Professor Kolack

Intro

Matter

Measurement

Why are we here?

- Legislation is passed, judgments are made, about what to make, what to eat, how to produce food and materials, etc, etc, without any knowledge of the science behind the emotion.
- For example, There is plenty of junk science being sold to you by the media and the government. Remember the bird flu (hoax)? Who do you suppose made money when the government stockpiled billions of dollars worth of TamiFlu, the efficacy of which was never proven? If you're interested, read "The Great Bird Flu Hoax" by Dr. Joseph Mercola.
- The previous sentences were written in 2006, before the great swine flu "pandemic" of last year... and despite TamiFlu being shown to be ineffective against swine flu (as well as bird flu before it), it was stockpiled again. So it's not just ancient history that repeats itself. Politics and greed and ignorance are alive and well in our modern times.
- OK, and to get a perfect score and to get ahead.

Chemistry

- The study of the COMPOSITION, STRUCTURE, and PROPERTIES of matter and the CHANGES that occur in matter.

THE BIG SECRET

- Treat chemistry as a second language.
- IF YOU EVER DON'T UNDERSTAND A WORD YOU READ OR A WORD I SAY IN CLASS, LOOK IT UP OR ASK FOR CLARIFICATION.

Matter

- MATTER
  - Everything in the physical world... everything we see, touch, taste, etc.
- *MACRO*SCOPIC
  - Able to be seen with the naked eye. Normally, we are dealing with things too small to be seen (*MICRO*SCOPIC) so we "scale up" our discussion to numbers and/or sizes we can "put our hands on."

Atom

- Smallest DISTINCTIVE unit of matter.
- Composed of protons (positively charged), electrons (negatively charged), and neutrons (no charge)).
- An atom is the smallest unit of matter which retains the same properties as the bulk element.
- There are other subatomic particles (generally studied in advanced Physical Chemistry or Particle Physics) which we do not cover.

Atom (cont'd)

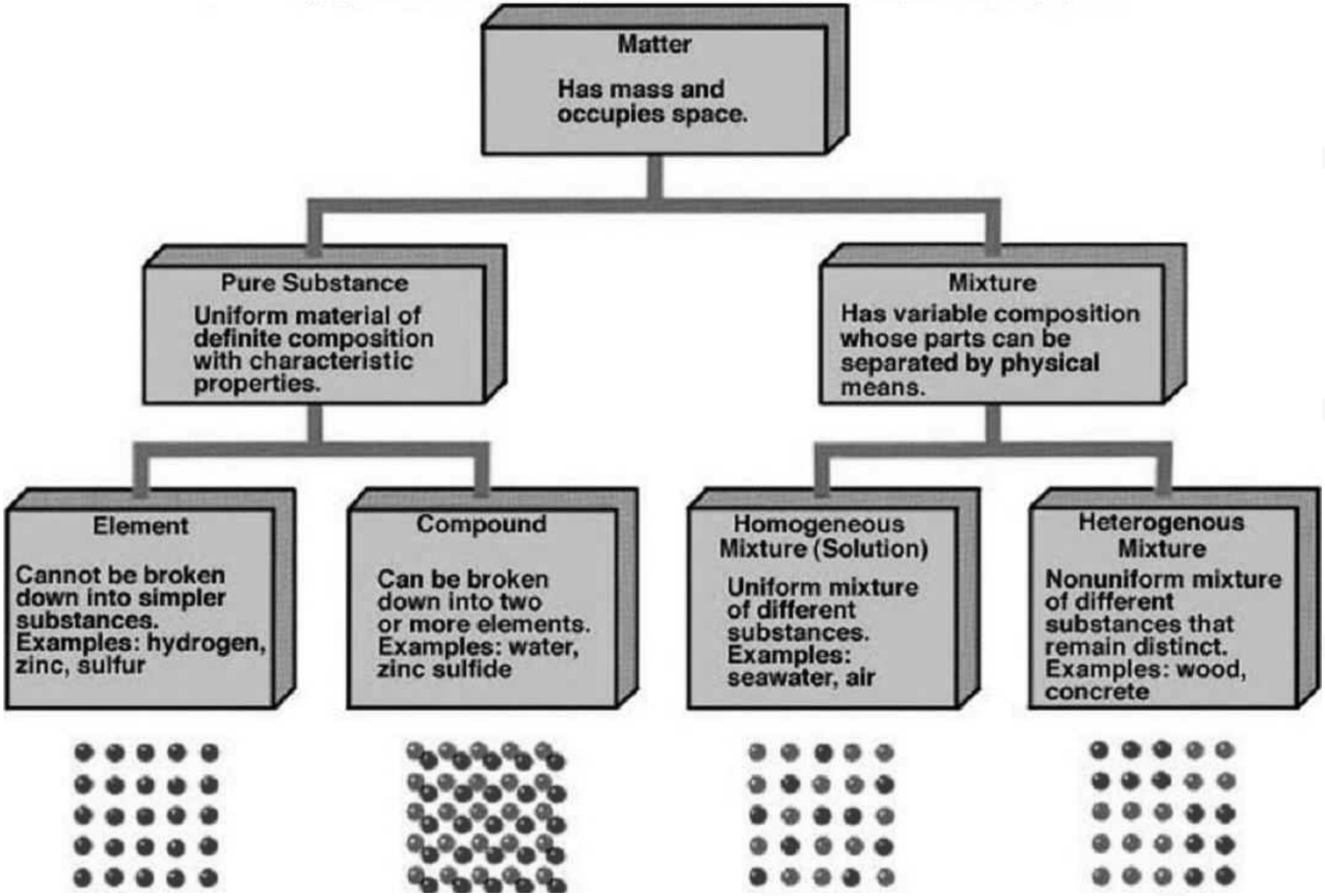
- Protons and neutrons are in the nucleus of the atom and make up the bulk of the mass of an atom
- Electrons are moving around the nucleus and have approx. 1/2000 the mass of a proton or neutron (negligible)

