I Course Prefix/Number/Course Title: CHM 1033 Chemistry for the Health Sciences

Co-requisite: MAT 1033

This course applies to the A.A. degree in the General Education Requirements Area III as a Natural Science.

II Credit Hours/Contact Hours: 3 Credit hours, 45 contact hours (lecture). Three hours of lecture per 15-week term. Course offered in D2L format. Office hours for standard lecture; Office hours for D2L Web based class are 9 a.m. to 10:00a.m. weekdays in the Course Chat.
e-mail address: bruce.gragg@fkcc.edu

III Instructor/Office Number/Telephone Extension: Bruce R. Gragg, Ph.D.
Room D108A
Phone: 296-9081, X 212
Office Hours: Above

IV Course Description: The web based format requires the student to dedicate enough time to the course to be successful.

This course meets the new curriculum requirements of FKCC's pre-nursing program approved by the State of Florida's Board of Nursing. This course emphasizes chemistry topics related to the allied health sciences through the study of the essentials of inorganic and organic chemistry and biochemistry as it relates to processes and functions of the human body.


VI Specific Course Objectives:

The primary course objective is to allow students to fulfill the chemistry requirements for the pre-nursing curriculum at FKCC. The student will be conversant with chemical terminology as appropriate to the field of nursing.
Important learning outcomes

1. Communicate effectively using listening, speaking, reading and writing skills.
2. Describe how natural systems of the human body function.
3. Solve problems using critical and creative thinking and scientific reasoning.
4. Use quantitative analytical skills to evaluate and process numerical data.
5. Be able to use the System International (SI) system of weights and measures to understand dosing requirements and verify proper quantities of medicines are being prescribed or delivered to the patient.
6. Be able to read first year level formulae and names of simple compounds.

Major Topics

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College-level Competencies

Florida Keys Community College graduates who complete the core curriculum possess the knowledge, skills and values associated with college-educated individuals. Our graduates demonstrate mastery of competencies integrated within the academic disciplines, such as the ability to effectively communicate, seek creative solutions to problems, exhibit cultural awareness, and command basic technological skills.

1. Communication: Comprehend and articulate effectively – written and oral communication
2. Critical thinking: Demonstrate mastery of problem-solving skills in the discipline
3. Diversity: Interpret and evaluate societal and ethical issues, problems and values
4. Technology: Utilize technology effectively

VI. Course Calendar

1. The Course Calendar lists the learning activities and assessment measures that comprise this course on a weekly basis. These activities and assessments are directly related to learning outcomes that support the overall course objectives. The “Student Assessment” column lists all of the assignments required by this course and their due dates. I strongly recommend you print this out and refer to it often.
2. Students are responsible for following the course calendar. Consult your calendar before you start a new chapter or section. (Note: Some sections may not be covered in the same order as in the text). If
you ever have a question that begins with “When is ___”, the answer is probably already published in this Course Calendar. Looking here first will probably get you a quick answer to your question.

<table>
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<tr>
<th>Module/Week Competencies</th>
<th>Learning Outcomes</th>
<th>Learning Activities</th>
<th>Student Assessments</th>
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</thead>
<tbody>
<tr>
<td><strong>Module/Week 1 / 1,2,4</strong></td>
<td>1. Be able to use the SI system of weights and measures to convert from one unit to another.</td>
<td>1. Read Chapter 1 carefully. Try out the Power Point Presentation and see how you like the Audio book portion of the text. When you are ready, click on this link Textbook and go to Chapter 1 in the Chemistry First version of the text (be patient, anytime you open a Chapter, you are loading several megabits of data) and work Questions: 1 - 29 odd numbered problems.</td>
<td>1. Work questions 1-29 odd numbered problems.</td>
<td></td>
</tr>
<tr>
<td><strong>Objective: Chapter 1</strong></td>
<td></td>
<td>2. Next work on the Discussion section of the Course for Chapter 1. Be sure to post a response to receive credit for class participation.</td>
<td>2. Submit Discussion 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Appendix &quot;A&quot; of your textbook has the solutions for selected problems for each Chapter. You can access this appendix by clicking on the Link above. After selecting the Chemistry First Version, click the &quot;Selected Answers&quot; prompt under the chapter number selection line. This will take you to the end of the textbook. There</td>
<td><strong>Due Date: End of Week 1.</strong></td>
<td></td>
</tr>
<tr>
<td>Module/Week 2/1,2,4</td>
<td>1. Know the names and symbols for the 1A, 2A, 7A, and 8A families of elements.</td>
<td>1. After becoming familiar with the chapter 2 objectives, read the chapter carefully. For additional Instructional Activities work on questions: 1, 2, 3 - 31 odd numbered only, and 40, 43, 46, 52, 58, 63, and 66. These questions start on page 60 of chapter 2 - The Structure of Matter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective: Chapter 2</td>
<td></td>
<td>1. Work assigned problems.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. You know how to write names of</td>
<td>2. After completing the recommended questions, go to the Discussion section of the course by clicking the navigation bar and work on the Discussion question for chapter 2. Be sure to post a response to receive class participation credit.</td>
<td>1. Complete Discussion 2 by listing the symbols of the Families of elements we have studied and name them.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Due Date: End of Week 6.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Module/Week 3/1,2,4

