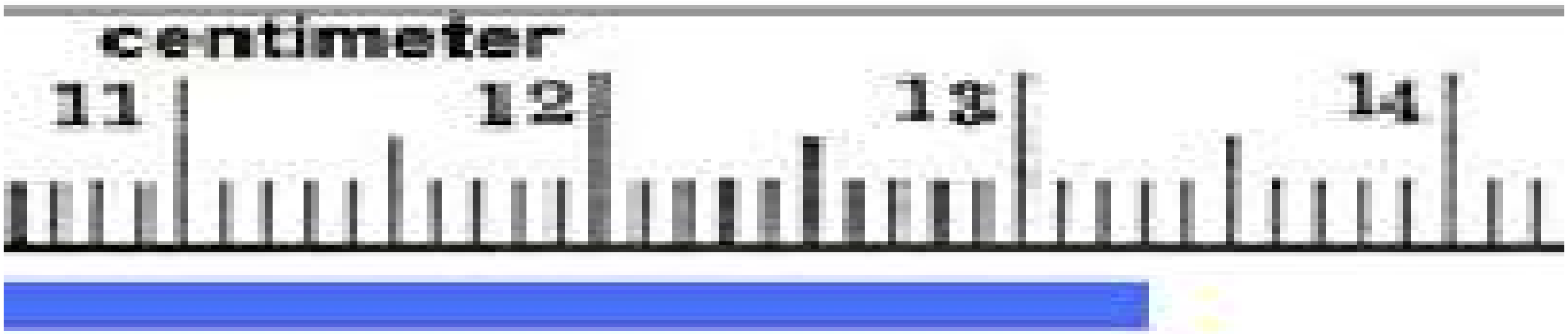
mm is millimeters

- **In general, a calculated answer cannot be more precise than the least precise measurement from which it was calculated.**
  - Example: if measuring with a standard ruler and recording the measurements in cm you measurement can only have two decimal places.
  - The line below would be measured at 3.79 cm.

____



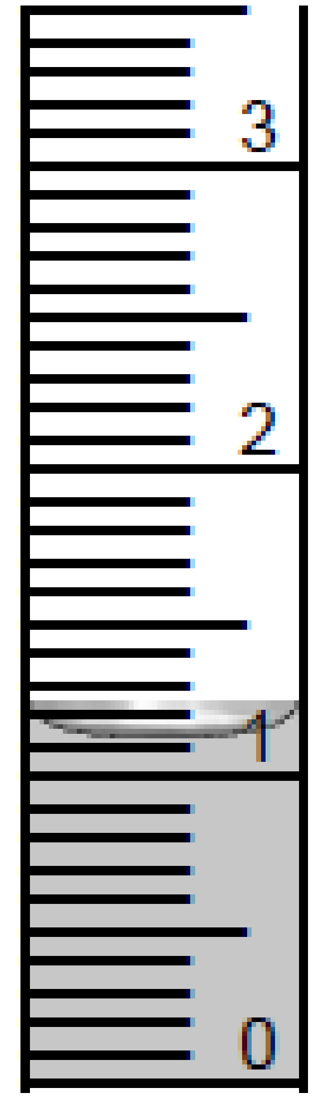
Ruler Example



- The blue line would be recorded to be 13.3_ cm long. With the _ being the estimated digit.
- 13.30 cm, 13.31 cm would both be valid measurements.
- 13.300 cm or 13.310 cm would NOT be valid
- **Read to the unit you are certain of, then estimate one more place.**

