WHAT IS CHEMISTRY?

- Chemistry is the science that deals with the **_materials_** of the universe, and the **_changes_** they undergo.

- *Materials* of the universe can be of several forms:

> **Gas:**   air, oxygen
>
> **Liquid:**   water, gasoline, vinegar, orange juice,
>
> **Solid:**   rocks, charcoal, table salt, sugar, wood, baking soda

- Some examples of **changes**:

Burning of charcoal

> charcoal + oxygen $\longrightarrow$ carbon dioxide

Burning of gasoline

> gasoline + oxygen $\longrightarrow$ carbon dioxide+ water vapor
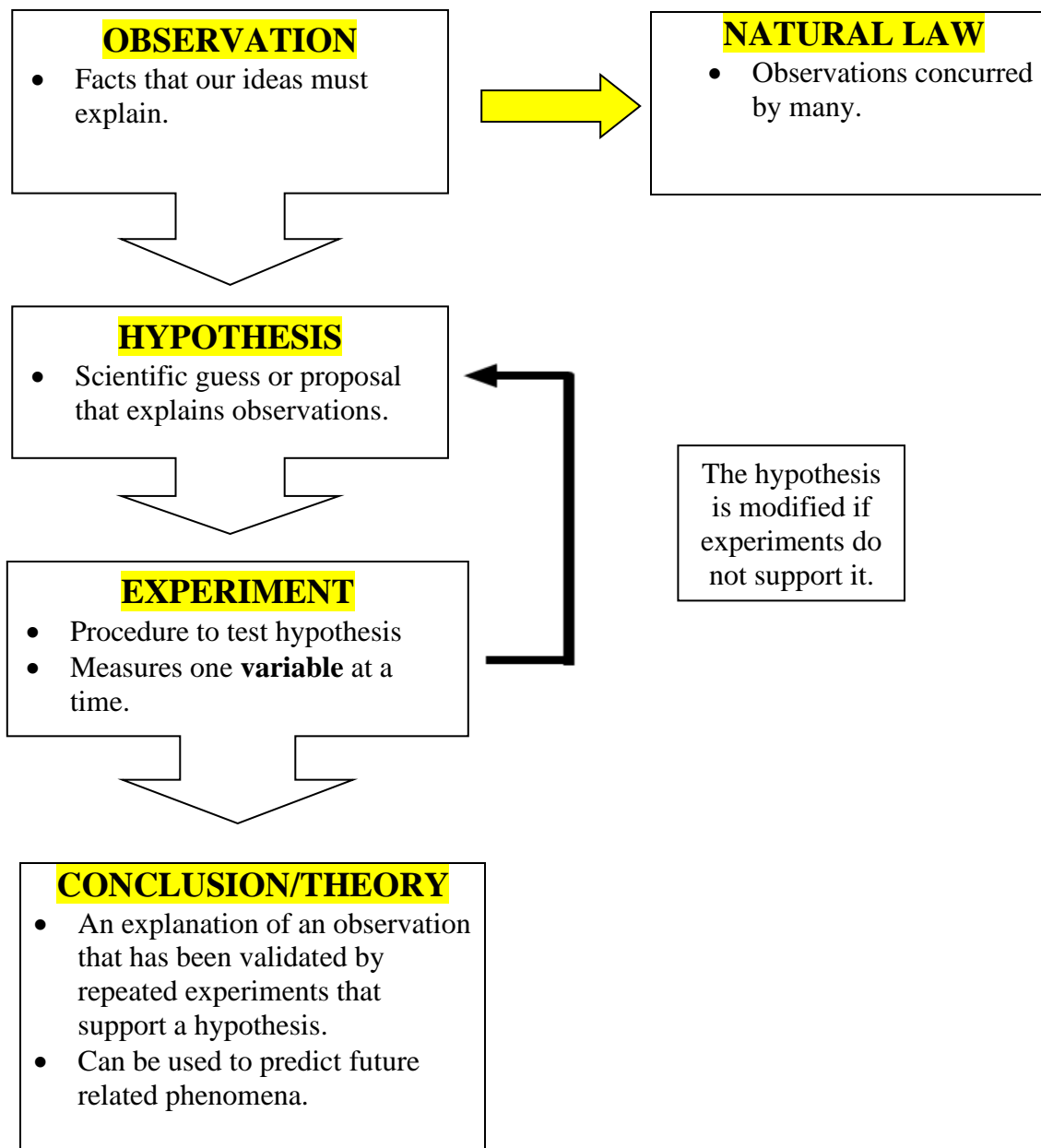
Fermentation of grape juice

> glucose $\longrightarrow$ ethyl alcohol + carbon dioxide
> (in water)   (in water)

Souring of wine

> ethyl alcohol + oxygen $\longrightarrow$ acetic acid
>   (in water)   (from air)   (in water)

THE SCIENTIFIC METHOD

- The scientific method is a **process** of creative thinking and testing aimed at **objective** and **verifiable** discoveries. It is generally composed of the following steps:

OBSERVATION
- Facts that our ideas must explain.

NATURAL LAW
- Observations concurred by many.

