The Nature of Chemistry

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Science:

- Uses a process
- Objective
- Updated constantly

Pseudo Science:

- Lacks process
- Subjective
- Resistant to new information

- Chemistry is the "central science"
- Chemistry is important to society, but can be harmful at the same time.
- What makes information trust worthy depends on reliability.

Hypotheses, Laws, and Theories

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Difference between hypotheses, theories and laws:

- Hypotheses: Testable explanation of a scientific problem that is based on research and observation.
  Example: If the chemicals react, then their mass will not change because matter cannot be created or destroyed in chemical reactions.
  - Uses the if/then/because statement
  - Must be testable through a scientific investigation
  - Must be falsifiable (could be rejectable)
  - Can be supported or refuted by data
- Theory: Well-supported, widely accepted explanation for many observations.
  Example: Dalton's atomic theory
    - All matter is composed of atoms
    - Chemical reactions occur through the rearrangement of atoms
    - Atoms cannot be made or destroyed during chemical reactions
  - Must be testable
  - Must be falsifiable
    - Requires many confirmed data to overturn or modify
  - Can be used to make predictions
  - Can explain observations
- Laws: Description of a naturally occurring process or event
  Example: Matter cannot be created or destroyed in a chemical reaction.
  - Can be used to predict events or experimental results
  - Is supported by all available observations and data
  - Does not explain observations

All three of these can be testable and can be falsifiable.

How scientists work with a Hypothesis:

- Make a hypothesis:
  - Attempt to explain an observation or answer a question.
- Test the hypothesis through experimentation..
- Support the hypothesis:
  - See if data agree with the hypothesis.
- Refute the hypothesis:
  - See if there is some data available that do not support the hypothesis.
- New data lead to a new hypothesis
- Continue to evaluate as new data become available.

- Phlogiston hypothesis - Materials contain phlogiston, which is released when material burns.
  - Mass of ashes < Mass of wood
- Test: Lavoisier headed mercury.
  - Mass of product > Mass of mercury.

Dalton's Atomic Theory:

- All matter is composed of atoms
- Atoms cannot be made or destroyed during chemical reactions
- All atoms of an element are identical
- Different elements have different kinds of atoms

Write 2.5 x 10^5 km in standard notation

- 2,5 x 10^5 km = 250,000 km

How to multiply And Divide in scientific Notation:

- Exponents are added or subtracted when multiplying or dividing.
- Multiplying: multiply the two coefficients (numbers) and add the exponents
- Dividing: divide numbers by numbers and subtract exponents when dividing.

Significant Figures	The digits that are known for a measurement plus one estimated digit.

Rules of Significant Figures:

1	ALL non-zero numbers are ALWAYS significant
2	ALL zeros between non-zero numbers are always significant
3	ALL zeros which are to the right of the decimal point and at the end of the number are always significant.
4	All zeros which are to the left of a written decimal point and are in a number >=10 are always significant

58.4428 g = 6 significant figures
58.44 g = 4 significant figures

Mass of the Moon:
73,476,730,924,573,5 | 00,000,000 kg

- 15 Significant figures
- 8 Place holder Zeros

Adding / Subtracting Significant Figures:

- Adding: Line the decimal points up
    - 145.78
      \+ 6.8138 = 152.5939

    - Able to oxidize in air
- Easily lose an electron to form a +1 Cation.

Alkaline Earth Metals	Group 2 or 2A	

- Typical Properties:
    - Silver in color
    - More brittle than alkali metals
    - Somewhat reactive
    - Low in density, with low melting and boiling points
- Lose two electrons to form a +2 cation.

Halogen	Group 17 or 7A	Fluorine, Chlorine, Bromine, Iodine, Astatine, Ununseptium

- Typical Properties:
    - Highly reactive with metals
    - Toxic to organisms
    - Most occur as diatomic molecules
    - Reacts with metals to form salts.
- Easily gain an electron to form a -1 anion

Noble Gases	Group 18 or 8A:	Helium, Neon, Argon, Krypton, Xenon, Radon, Ununoctium.

- Inert Gases (nonreactive)
- Typical Properties:
    - Odorless and tasteless
    - Nonreactive and nonflammable
    - Extremely low boiling points
    - Produce characteristic colors when excited electrically

Transition Metals	Groups 3 - 12 or Group B	

- Typical Properties:
    - Form colored compounds
    - May have unusual properties:
        - Magnetism
        - High Conductivity

Lanthanides	Elements 57 to 71
Actinides	Elements 89 to 103

- Typical Properties:
    - Radioactivity
    - Unstable
    - Present in only trace amounts on Earth.

Molar Masses

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Mole (Mol)	The SI unit for the amount of a substance; The number of atoms in 12 g of C-12, or 6.02×10^{23}
Avogadro's Number	The number of units in a mole, 6.02×10^{23}

- Chemists use the mole and Avogadro's number to relate average atomic mass to molar mass
    - Periodic table: average atomic mass, AMU
    - Molar Mass: The mass in grams of 1 mole of a substance

The molar mass of an element, in grams per mole, has the same value as the average atomic mass of the element in amus.

Finding the molar mass of compounds:

- Identify the component elements and their average atomic masses
- Identify the number of atoms of each element in one unit.
- Calculate the mass of one unit by multiplying the amount of atoms by each element's atomic mass, and then adding both of those numbers together.
- Convert from atomic mass units to grams per mole.

Solids & Plasmas

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