| 1. You know how to write names of | 1. Chapter | 1. Do the recommended |
| | | 6.67 |
Objective: Chapter 3

Our main Objective is to learn the names, charges, and symbols of the cations and anions presented in your text. Additionally, you will learn to write the formulas and names of some binary compounds.

3 Instructional Activities - Make a series of 3 x 5 cards with the formula and charge of the cations on one side and the name on the other. Do this for the anions as well. Find one or more partners to play a flash card game with to help learn this material. This will help you succeed in writing formulas of salts quickly and accurately.

If you can not translate the word formulas in a sentence such as, **Silver Nitrate** reacts with **Sodium Chloride** to produce a precipitate of **Silver Chloride** and a **Sodium Nitrate** solution, into chemical formulas it will be impossible to balance and use chemical equations.

\[ \text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3 \]

After you have read chapter 3, go to page 112 and complete the following Questions: 1 - 11, 12 - 102 even only. The link above will take you to the Textbook. Select Chapter 3 - Chemical Compounds.

Remember to post a response to the Chapter 3 discussion question by going to the Discussion section of the course and clicking problems.

2. Submit a Discussion response to the question for chapter 3.
Module/Week 4/ 1,2,4  

**Objective: Chapter 4**

Being able to write and balance chemical equations is essential to success in chemistry. Most equations can be balanced by inspection. That is, you can find the small whole numbers that ensure you have the same number of atoms of a given element on each side of the equation. They will be bonded to something different, but the number must be the same.

Oxidation - Reduction reactions are the most difficult. Especially if they occur in acidic or basic solutions. A process is presented using the half-reaction method to facilitate balancing.

You need to become familiar with guidelines for determining if a compound is water soluble or insoluble. Some brief rules:

- **a.** All alkali metal salts are soluble.
- **b.** All nitrate salts are soluble.
- **c.** All halide salts (Fl⁻, Cl⁻, Br⁻, I⁻) are soluble except Ag⁺, Pb²⁺ and Hg₂⁺².
- **d.** Consider all hydroxides, carbonates, sulphates, sulfides, oxides, etc., insoluble, except for the alkali metals.

If you mix two aqueous solutions together, a precipitate (solid) will form if the new solution contains incompatible ion combinations. That is, violate the solubility rules above.

| 1. You have the skill and knowledge to balance named reactions by the inspection method. | 1. Read the Chapter carefully and supplement the reading with the many textbook support areas. When you have completed your studies of this section, go to page 146 of the Textbook and do the following recommended Questions that have Selected Answers: 1-6, 7 - 37 odd, 42, 46, 52, 54, 58, 60, and 68. |
| 2. Students can balance oxidation-reduction reactions by the half-reaction method. | 2. Also respond to the discussion question, problem 85 on page 157, at the end of the Chapter 4 material. This is to be done in the Discussion part of the Course as a response to Discussion - 4. Select Discussion on the course navigation bar when you are ready to post the work for class participation credit. |
|  | 1. Completed recommended reading and problems. |
|  | 2. Responded to discussion question for week 4. |

**Due Date: End of Week 4.**
The textbook goals for Chapter 4 are on page 146. Click this link to go to the text. [Textbook](#)

**Module/Week 5 / 1., 2., 4**

**Objective: Chapter 5**

Spend a lot of time in this chapter learning to name compounds and write formulas. Use 3 X 5 cards to write the names on one side and the chemical formulas on the other. Get very good at doing this. You will excel in other areas of the course if you invest time in this effort.