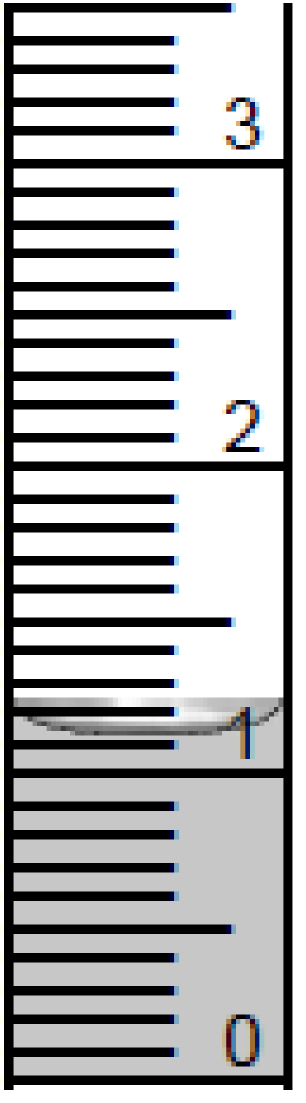
Graduated Cylinder

- In order to read the graduated cylinder correctly, it must be placed on a stable surface such as the desk top of the work area
- And you MUST be at eye level with the meniscus
- To determine the volume of liquid use the number that is directly at or below the bottom of the meniscus



Graduated Cylinder

- You must estimate one more digit that you can precisely measure.
- The graduated cylinder pictured measured in mL and 10th of a mL.
- The blue liquid would have a volume of 1.11 mL or 1.12 mL.
- A measurement of 1.110 mL or 1.1120 mL is more precise than the tool allows.
- **Read to the unit you are certain of, then estimate one more place.**



Significant Figures and Calculations

Complete Significant Figure activity to identify the significant figure rules

Scientific Notation

- When writing very large or very small numbers, scientists use a kind of shorthand called scientific notation.
- This is a way of writing a number without so many zeros.
- Example 1: The speed of light is about 300,000,000 m/s
  - Or 3.0×10^{8}
- Example 2: The mass of a proton is

0.00000000000000000000000001673

  - Or $1.673 \text{ X } 10^{-24}$

All you do is move the decimal so that you **only have one** number before the decimal.

- 850,000,000.0

8 5 0 0 0 0 0 0 0 . 0

$= 8.5 \times 10^{8}$

For large numbers the exponent is positive!!

- 0.000,000,025

0 . 0 0 0 0 0 0 0 2 5

$= 2.5 \times 10^{-8}$

For small numbers the exponent is negative!!

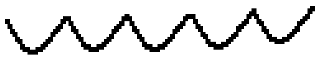
Scientific Notation Examples

- 0.007899 = ?
  - Small number = - exponent 7.899×10^{-3}
- 898745.30 = ?
  - Large number = + exponent 8.9874530×10^{5}
- 0.00003657= ?
  - Small number = - exponent 3.657×10^{-5}
- 531120 = ?
  - Large number = + exponent 5.31120×10^{5}

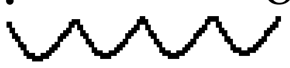
Getting numbers **out of** Scientific Notation

- Look at the exponent of the number to determine if it needs to get smaller or larger
  - Positive exponent means the number get larger so the decimal moves to the right
  - Negative exponent means the number gets smaller so the decimal moves to the left
- Add zeros to fill in any “BLANK” spaces

- Example 1: 2.35×10^5
  - The exponent is positive so the number needs to get larger
  - 2 3 5 .



  - 2 3 5 0 0 0. or 235000
- Example 2: 8.68×10^{-4}
  - The exponent is negative so the number needs to get smaller
  - . 8 6 8



  - 0. 0 0 0 8 6 8 or 0.000868

Scientific Notation Examples

- 3.256×10^4
  - positive exponent = large number 3256
- 9.78×10^9
  - positive exponent = large number 978000000000
- 5.24×10^{-3}
  - Negative exponent = small number 0.00524
- 2.41×10^{-7}
  - Negative exponent = small number 0.000000241

- When rounding first decide how many significant figures the **answer should have.**
- Next round to that number of digits , counting from the left.
- If the number to right of the last significant digit is 4 or less round down, if it is 5 or up round up.
- Make sure you don't significantly change the value of the original number. Can't round 556 to 6 must be 600
- Example: 5,274.827
  - 6 significant figures:
    - 5,274.83
  - 4 significant figures:
    - 5,275
  - 2 significant figures:
    - 5300

- Practice

A. Round 2.3567 to 3 significant figures
B. Round 56913 to 4 significant figures
C. Round 2.0132 to 2 significant figures
D. Round 5678 to 2 significant figure

