Welcome to Chem Up!

An Introduction to Basic Chemistry Concepts

Please sign in.
### Course Overview

<table>
<thead>
<tr>
<th>Day 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Foundations</td>
</tr>
<tr>
<td>• Course Expectations and Note Taking</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reading Your Text Book</td>
</tr>
<tr>
<td>• What is an Atom?</td>
</tr>
<tr>
<td>• Acids and Bases</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Compounds and Mixtures</td>
</tr>
<tr>
<td>• How do Atoms Interact?</td>
</tr>
<tr>
<td>• How does Learning Work?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Properties of Water</td>
</tr>
<tr>
<td>• Organic vs. Inorganic Molecules</td>
</tr>
<tr>
<td>• Molecules of Life</td>
</tr>
</tbody>
</table>
Agenda for Day 3

- How Does Learning Work?
  - Memorization Techniques
- Compounds and Mixtures
- Bonding
- Chemical Reactions
  - Hydrogen Bomb
  - Whoosher Bottle
I went to class, I’ve read my textbook, now what?

▶ Re-read your notes the same day. Make sure that you got everything and didn't miss something important. If you wait a couple of days before looking at your notes, you won't remember the lecture and you will be relying on your notes alone, instead of your memory.

▶ Summarize your notes (in YOUR words). This is best done right after you have re-read your notes. These will make great study sheets for the exam.

▶ Look at the problems soon after you have done one in class. Each day after lecture, look at the back of the chapter and find the types of problems you did that day in class. Do those problems then; don’t wait until right before the exam. If you do them that day, you will still have the method in your mind.

Information from
http://www.jccmi.edu/academics/science/How_To_Study_Science/
How Does Learning Work?

We Learn

- 10% of what we hear
- 15% of what we read
- 20% of what we see and hear
- 40% of what we discuss
- 80% of what we experience and practice
- 90% of what we attempt to teach

What does this mean for you?

How can you use this to help direct your study?

Information from
http://www.jccmi.edu/academics/science/How_To_Study_Science/
How to Study for Science Class...

Location

- Find a place to study that is free of interruptions and distractions. This is necessary to master information.

Self direction

- Establish your own pattern of what, when, where and how much to study. Establish your own directives, or discuss others' suggestions. Don’t be afraid to ask for help and seek encouragement from your classmates. Use what others have found helpful.

Self-discipline

- Develop your own study rules and stick to them. You must motivate and remind yourself. You must establish your own study times, listen to lectures actively, conscientiously do the lab exercises, etc.

Information from http://www.jccmi.edu/academics/science/How_To_Study_Science/
How to Study for Science Class...

Study in 1 hour blocks

- The amount you need to study for a class differs from person to person, but you should never study in blocks longer than 1 hour. If you sit with a textbook for 4 hours, you only gain information during the first hour; after that your brain leaves.

How to begin

- Every time you sit down, quickly overview all of the material. Figure out what you don’t know and focus your study time on that first. Then return to what comes easier. Practice each day.

Repeat

- The only way to learn is repetition. After you initially memorize information and do nothing to reinforce it, within 24 hours after you have been exposed to the information you will have only about 35% of the memorized information. Only about 10% remains after an additional 24 hours.

Information from http://www.jccmi.edu/academics/science/How_To_Study_Science/
How to Study for Science Class...

Techniques

- teach someone else or pretend to study
- study with a partner
- re-do drawings
- write memory songs/poems
- link with applications
- study in a group
- get a tutor
- draw it or symbolize it
- write it out
- speak the words out loud
- explain in sequence a list of events

Techniques

- make a little story out of the information
- make flash cards for terms or symbols
- Imagine what questions you would ask if you were the professor
- Learn the new terms and symbols.
- Relate the information to what you already know or to experiences you have had.
- Teach someone in your family and have them quiz you.

FIND THE TECHNIQUES FOR STUDY THAT WORK BEST FOR YOU AND MAKE TIME TO FOCUS ON THOSE.

Information from http://www.jccmi.edu/academics/science/How_To_Study_Science/
How to Study for Science Class...

Study in groups

- Find 4 - 6 fellow members of your class and form a study group. In a good study group, for every concept there is usually someone who understands that concept. Your strength might be someone else’s weakness. If you can explain a concept to someone, then (and only then) do you understand it yourself.