<table>
<thead>
<tr>
<th>1. Developed skills for better formula writing and naming of compounds.</th>
<th>1. Listen to the Audio Book Lesson for Chapter 5. This will help you learn the content as you read the Chapter. The <a href="#">Textbook Chemistry First</a> contains much more than just written text. For variety in your studies, also view the Power Point Presentation as a prelude to reading the chapter. The Objectives of this chapter are found on page 195. Review these objectives and when you’re studying of Acids/Bases is complete, go to the Textbook Chemistry First link above and immediately following the Objectives work on the following questions for the chapter starting on page 196: all questions 1-106 marked with red enumeration.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Answer the three discussion questions at the end of the Review in the &quot;Discussion&quot; section of the Course and post your responses there for class participation credit.</td>
<td>1. Complete reading and problems for Chapter 5. Submit Discussion topic. 2. <strong>Take and submit Exam I over Chapters 1 – 5.</strong> <strong>Due Date: Should be completed by the end of Week 5.</strong></td>
</tr>
</tbody>
</table>
**Module/Week 6 / 1,2,4**

**Objective: Chapter 6 - Oxidation Reduction Reactions**, you will learn the following in this chapter.

These reactions are often called Redox Reactions and involve the transfer of electrons from one source (the reducing agent) to another source that receives these electrons (oxidizing agent). In a balanced Redox reaction equation, just as many electrons must be transferred as are received.

Valence electrons are those electrons in the outer layers (orbitals) of an atom. Atoms of elements try to gain valence electrons (be reduced) or lose valence electrons (be oxidized) to "look" like the nearest Noble gas in their valence electron level. For example, in a Redox reaction Oxygen will gain two electrons to look like Neon and have a minus 2 charge while sodium, Na, will lose one electron and have a plus 1 charge to look like Neon. Both O\(^{-2}\) and the Na\(^{+1}\) ions have the same number of electrons as Neon. These three species are said to be isoelectronic - having the same number of electrons.

The major Learning Objectives of Chapter 6 are on page 231 of the Textbook. Review these Objectives and begin the work in Chapter 6 under Instructional Activities.

**Module/Week 7 / 1,2,4**

**Objective: Chapter 7**

You will be introduced to the concept of light and energy transfer.

Energy manifests itself in many ways. Electromagnetic Radiation is

1. Know how to use Maxwell’s equation.
1. Read Chapter 7 of the Textbook carefully. Use any of the teaching/learning aids available as part of the textbook site. Work on the questions with
1. Work recommended problems.

2. Have a concept of how light is produced and analyzed
2. Complete Discussion for Chapter 7.

Due Date: End of Week 6.
any form of energy carried by a photon through space. The term "Photon" was given to us by Albert Einstein in the early 1900s. Max Planck discovered that energy is transferred in small packets he called quanta. Einstein expanded this idea to say that each photon carried a discreet amount of energy called a quantum of energy unique to that photon's wavelength and frequency. Green light carries a different amount of energy than Red light even though they travel at the same velocity.

Elements and compounds contain stored energy due to the nature of their existence. Stored energy is energy that has the "Potential" of doing work, usually due to a chemical reaction that releases heat and creates new compounds. Energy stored by an object or compound is thus called "Potential Energy" due to its state or position.

Kinetic energy is associated with an object in motion. Abbreviated K.E., kinetic energy is calculated by multiplying the mass of the object times its velocity squared divided by 2.

\[ \text{K.E.} = m \times v^2 / 2 \]

Radiant or Heat energy can be considered a subcategory of electromagnetic radiation. Heat energy is in the microwave to infrared range.

A good way to be introduced to this material is to view the Power Point Presentation. Then read the chapter carefully to acquaint yourself with the Objectives of the Chapter.