- Answers

E. 2.36
F. 56910
G. 2.0
H. 5700

Significant Figures Rules

- Significant Digits - Number of digits in a figure that express the precision of a measurement instead of its magnitude.
- Significant figures are just a way of keeping track of our level of precision so that when we do calculations with our data, we don't end up exaggerating it

Significant Figures Rules Simplified

- Rules for determining whether a digit in a stated value is significant
  - Ignore leading zeros. (0.0053 has 2 sig figs)
  - Ignore trailing zeros, unless they come at the **end** of a number **AND** there is a decimal point.
    - 35200 has 3 sig fig
    - 35200. has 5 sig fig
    - 35.200 had 5 sig fig
  - Everything else is significant
  - Defined quantities and counted quantities have unlimited number of significant figures. 1 ft = 12 in has ∞ sigfigs.

Significant Figures Rules Version 2

- Rules for determining whether a digit in a stated value is significant

- If the decimal point is present, start counting digits from the Pacific (left) side, starting with the first non-zero digit. Example: 0.003100 (4 sig. figs.)

- If the decimal point is absent, start counting digits from the Atlantic (right) side, starting with the first non-zero digit. Example: 31,400 (3 sig. figs.)

Significant Figures Complete Rules

- Rules for determining whether a digit in a measured value is significant
  1. Nonzero digits are significant. 5.23 has 3 significant figures
  2. Zeros between nonzero digits are significant. 5001 has 4 significant figures. **[Sandwich rule]**
  3. Zeros at the end of a number **and** to the right of a decimal place are significant. 1.0100 has 5 significant figures
  4. Zeros in front of nonzero digits are not significant, they are only **place holders**. In general start counting at the 1st NON zero number 0.000099 has 2 significant figures. *Start counting at 1st non-zero number.*
  5. Zeros to the left of an understood decimal point are not significant, they are only **place holders**. 55000 has 2 significant figures
  6. Defined quantities and counted quantities have unlimited number of significant figures. 1 ft = 12 in has ∞ sigfigs.

Significant Figures Examples

a) 2.03	a) 3
b) 1.0	b) 2
c) 0.00860	c) 3
d) 4.50×10^{12}	d) 3
e) 5.1020	e) 5
f) 780	f) 2
g) 780,000	g) 2
h) 0.78000	h) 5
i) 50.	i) 2

8-7-17 Opener

- Identify the number of significant figures in each number then write them in scientific notation
- 0.000450
- 2306000
- 0.00009402
- 78000
- 0.002300
- 80200

Significant Figures and Calculations

- With multiplication and division the calculation should be rounded to the same number of significant figures as the measurement with the LEAST number of significant figures
- Example: $2.100 \times \frac{5.32}{12} =$
- Calculator give 0.931
- 12 has only 2 significant figures so the answer must have only 2 significant figures
- Answer MUST BE 0.93

Significant Figures and Calculations

- With addition and subtraction the answer must be rounded to the same number of DECIMAL places as the value with the lease number of decimal places.
- Example: 2.450 – 14.2
- Calculator gives: -11.75
- But must be rounded to 1 decimal place so answer is -11.8

Practice

- Perform the following calculations and round correctly.

	Calculator	Rounded
❑ 2.680 x 0.0051	= 0.013668	= 0.014
❑ 3.120 / 6	= 0.52	= 0.5
❑ 2.45 + 550.9	= 553.35	= 553.4
❑ 9.056 – 4.25	= 4.806	= 4.81

8-8-17 Opener

- Perform the following calculations make sure to following rounding and significant figure rules.
- 22.5 + 13.00 – 8.124
- 13.6 / 3.300
- 0.00230 x 22.4
- 298.50 - 24

- **<u>Dimensional Analysis</u>** is a way to analyze and solve problems using the units of the measurements.
  - It is converting one thing to another without changing its value
  - Requires equality statements and conversion factors.
- **The key to dimensional analysis is to set it up so that the UNITS cancel.**
- **All numbers must have a unit!**
  No Naked Numbers!!!!

