Intro/Scientific Method

1. Intro
    1. Welcome to Chem 1! Your first assignment is to give me some information about you.
    2. Handout: Text Notes for this Unit, Expectations and Late Passes
    3. Demo: Gummy Bear Safety
    4. Lab: Alchemist's Dream Come True (sort of)
    5. What is chemistry?
        1. An alchemist recipe: (from "Chemistry" by Masterton, Slowinski, and Walford) "Take all the mineral salts there are, also all salts of animal and vegetable origin. Add all the metals and minerals, omitting none. Take two parts of the salts and grate in one part of the metals and minerals. Melt this in a crucible, forming a mass that reflects the essence of the world in all its colors. Pulverize this and pour vinegar over it. Pour off the red liquid into English wine bottles, filling them half-full. Seal them with the bladder of an ox (not that of a pig), Punch a hole in the top with a coarse needle. Put the bottles in hot sand for three months. Vapor will escape through the hole in the top, leaving a red powder, ..."
        2. Why might it be hard to reproduce the alchemist's experiment as described above? Be specific.

        3. What do you think of when you hear the work chemistry? What is chemistry?

        4. Chemistry (a definition): the study of substances using the scientific method to understand the relationship between what can be observed in experiments and the underlying atoms and molecules which are too small to be seen.
    6. Set up lab drawers.
2. Doing Science

1. The Glowing Tomato
    1. How fireflies make light: Luciferase, an enzyme, catalyzes the oxidation of luciferin. During this process the luciferin gives off light. See this article from ChemMatter 8/95 for more detail.
    2. One of the first experiments which was done in transferring genes from one species to another was the transfer of the gene which produces Luciferase from a firefly into a tomato plant. Imagine that you are chemist working for a company that wants to market this new tomato plant which glows wherever the surface of the plant is damaged. How would you determine if the tomato is safe for people to eat?

2. Homework: Write up a plan for how you would determine the safety of this tomato for public consumption.

3. Scientific Method
    1. Whenever possible a control should be used. A control experiment is an experiment which duplicates another experiment in every way possible except for the particular factor being tested. For example: If you wanted to test the efficacy of a new drug, you would have at least two groups of people, neither of which knows if they are taking the drug. One group would be given a pill that contains the drug being tested, and the other would get a placebo (a pill not containing any active ingredients). Everything else about the two groups should be as identical as possible. The group taking the placebo is called the control group or experiment.
    2. Experimenting using the scientific process follows a certain cycle.
        1. Make observations that lead you to ask a question.
        2. Come up with a hypothesis to explain your observations.
        3. Collect data on experiments that you did to test you hypothesis.
        4. Analyze the data and go back to step iii.
        5. Repeat the above cycle until you have enough evidence/data to suggest that you may have the correct answer to your questions.

3. The two most important pieces of the Scientific Method are using a control when possible and repetition of experiments to verify results.
4. Cold fusion story.

4. Homework: Read the article on "Smoking Moms" and determine which group is the control and which is the experimental. Write a short paragraph explaining why you made this choice.
5. How does a candle work? If you don't know, how would you test some ideas? If you think you do know what tests could you do that would provide evidence to support your theory?
6. Lab: Determine how a candle works.
7. Homework: Write as much as you can about how you think a candle works. Make specific references to the experiments you performed that lead you to believe your conclusions.

3. Properties
    1. Properties Definition
        1. Properties are the defining characteristics of a substance. The type of properties that we are interested in are the properties of substances not objects. Aluminum, for example, can be shaped into many different objects. However, we are interested in what properties all of these objects share.
        2. Physical Properties
            1. Physical properties can be determined without destroying the original substance.
            2. Physical properties tend to be those which are easily observed or measured without reacting the substance with another chemical.
            3. What are some examples of physical properties?
        3. Chemical Properties
            1. Chemical properties describe how one substance can react with another substance. To determine chemical properties and experiment must be done in which some of the original

substance is reacted with another substance.