Molecules

- Molecule
  - A fixed combination of atoms
- Composition
  - Type and number of atoms in a COMPOUND.
  - All samples of a compound have the same composition.
  - All samples have the same proportions by mass of the elements present according to Proust's Law of Definite Proportions.
- Physical changes (such as changes of state (solid to liquid to gas)) do not change composition .
- Chemical change - the formation and breaking of bonds.
  - The former releases energy, and the latter requires energy. Composition changes.
- Nuclear change
  - A change in the number of protons/neutrons in the nucleus of the atom. The atom becomes a different atom.

“Substances” and mixtures

- So, a pure “substance” is either an element or a compound if it can’t be separated by physical methods.
  - THIS IS DUMB BUT IT’S IN A LOT OF BOOKS.
- A MIXTURE is exactly what it sounds like- a physical combination of one or more compounds and/or elements.
- If the mixture is uniform throughout, it is *HOMO*GENEOUS.
  - Also known as a SOLUTION.
- If the mixture is nonuniform throughout, it is *HETERO*GENEOUS.


Matter
Has mass and occupies space.
Pure Substance
Uniform material of definite composition with characteristic properties.
Mixture
Has variable composition whose parts can be separated by physical means.
Element
Cannot be broken down into simpler substances. Examples: hydrogen, zinc, sulfur
Compound
Can be broken down into two or more elements. Examples: water, zinc sulfide
Homogeneous Mixture (Solution)
Uniform mixture of different substances. Examples: seawater, air
Heterogenous Mixture
Nonuniform mixture of different substances that remain distinct. Examples: wood, concrete

States of matter

- Three common states:
  - Solid
  - Liquid
  - Gas
- Others
  - Plasma
  - Liquid crystal

The MKS system

- MKS = meter, kilogram, second
  - Length, mass, time
  - SI (system international) units
- Other basic units
  - Temperature is in Kelvin
  - Amount of something in moles
  - Electric current in Amperes
- Derived units
  - Density $\rho = kg/m^3$
  - Force $N = kg\ m/s^2$
  - Pressure $Pa = N/m^2$
  - Energy $J = kg\ m^2/s^2$
  - Electric charge $C = A\ s$
  - Electric potential difference $V = J/C$