- Many quantities can usually be expressed different several different units
- **Equality Statement** shows how two (or more) different units are related
  - Example: 1 dollar = 4 quarters
- **Conversion factor** is a ratio of equivalent measurements.
  - Example: $\frac{100\ pennies}{1\ dollar}\ or\ \frac{1\ dollar}{100\ pennies}$
- Whenever two measurements are equivalent, a ratio of the their measurement will equal 1

- **When a measurement is multiplied by a conversion factor, the number changes, but the actual size of the quantity measured remains the same.**
  - Example: 2.0 hours = 120 minuets = 7200 seconds
- **when using conversion factors the final answer has the same number of significant figures as the starting number**

Name	Symbol	Meaning
Tera	T	10^{12}
Giga	G	10^{9}
Mega	M	10^{6}
Kilo	k	10^{3}
Hecto	h	10^{2}
Deca	da	10^{1}
Base	(g, l, m, s)	10^{0}
Deci	d	10^{-1}
Centi	c	10^{-2}
Mili	m	10^{-3}
Micro	u	10^{-6}
Nano	n	10^{-9}
Pico	P	10^{-12}

Metric Conversions

Look at your units

Largest unit gets a 1

Smallest unit gets $10^{(x)}$

x= lg exponent- sm exponent

Example

_____ mL = ______ ML

Mega is larger so ML = 1

$10^{(6- -3)}$ ml = 1 ML

$10^{(9)}$ ml = 1 ML

Example 1 (metric)

- If a object has a volume of 0.0234 L how much is the volume in pL?

recall that to set up equality statement for metrics you need to write 1 Largest unit= $10^{(x)}$Smallest unit

and x = lg exponent- sm exponent

1 L = $10^{(0-(-12))}$ pL

1 L = 10^{12} pL

$$0.0234\ \text{L} \times \frac{10^{12}\ pL}{1\ \ L} = 2.34 \times 10^{10}\ \text{pL}$$

Example 2 (metric)

- If a student runs 37600 dm how many Mm is it?

recall that to set up equality statement for metrics you need to write
1 Largest unit= 10^(x)Smallest unit

and x = lg exponent- sm exponent

$1\ Mm = 10^{(6-(-1))}\ dm$

$1\ Mm = 10^{7}\ dm$

$$37600\ dm \times \frac{1\ Mm}{10^{7}\ dm} = 3.76 \times 10^{-3}\ Mm$$

$= 0.00376\ Mm$

Example 3 (metric)

- If a object has a volume of 0.00564 daL how much is the volume in pL?

recall that to set up equality statement for metrics you need to write 1 Largest unit= $10^{(x)}$Smallest unit

and x = lg exponent- sm exponent

1 daL = $10^{(1-(-12))}$ pL

1 daL = 10^{13} pL

$$0.00564 \text{ daL} \times \frac{10^{13}\ pL}{1\ daL} = 5.64 \times 10^{10} \text{ pL}$$

8-9-17 Opener

1. Write the metric prefixes in order with their meaning is powers of 10
2. Convert the following metric units. Show ALL calculations with UNITS.
    a. 0.08300 s = ?? ms
    b. 246000 nL = ?? KL
    c. 0.002045 Mg = ?? dg

Equality Statements that you should know.

1 min =	60	seconds
1 hour =	60	minuets
1 day =	24	hours
1 week =	7	days
1 year =	52	weeks
1 year =	365	days
1 foot =	12	inches
1 yard =	3	feet

Metric Conversions

Largest unit = 1
Smallest unit = 10^(x)

x= lg exponent- sm exponent

Example
____ mL = ______ ML

$10^{(6- -3)}$ ml = 1 ML

$10^{(9)}$ ml = 1 ML

Steps for using dimensional analysis.

1. Write equality statement for units needed in problem
2. Write given number and unit then multiply by a fraction.
3. The unit you are getting rid of goes on bottom (starting unit)
4. The unit you are going to goes on top (ending unit)
5. Fill in the fraction with the values from the equality statement and solve.

Example 1

- If a move is 1.48 hours long how many minutes are you in the theater?