Exams with problems to solve

- When studying, look at potential exam problems and mentally solve the problems. After all, this is what you are going to have to do during an exam since you have a time crunch. Know the steps you will do in what order, what information you need, and what equations. When doing chapter problems (as well as exam problems) method is the important thing.

Information from
http://www.jccmi.edu/academics/science/How_To_Study_Science/
How to Study for Science Class...

Study Effectively

- Make your study time as uninterrupted as possible. Keep stocked up on things you need so there is no reason to interrupt your studies. Make a regular study area - no clutter around you. Be efficient with your time. Study in seclusion (when the kids are at school). Turn off the phone, TV etc. Put away all other distractions. Even make it a luxury for yourself. Every time you get interrupted, you lose information.

Test Yourself

- Develop a method of testing yourself to make sure you are retaining information. (Index cards, study notes, study tapes.)

Be realistic about expectations for yourself!

Information from http://www.jccmi.edu/academics/science/How_To_Study_Science/
Compounds and Mixtures

- Compounds are composed of two or more elements chemically combined in a definite ratio.

- Mixtures are two or more substances which are physically mixed but not chemically combined.
  - **Homogeneous mixtures:**
    - Have uniform composition
    - Different components are not visible
    - Liquid homogeneous mixtures are called solutions
  - **Heterogeneous mixtures:**
    - Do not have uniform composition
    - Different components are visible
Compounds and Mixtures

Image from http://elements97.wikispaces.com/Mixtures+and+How+They+are+Different+from+Compounds.
Compound, Homogeneous Mixture, or Heterogeneous Mixture?

- Blood
  - Homogeneous mixture
- Soil
  - Heterogeneous mixture
- Air
  - Homogeneous mixture
- Water (H₂O)
  - Compound
- Table salt (NaCl)
  - Compound
- Orange Juice
  - Homogeneous mixture
- Orange Juice with Pulp
  - Heterogeneous mixture
- Oil and water
  - Heterogeneous mixture
- Vinegar
  - Compound
- Pizza
  - Heterogeneous mixture
- Sugar
  - Compound
- Coffee
  - Homogeneous mixture
The Octet Rule

- The **octet rule** states that elements gain or lose electron(s) in an attempt to reach eight electrons in their outer most electron shell.

- Exceptions to the octet rule include:
  - Hydrogen (H) and Helium (He) only attempt to gain two electrons.
  - Boron (B) is only capable of getting to six electrons.
  - Other common exceptions, include, P, S, Cl, Br, and I which can have expanded octets of 10, 12, or even 14 electrons.
Ionic and Molecular Compounds

- Ionic bonds occur between a metal and a nonmetal.
  - The nonmetal takes the electron(s) from the metal.
- Covalent bonds occur between two nonmetals.
  - The electrons are shared.

Transfer of electrons

Sharing electrons

M is a metal
Nm is a nonmetal
Multiple Covalent Bonds

Multiple bonds form when there are not enough valence electrons to complete octets.

- In a **single bond**, one pair of electrons is shared.
  - The covalent bond on the previous slide is an example of a single bond.
- In a **double bond**, two pairs of electrons are shared.
- In a **triple bond**, three pairs of electrons are shared.
Electronegativity

- is the relative ability of atoms to attract shared electrons
- is higher for nonmetals; fluorine (F) has the highest value of 4.0
- is lower for metals; cesium (Cs) and francium (Fr) have the lowest value of 0.7
Non-polar and Polar Covalent Bonds

Non-polar Covalent Bond
- Consists of an equal (or almost equal) sharing of electrons between two nonmetals.
- Has a zero (or almost zero) electronegativity difference (difference of less than 0.4).

Polar Covalent Bond (Dipole)
- Consists of an unequal sharing of electrons between two nonmetals.
- Has an electronegativity difference of 0.5 to 1.7.
- Bonds become more polar as the difference in electronegativity increases.
Polar and Non-polar Covalent Bonds

Equal sharing of electrons in a nonpolar covalent bond

Unequal sharing of electrons in a polar covalent bond
Attractive Forces

- Attractive forces between molecules and ions hold them close together in liquids and solids.

- Solids melt, and liquids boil when the attractive forces between molecules are broken

- Attractive forces include
  - Dispersion forces
  - Dipole-dipole attractions
  - Hydrogen bonding
London Dispersion Forces

- London Dispersion forces are weak attractive forces that occur due to movement of electrons around an atom causes one side of the atom to be temporary more negative than the other side.