**Module/Week 8 / 1,2,4**

**Objective: Chapter 8**

1. A student can convert measurements from the US system to the SI

Due Date: End of Week 7.

1. Instructional Activity Chapter 8 - Unit

1. Complete recommended problems.
We will learn to use conversion factors to change from one unit of measure to another.

Chapter 8 Objectives are listed on page 315 of the Textbook - Chemistry First. Review these concepts before reading the chapter.

Conversions factors have been the bane of existence for new students of chemistry over the centuries. A conversion factor is an equivalency expression. For example, for length we use 1 inch is the same distance as 2.54 cm. So we say 1 in = 2.54 cm or for weight 2.2 lbs = 1 kg. If you want to change 100 lbs to kgs set up the equivalency expression in such a way that when you multiply, pounds cancels out or 100 lbs x 1 kg/2.2 lbs = 45.45 kg.

Your equivalency expression is turned into a fraction with the unit you want to get rid of on the bottom, in the denominator, 1 kg/2.2 lbs.

View the Power Point Presentation to help you familiarize yourself with the chapter Objectives and then proceed to additional Instructional Activities.

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Module/Week 9/1,2,4

Objective: Chapter 9

The Objectives for Chapter 9 are found on page 365 of the Textbook - Chemistry First - Chapter 9.

One of the most important things we learn in Chemistry is to determine the molecular composition of a compound and use that data to determine its molecular formula. To do this we must first find the system and from the SI system to the US system.

Conversions

Carefully read Chapter 8. You may also want to view the Power Point Presentation and/or listen to and watch the Audio Book Chapter 8.

As you complete sections of the chapter work on the exercises and problems you encounter. Do the recommended questions (1-4, 5-25 odd, 26, 28, 36, 38, 40, 42, 44, 52, and 56) starting on page 316 of the Chapter. These are numbered in red and the answers can be found by going to the end of the Textbook Selected Answers. When you are ready, go to the Discussion for Chapter 8 in the course Navigation Bar. Be sure to post a Discussion response to receive class participation credit.

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1. Students can calculate empirical formulas and determine molecular formulas from them where appropriate.

1. Chemical Calculations and Chemical Formulas

Chapter 9 teaches you how to determine the percentage composition of a compound, its empirical formula and its molecular formula, if the molar mass is known.

This is interesting and

1. Work recommended problems.

2. Submit a Discussion response.

Due Date: End of Week 9.

6.7
The empirical formula of a compound is the smallest whole number ratio of the atoms that make up one molecule of the compound. Salts, pure substances containing cations and anions, have crystal lattices composed of millions of repeating forms. Salts, therefore, do not have molecular formulas, only empirical formulas. The salt we are most familiar with is sodium chloride, NaCl.

Covalent compounds, also pure substances, can be isolated as individual molecules, such as glucose or water. Thus we can obtain the formula of one molecule. This is done by first obtaining a very pure sample of the compound and analyzing it to find the percentage composition of the elements present. From this information we can obtain the smallest whole number ratio of the atoms that compose the molecule - the empirical formula.

Example, consider a compound called benzene. This compound was found to be composed of only carbon and hydrogen. Benzene is 92.26% C and 7.74% H. You assume you have 92.26 grams of C and 7.74 grams of H. You divide these weights by their respective atomic masses to get the relative number of moles of each.

Moles of C = 92.26g/12.01g/mol = 7.68 moles of C in Avogadro's number of particles of benzene. Do the same for H = 7.74g/1.008g/mol = 7.68 moles of H in Avogadro's number of particles of benzene.

Next, you divide the smallest number of moles found into the moles of all atoms present. This is called normalizing. You force the
atom with the smallest number of moles to take on a ratio of 1 compared to the others. In our example this is simple because C and H are present in the same mole ratio. We say they are 1 : 1 or for every C in benzene there is 1 H, thus giving a C : H ratio of 1 : 1.

This gives us an empirical formula of C\textsubscript{1}H\textsubscript{1}. To determine the molecular formula, which is some multiple of the empirical formula, we must have the molar mass of the compound. This is obtained from a separate experiment. Without the molar mass, the molecular formula cannot be determined. There are many ways to determine the molar mass. For our work we will use the known value of 78.11 grams/mole.