Step 1: 60 minutes = 1 hour

Step 2: 1.48 hours ----------

Step 3: $1.48\ hours\ \frac{\qquad}{Hours}$

Step 4: $1.48\ hours\ \frac{min}{Hours}$

Step 5: $1.48\ hours\ \frac{60\ min}{1\ Hour}\ 88.8\ min$

Example 2 ~~ two step problem

- If a movie is 1.75 hours long how many seconds are you in the theater.
  - We don't have one equality statement that relates seconds and hours so we used two

Step 1: 1 hour= 60 min, 1 min = 60 seconds

Step 2-3: $1.75\ Hours \frac{\quad}{Hour} \frac{\quad}{\quad}$

Step 2-4 $1.75\ Hours \frac{min}{Hour} \frac{seconds}{min}$

Step 5: $1.75\ Hours \frac{60\ min}{1\ Hour} \frac{60\ seconds}{1\ min} = 6300\ seconds$

Example 3 ~~ three step problem

- A sample is 3.324×10^8 minuets old how many years old is it?

step 1: 1 year = 365 days, 1 day = 24 hours,
1 hour = 60 minuets

step 2-4:

$$3.324 \text{ x} 10^8 min \frac{hour}{min} \times \frac{day}{hour} \times \frac{year}{day}$$

step 5:

$$3.324 \text{ x} 10^8 min \frac{1\ hour}{60\ min} \times \frac{1\ day}{24\ hour} \times \frac{1\ year}{365\ day}$$

= 632.4 years

Remember

NO NAKED NUMBERS!!!!

Show ALL units

at every step.

Round at the end.

8-10-17

- How many min are in 4.50 days?

- How many years are in 7.920 x 10^{15} seconds

Density

- Density is a unit of mass per unit of volume
  - SI Units of density: g/mL or g/cm^3 or Kg/m^3

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

$$d = \frac{m}{v}$$

- A block of work has a volume of 28.5 m^3 and a mass of 14.05 Kg. What is it's density?

Given	Equation	Solve
v= 28.5 m^3 m= 14.05 Kg D = ?	$D = \frac{m}{v}$	$D = \frac{14.05\ Kg}{28.5\ m^3} = 0.493 \frac{Kg}{m^3}$

Solving word problems

- Example 1: Robin measured the mass of a metal cube to be 25.48 g and the cube measures 3.0 cm on each side. What is the cube density?

- A marble has a mass of 12.48 grams and when placed in a graduated cylinder with 20.0 mL the volume increased to 24.5 mL. What is the marbles density?
  - Given: m= 12.48g d = ?

    v initial= 20.0 mL

    v final= 24.5 mL
  - Equation: d = m/v v = $v_f - v_i$
  - Solve: v = 24.5 ml – 20.0 mL

    d = (12.48 g / 4.5 mL) =2.7733 g/mL

    d = 2.77 g/mL

Using Density

- Rearranging the density equation
  - First get it in a liner format by multiplying by volume
    - Density x Volume = mass
  - If wanting volume then divide by density

$$\text{Volume} = \frac{\text{mass}}{\text{density}}$$

  - These equations can be used to find information using known density values

- The density of copper is $8.920\ g/cm^3$ if you have $52.75 cm^3$ sample of copper how much does it weigh?
  - Given: $d = 8.920\ g/cm^3$

    $v = 52.75 cm^3$

    $m = ?$
  - Equation: $d = m/v$ or $d(v) = m$
  - Solve: mass = $(8.920\ g/cm^3)(52.75 cm^3) =$

    mass = 470.5 g

- A 250.0 g sample of lead occupied what volume? [density of lead is 11.340 g/cm^3]
  - Given: $m = 250$ g

    $d = 11.340\ g/cm^3$

    $v = ?$
  - Equation: $d = m/v$ or $v = m/d$
  - Solve: $v = 250.0\ g / (11.340\ g/cm^3)$

    $v = 22.05\ cm^3$

1. A metallic substance has a volume of 243 cm^3 and a mass of 1915 g what is it’s density?

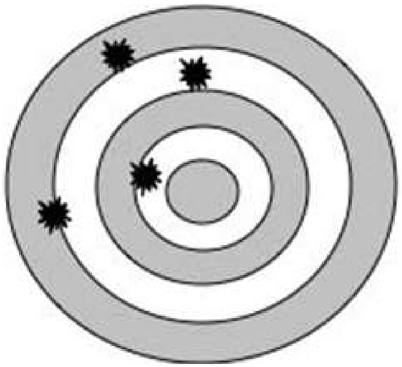
2. Knowing that the density of Zinc is 7.13 g/ cm^3, Iron is 7.87 g/ cm^3 and Nickel is 8.90 g/ cm^3. What is the substances identity?