- All molecules possess dispersion forces, whether they are polar or nonpolar.
**Dipole-Dipole Attractions**

- Polar molecules are attracted to each other by dipole-dipole attractions.
- When the positive end of one dipole is attracted to the negative end of a second dipole
- such as the attractive forces between two molecules of H–Cl
Hydrogen Bonding

- Hydrogen bonds are an especially strong dipole-dipole attraction that occurs between
  - polar molecules containing hydrogen atoms bonded to very electronegative atoms such as fluorine (F), nitrogen (N), and oxygen (O)
  - a hydrogen atom with a partial positive charge attached to N, O, or F and a partial negative charge on N, O, or F
Bonding Activity

"Perhaps one of you gentlemen would mind telling me just what it is outside the window that you find so attractive...?"
Chemical Reactions

- involve chemical change
- represent the formation of a new substance with new properties

Evidence of a chemical reaction includes:
1. Formation of gas (bubbles)
2. Change in color
3. Formation of a solid (precipitate)
4. Heat is produced or absorbed
Chemical Equations

A chemical equation tells us the materials needed and the products formed in a chemical reaction.

- Reactants are the materials needed.
- Products are the materials built.

- Some reactions are reversible.
Balanced Chemical Equations

- Every chemical reaction is written as a balanced equation, such that atoms of each element are the same in the reactants and products.
- To balance a reaction, coefficients are written in front of chemical formulas.

\[ 2\text{H}_2(g) + \text{O}_2(g) \rightarrow 2\text{H}_2\text{O}(g) \]

This is due to the law of conservation of mass.
Chemical Reactions and Energy

- Energy must be added to break the bonds that hold molecules together. When chemical bonds are formed in creating a product, energy is released.

- The energy required to start the reaction is called energy of activation.

- If the amount of energy needed to break bonds is more than the energy released when new bonds form, energy must be absorbed from the surroundings. This is called an **ENDOTHERMIC** reaction and results in a decrease in temperature.

- If the amount of energy needed to break bonds is less than the energy released when new bonds form, energy is released to the surroundings. This is called an **EXOTHERMIC** reaction and results in an increase in temperature.
Catalysts and Enzymes

- A catalyst is a substance that alters the reaction rate of a particular chemical reaction.
- Catalysts are chemically unchanged at the end of the reaction.
- Catalysts can either increase or decrease the rate of a reaction by providing an alternative pathway with higher or lower activation energy.
- Enzymes are a type of catalyst for biological systems. All cells require chemical reactions to function.
Types of Reactions

Combination Reactions

- Two or more substances combine to form one product.

**Combination**

<table>
<thead>
<tr>
<th>Two or more reactants</th>
<th>combine</th>
<th>to yield a single product</th>
</tr>
</thead>
<tbody>
<tr>
<td>A + B</td>
<td></td>
<td>AB</td>
</tr>
</tbody>
</table>

Decomposition Reactions

- One reactant splits into two or more simpler substances.

**Decomposition**

<table>
<thead>
<tr>
<th>A reactant</th>
<th>splits into two or more products</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>A + B</td>
</tr>
</tbody>
</table>
Types of Reactions

Single-replacement Reaction
- An uncombined element replaces an element in a compound.

Single replacement

One element replaces another element

\[
\text{A} + \text{BC} \rightarrow \text{AC} + \text{B}
\]

Double-replacement Reactions
- Two elements in the reactants exchange places.

Double replacement

Two elements replace each other

\[
\text{AB} + \text{CD} \rightarrow \text{AD} + \text{CB}
\]
Types of Reactions

Combustion Reactions

- Carbon containing compounds or H₂ (fuels) burn in oxygen from the air to produce carbon dioxide CO₂, water H₂O. Combustion reactions are **exothermic**.

Examples of Combustion Reactions

- Hydrogen Fire Bomb
  
  \[ 2H_2(g) + O_2(g) \rightarrow 2H_2O(g) \]

- The “whoosher bottle”
  
  Alcohol (g) + O₂ (g) → CO₂ (g) + H₂O (g)
Hydrogen Fire Bomb Demonstration
“Whoosher” Bottle Demonstration
Questions?

Compiled by
J. Picione (Chemistry Faculty)
A. Kandefer, D. Leonard, E. Scott, G. Stone, J. Brown, and R. Wendt (Learning Specialists)
The Academic Support Center @ Daytona State College
http://www.daytonastate.edu/asc/ascsciencehandouts.html