HYPOTHESIS
- Scientific guess or proposal that explains observations.

The hypothesis is modified if experiments do not support it.

EXPERIMENT
- Procedure to test hypothesis
- Measures one **variable** at a time.

CONCLUSION/THEORY
- An explanation of an observation that has been validated by repeated experiments that support a hypothesis.
- Can be used to predict future related phenomena.

Examples:
Identify each of the following as an *observation*, a *hypothesis*, an *experiment* or a conclusion:

1. Drinking coffee at night keeps me awake.   _____

2. I will try drinking coffee only in the morning.   _____

3. If I stop drinking coffee in the afternoon, I will   _____
   be able to sleep at night.

4. When I drink decaffeinated coffee, I sleep better   _____
   at night.

5. I am going to drink only decaffeinated coffee.   _____

6. I sleep better at night because I stopped drinking   _____
   caffeinated drinks.
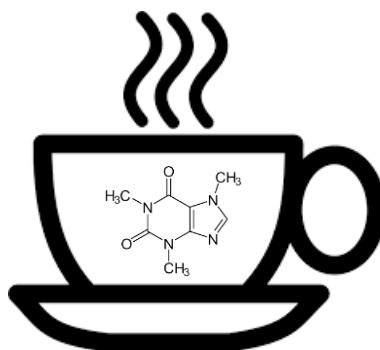
KEY MATH SKILLS & CONCEPTS

- Knowledge of the skills and concepts listed below are essential in your success in this course. Use the resources available at the college to brush up your knowledge of these skills and concepts at the start of the semester in order to be more successful in this course.

Calculating Percentages:
To determine a percentage, divide the parts by the total (whole) and multiply by 100. For example, if an aspirin tablet with a mass of 545 mg has 325 mg of active ingredient, the percentage of aspirin (active ingredient) in the table can be calculated as shown below:

$$\frac{325 \text{ mg}}{425 \text{ mg}} \text{x}100 = 59.6\% \text{ aspirin}$$

Solving Equations:
In chemistry, we use equations that express the relationship between certain variables. Solving for the variable in these equations are important, as they represent the information desired. As an example, the steps below shown how to solve for x in the equation $2x + 8 = 14$

$$2x + 8 = 14$$

combine like terms: $2x + 8 - 8 = 14 - 8 \quad \rightarrow \quad 2x = 6$

isolate the variable $\dfrac{2x}{2} = \dfrac{6}{2} \quad \rightarrow \quad x = 3$

Examples:
1. A bag of gumdrops contains 16 orange gumdrops, 8 yellow gumdrops and 16 black gumdrops. What is the percentage of each color of gumdrops in a bag?

2. Solve each equation below for m:

   a) $q = m \text{ x } \Delta T \text{ x } C$ b) $d = \dfrac{m}{V}$

SCIENTIFIC NOTATION

- Scientific Notation is a convenient way to express **very large** or **very small** quantities.

General form:

$$\textbf{A x 10}^{\textbf{n}} \qquad \textbf{1} \le \textbf{A} \textbf{<10} \qquad \textbf{n= integer}$$

- Converting between decimal and scientific notation:
    1. Move the decimal point in the original number so that it is located after the first nonzero digit.
    2. Follow the new number by a multiplication sign and 10 with an exponent (*power*).
    3. The exponent is equal to the number of places that the decimal point was shifted.
    4. For numbers smaller than 1, the decimal moves to the right and the power becomes negative.

> 75,000,000   changes to 7.5×10^{7} (7 to the left)
> 0.00642   changes to 6.42×10^{-3} (3 to the right)

Examples:

      1. Write 6419 in scientific notation:

      2. Write 0.000654 in scientific notation:

- Addition and subtraction (NOT COVERED)
- Multiplication and division :
    1. Change numbers to exponential form.
    2. Multiply or divide coefficients.
    3. **Add** exponents if **multiplying**, or **subtract** exponents if **dividing**.
    4. If needed, reconstruct answer in **standard** exponential notation.

Examples:

      1. Multiply 30,000 x 600,000

$$(3 \times 10^4)\,(6 \times 10^5) = 18 \times 10^{(4+5)} = 18 \times 10^9 = 1.8 \times 10^{10}$$

      2. Divide 30,000 by 0.006

$$\frac{3 \times 10^4}{6 \times 10^{-3}} = \frac{3}{6} \times 10^{[4-(-3)]} = 0.5 \times 10^7 = 5 \times 10^6$$

Follow-up Problems:

1. $(5.5 \times 10^3)(3.1 \times 10^5) =$

2. $(9.7 \times 10^{14})(4.3 \times 10^{-20}) =$

3. $\dfrac{2.6 \times 10^6}{5.8 \times 10^2} =$

4. $\dfrac{1.7 \times 10^{-5}}{8.2 \times 10^{-8}} =$

5. $(3.7 \times 10^{-6}) \times (4.0 \times 10^8) =$

6. $(8.75 \times 10^{14})(3.6 \times 10^8) =$

7. $\dfrac{1.48 \times 10^{-28}}{7.25 \times 10^{13}} =$