3. If you had 3.5 kg of the substance what would its’ volume be?

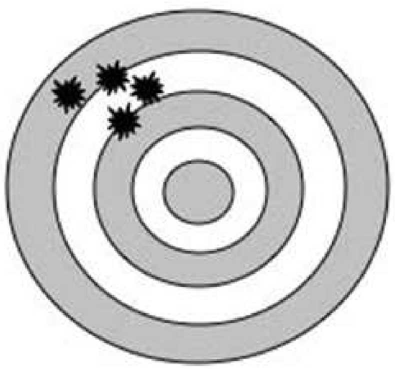
Limits of Measurement

- **Precision** is a gauge of how exact a measurement is.
- Precise measurements are close to each other
- MUST have more than one measurement

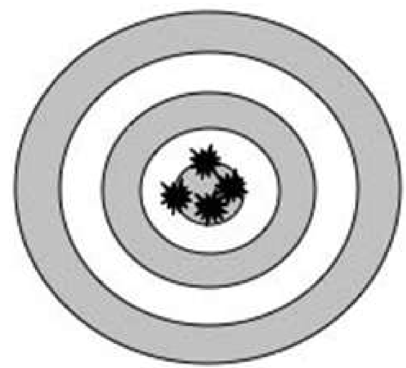
- **Accuracy** is the closeness of a measurement to the actual value of what is being measured
- An accurate measure is close to the true or expected value
- MUST have true or expected value



NOT Accurate (not near center)
NOT precise (not near each other)



NOT Accurate (not near center)
Precise (close to each other)



Accurate (Near center)
Precise (close to each other)

Sally	Annie	Travis	Jeff
1.95 g/cm^3	2.69 g/cm^3	3.12 g/cm^3	2.71 g/cm^3
1.89 g/cm^3	2.73 g/cm^3	2.70 g/cm^3	
1.92 g/cm^3	2.65 g/cm^3	2.25 g/cm^3	

To the right is the data collected by students during a lab.
Actual Density of Aluminum is 2.70 g/cm^3

1. Which students data is accurate and precise?
2. Which students data is accurate but NOT precise?
3. Which students data is NOT accurate but IS precise?
4. Which students data is NEITHER accurate nor precise?

1. Annie
2. Jeff
3. Sally
4. Travis

8-15-17 Opener

- TURN in Density Practice problems at the start of the period (into bin on demo table)
- Give two examples of
  - Qualitative data
  - Quantitate data
- Identify the independent and dependent variables and any constants.
  - Student test how effective tide, gain and purex are at removing coffee stain from a white cotton towel.

Density Practice Problems ANSWERS

3) 13.6 g/mL
4) 158 g
5) 8.9 g/cm^3
6) 238 cm^3
7) 0.00196 g/mL [add decimal to volume]
8) 219.7 g
9) 114 g/cm^3 [can't identify substance]
10) 18.3 cm^3
11) 0.826 g/cm^3

Chemistry Unit 1 Measurement & Calculations review:

12 a. two sig figs

12.b two sig figs

12.c two sig figs

12.d one sig fig

13. ESTIMATE one more decimal place than the device sows. ALL should have 2 decimal places

Chemistry Unit 1 Measurement & Calculations review:

All answers should be to the correct number of significant figures and do NOT have to be in scientific notation (but can be)

14 a. 1.81×10^{8} sec

14 b. 0.187 years

14 c. 2.86×10^{-12} sec

14 d. 5.86×10^{9} ng

14 e. 16600 yards

14 f. 4.23×10^{5} mL

15 a. 0.850 g/cm^3

15 b. 1.1 g/cm^3

15 c. 8.85 g/cm^3

15 d. 250. mL

15 e. 90.4 mL