Measurements

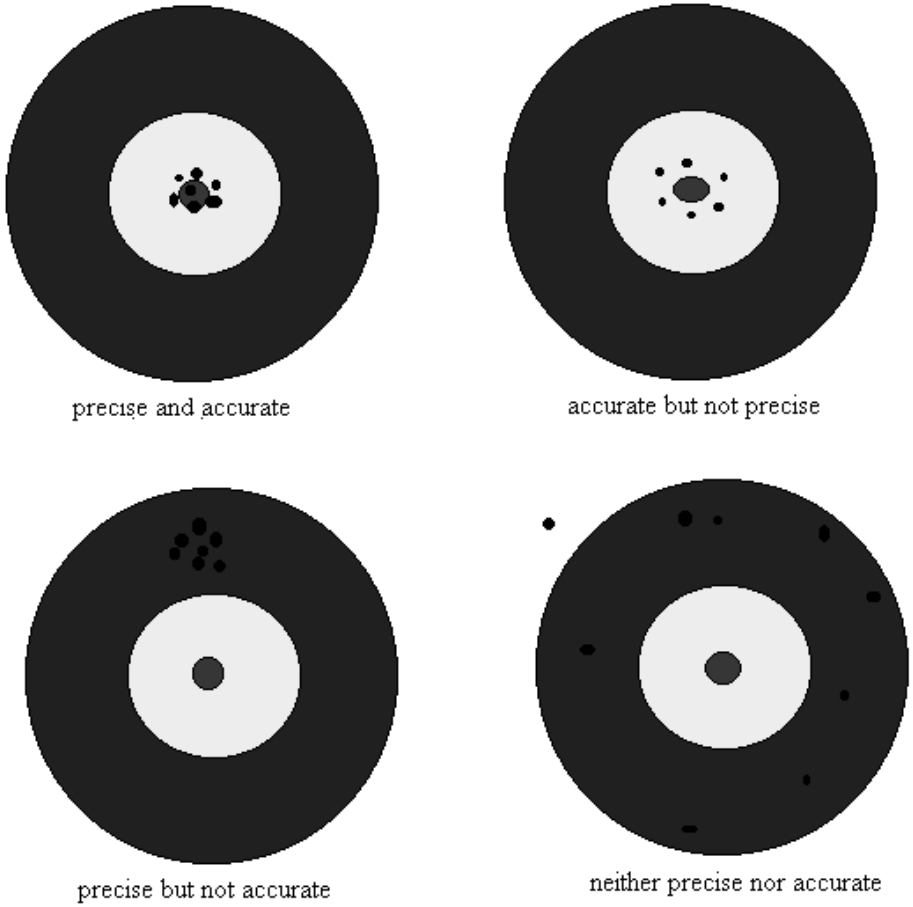
- UNITS, UNITS, UNITS!!!!
  - If your units are correct, the answer will be correct.
  - Use dimensional analysis, factor labeling, whatever you want to call it, to convert what you are given into what you are asked for.

- How many centimeters are in a mile given that one mile is 5,280 feet and there are 3.28 feet per meter?

Measurements (cont'd)

- Accuracy
  - How close to an accepted value a measurement is.
- Precision
  - How close to each other a series of measurements are.

Precision vs accuracy



Which is more accurate, a scale that weighs things to pounds and ounces or to the pound only?

Significant figures

- All nonzero digits are significant.
- Trailing zeroes AFTER a decimal point are significant.
- Trailing zeroes WITHOUT a decimal point are NOT significant.
- Zeroes between significant figures are significant.
- In an addition or subtraction, the answer has as many digits past the decimal point as the number with the least number of digits past the decimal point in the question.
- In a multiplication or division, the answer has as many significant digits as the number with the least number of significant digits in the question.
- When performing calculations, do NOT limit the number of significant digits in your answer because of a conversion factor.

Exponents & scientific notation

- Chemists are lazy and like shorthand
  - Numbers are expressed showing only the significant digits
  - eg 171,000 = 1.71×10^{5}
  - eg 0.0092 = 9.2×10^{-3}
  - Exactly 1 digit before the decimal place
- Don't forget your algebra rules!
  - To add/subtract, you need the same exponent
    - $(A \times 10^{x}) + (B \times 10^{x}) = (A+B) \times 10^{x}$
    - $(A \times 10^{x}) + (B \times 10^{y}) = ???$
  - For multiplication
    - $(A \times 10^{x}) \times (B \times 10^{y}) = (AxB) \times 10^{x+y}$
  - For division
    - $(A \times 10^{x}) / (B \times 10^{y}) = (A/B) \times 10^{x-y}$
  - For exponentials
    - $(A \times 10^{x})^{y} = A^{y} \times 10^{xy}$

Logarithms

- Generally only used when discussing acids/bases (pH) in AP chemistry
- $\log_{\text{base}}$ answer = exponent
- eg for 1.0×10^{-10}
  $\log_{10}$ .0000000001 = -10
- Negative log (-log) is not the same as inverse log (10 to the whatever power)
- ln x = m for $x = e^m$