Ch. 1 Notes (part 1) – THE CENTRAL SCIENCE

NOTE: Vocabulary terms are in **boldface and underlined**. Supporting details are in *italics.*

I. Chemistry

A. Why study chemistry?
CHEM IS LIFE! Chemistry is the study of everything around us.
Everything in the natural world can be connected to chemistry.

B. What is **chemistry**? some definitions…
1) *the study of matter and its changes*
2) a science that deals with the composition, structure, and properties of substances and their transformations
3) scientific study of matter, its properties, and interactions with other matter and energy
4) study of **substances** – matter with a definite composition (elements, compounds, etc.)

C. Some *branches of chemistry*
1) *Analytical* – chemical composition
2) *Astrochemistry* – of the cosmos (planetary atmospheres, comets, etc.)
3) *Biochemistry* – rxns. (reactions) of living organisms
4) *Environmental* – environmental issues: pollution, water quality, etc.
   a) ozone (O_3) vs. oxygen gas (O_2)
   b) chlorofluorocarbons (CFCs)
   c) acid deposition (H_2SO_4, HNO_3)
5) *Food and Cooking* – reactions during cooking, ingredients, etc.
6) *Geochemistry* – geological issues; petrology, etc.
7) *Industrial chemistry* – study and implementation of chemical processes in manufacturing goods
8) *Inorganic* – focuses on inorganic compounds (without carbon)
9) *Nuclear* – focuses on rxns. changing of matter to energy
10) *Organic* – focuses on carbon compounds
11) *Physical* – physical characteristics and reaction mechanisms
12) *Polymer chemistry* – study of chemical composition of plastics
13) *Thermochemistry* – thermodynamics; heat changes
14) *Theoretical chemistry* – "the examination of the structural and dynamic properties of molecules and molecular materials using the tools of quantum chemistry, equilibrium and nonequilibrium statistical mechanics and dynamics" (from Cornell)

II. Chemistry and Matter

A. Mass and weight
1) **matter**—*a substance that takes up space and has mass*
2) **mass**—*the amount of matter in an object*
3) *properties of matter—characteristics and behavior; can be physical or chemical*
4) **weight –** *Earth's gravitational pull on an object*

B. Structure and observable characteristics
1) *macroscopic view*—matter large enough to be seen
2) *submicroscopic view*—dealing with atoms

3) scientific **model**—a visual, verbal, or math explanation of data; helps you understand the relationship between macroscopic and submicroscopic views

III. Scientific Methods

A. Definitions of **Science** (both content and process)
1) a process of using evidence to construct testable hypotheses
2) process of attaining knowledge about the natural world through study and practice
3) knowledge about or study of the natural world based on facts learned through experiments and observation. (Webster)
4) "knowledge covering general truths of the operation of general laws, especially as obtained and tested through scientific method and concerned with the physical world" (from New Collegiate)

B. Science as a systematic approach to the process of learning
1) **scientific method**
   a) *systematic plan for testing ideas*
   b) *an organized way to solve problems*
2) **observation**—*gathering and recording information*
   a) *direct observation—made with the senses* (sight, sound, smell, touch, hearing) "It is hot in here."
   b) *indirect observation—made with measuring instruments* (thermometers, rulers, scales, clocks, etc.) "It is 83° in the room."
   c) **qualitative data**—*verbal*, not numerical, *description* (rough, bright, red...)
   d) **quantitative data** —*description by numbers* (10 lbs., 98.6°, 5'4" tall…)
3) **hypothesis**
   a) *educated guess; testable prediction/explanation*
   b) can be accepted or rejected, not proven
   c) many are made initially; most likely ones are chosen to pursue
4) experimental and control setups
   a) **experiment**—*a controlled test of a hypothesis*
   b) **experimental group**—*the variable being tested is present in this group*
   c) **control group**— *the variable being tested is absent from this group*
5) **variables**
   a) *anything affecting the outcome of the experiment*
   b) examples: temperature, air quality, amount of light, humidity
   c) *only one can be tested at a time for the experiment to be valid*
   d) **independent variable**
      - *changed by the experimenter*
      - abscissa: x axis
   e) **dependent variable**
      - *changes based on what the independent variable does*
      - ordinate: y axis
6) **conclusion**—*a judgment based on information gathered during an experiment*
7) What happens next? More research!
   a) review the existing literature
   b) experimental results are shared with other scientists
   c) repeat experiments to see if results are consistent

8) **theory**
   a) *repeatedly and thoroughly tested and supported explanation*
   b) *long description which tells why*
   c) *can never be proven*

The layman's definition of theory is incorrect! ("I have a theory why they aren't talking to me.")
Theories are not guesses, nor are they wild ideas.
Real theories have substantial scientific evidence behind them.

9) **scientific law**
   a) *concise statement which tells what*
   b) *relationship in nature that is supported by many experiments' results*
   c) *can be proven*

If a question asks for *lab design***,** include the following:

a. Your *hypothesis* and/or predictions/expected results
b. The *independent variable* - what treatments will you apply
c. The **dependent variable** - what will you measure
d. The **variables to be controlled** (very important)
e. The **organism/materials/apparatus to be used**
f. Describe what you will **actually do**
g. Describe how you will actually **take and record data**
h. Describe how the data will be **graphed and analyzed**
i. State how you will draw **a conclusion** (compare results to hypothesis and predictions)

Note: Your experimental design **needs to be at least theoretically possible** and it is very important that your conclusions/predictions be consistent with the principles involved and with the way you set up the experiment.

IV. Scientific research
   A. **Pure research**—investigation for the sake of knowledge
   B. **Applied research**—investigation to solve a specific problem