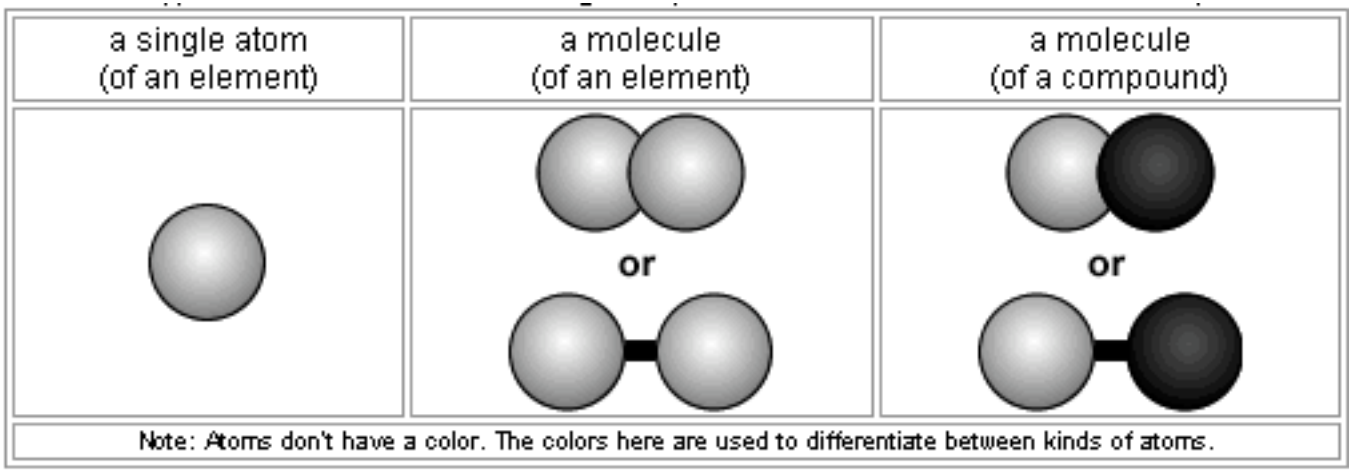
2. What are some examples of chemical properties?

4. Chemical reactions have occurred when you change the physical and chemical properties of the original reactants. The new substance will have new properties that may be completely different.
5. The properties of a substance are based on the underlying types and arrangement of atoms and molecules. The world of the unseen is our complete explanation for the observed properties. Carbon comes in several forms. Below are two of them: GRAPHITE and DIAMOND. Notice the differences between the two atomic structures. How can they explain the property of hardness?

2. Demo: rubber balls of different composition
3. Demo: three substances that look the same.
4. Demo: properties of hydrogen and oxygen.
5. What are the properties of candle wax?

6. Homework: Pick a substance and describe as many physical and chemical properties as you can. Be sure to categorize each property as physical or chemical.

4. Classification of Matter
    1. Pure Substances vs. Mixtures
        1. Matter can be classified in to two broad categories: pure substances and mixtures.
        2. Pure substances
            1. Elements - all the same type of atom.
                1. elemental info
                2. The Elements Song by Tom Lehrer
            2. Compounds - substances made from two or more different kinds of atoms.
        3. Mixtures
            1. Homogeneous
                1. Mixtures which are the same throughout with identical properties everywhere in the mixture.
                2. Not easily separated.
                3. This type of mixture is called a solution. A good example would be sugar dissolved in water or some type of metal alloy like the CROmium-MOLYbdenum steel used in many bike frames.
            2. Heterogeneous
                1. Mixtures which have different properties when sampled from different areas.
                2. Examples of this would be sand mixed with water or peanuts mixed with raisins.
        4. Atoms vs. Molecules
            1. Atoms - the smallest piece of matter you can have that chemists can do reactions with is an atom. Each element has it's own type of atom. How to distinguish between atoms will be explained in a later unit.
            2. Molecules - two or more atoms bonded together with a covalent bond (more on that bond later) is called a molecule.
                1. If all the atoms bonded together are of the same time the molecule formed is still an element.
                2. If different types of atoms are bonded together, then the molecule formed is a compound.



5. Click the image below for a graphical representation of these ideas.
6. Using molecular modeling kits create several examples of an element, compound, and a mixture.

2. Homework: Element, Mixture, and Compound sheet

5. Chromatography
   1. Demo: chromatography of black marker
   2. Lab: How does chromatography work?
   3. Homework: Write up chromatography lab results. How does this work? Make specific references to the experiments you performed that lead you to believe your conclusions.
   4. Handout: Chromatography guiding questions.
   5. Chromatography Details
      1. Chromatography is a process of separating mixtures.
      2. In order to perform chromatography you will need the following items:
         1. Chromatographic column (this is some sort of solid support)
         2. Solvent (this is often a liquid or a gas in which some mixture is dissolved)
         3. Mixture

3. A mixture by definition is made of more than one substance. Each substance will have its own set of properties. The substances in a mixture can be separated if they have differences in their properties. Chromatography uses two different properties for separation
    1. Adsorption - the property of how well a substance in the mixture sticks to the chromatographic column. The higher the adsorption the slower the substance will move along the column.
    2. Solubility - the property of how well a substance in the mixture dissolves into the solvent. The higher the solubility the faster the substance will move along the column.
4. By exploiting differences in these two properties we can make the different substances move at different speeds along a chromatographic column by choosing the appropriate solvent and column material.

6. Lab: Make chromatography bookmarks.
7. Homework: Assuming that each dye which makes up the color of a marker is a compound, draw a picture like that in the Element, Mixture, and Compound sheet to represent the following marker colors: yellow, green, and black.
8. Demo: Distillation as another example of separation through differences in properties.

6. First Quarter Project - Here are some examples of good papers
    1. Example 1 - with notations
    2. Example 2
    3. Example 3
7. Test Review