The molecular formula is some multiple of the empirical formula. Divide the molar mass of the compound in question by the weight of the empirical formula unit. This tells you how many of these units make up the real molecule.

Molar Mass of Benzene = 78.11 g divided by the weight of C\textsubscript{1}H\textsubscript{1} = 13.02 g gives 6 units of the C\textsubscript{1}H\textsubscript{1} formula. Thus a benzene molecule contains 6C and 6H for a molecular formula of C\textsubscript{6}H\textsubscript{6}.

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**Module/Week 10 / 1,2,4**

**Objective: Chapter 10**

The learning objectives for Chapter 10 can be found on page 393 of the Textbook - Chemistry First Version.

Once you learn how to write chemical formulas, you can move on to writing balanced chemical equations. This process starts by writing the Reactants on the left

1. Completing and balancing chemical equations.

2. Students can use balanced equations to make stoichiometric calculations.

3. Instructional Activities Chapter 10 Chemical Calculations and Chemical Equations

Review Questions, Key Ideas, and Chapter Problems beginning on page 394. The recommended questions are 1-4, 5-21 odd, 22, 26, and 31.


5. Submit a Discussion response to the Chapter 10 question. **Due Date: End of Week 10.**

6. Take and submit Exam II 106.7
hand side and the Products on the right hand side. This often includes a subscript after the formula of each indicating the phase of the material. Is it solid (s), liquid (l), gas (g) or an aqueous (aq) solution.

The next step involves guarantying that the same number of atoms of each element appear on both sides. They will be combined in a different way than when they were reactants, but the number must be the same - The Law of the Conservation of Matter. The small whole numbers used to bring this about are called coefficients, just like in algebra. They are called stoichiometric coefficients in chemistry.

Example: \(2 \text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow 2\text{H}_2\text{O} + \text{Na}_2\text{SO}_4\)

The 2 in front of sodium hydroxide is the stoichiometric coefficient. Notice that there are the same number of atoms of each element on each side of the equation. How does one find these coefficients, much less know what the products are going to be? To find the coefficients, we start by learning to balance by inspection. Just looking and trying to figure it out using the smallest whole numbers possible.

This works well for most reaction types; acid/base, precipitation, combustion and gas forming. However, when we come to Redox reactions, especially in acidic or basic solution, we need a process. This was presented in Chapter 6.

Determining what Products are going to be formed takes a lot of work. You must first learn to place the reaction in a category, as listed above. An acid/base reaction always gives water plus the salt of the conjugate acid/base pair. See Chapter 5. In the equation above

After reading Chapter 10 carefully, work on the selected questions numbered in red. This chapter introduces the idea of mole ratios taken from balanced chemical reactions to determine how much of something is needed to produce a certain amount of something else. These mole ratios are called stoichiometric factors.

In the balanced acid/base reaction presented earlier in Module 11 Chapter 10 Learning Objectives, we looked at the reaction of sodium hydroxide with sulfuric acid to give water and sodium sulfate.

\[
2 \text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow 2\text{H}_2\text{O} + \text{Na}_2\text{SO}_4
\]

If we have 3 moles of sodium hydroxide, how many moles of sulfuric acid are needed to exactly neutralize the sodium hydroxide and produce water and sodium sulfate? Here is a simple way of finding out. We are going to setup a simple proportion. Always start with what you want to know.

\[
? \text{moles of} \quad \text{H}_2\text{SO}_4 \quad \text{coefficient for} \quad \text{H}_2\text{SO}_4 \quad \text{from}
\]
the salt would be sodium sulfate.

Precipitation reactions are usually reactions between two aqueous solutions, solutions where water is the solvent. These reactions always form a solid, like snow falling out of the sky, but in many different colors. To know if a solid will form, you must learn the solubility rules for salts. This takes some time. See chapter 4.

Combustion reactions always produce carbon dioxide and water. Oxygen is always a reactant. A combustion reaction occurs when something burns, usually a hydrocarbon, such as benzene.

\[
C_6H_6 + \frac{15}{2} O_2 \rightarrow 3H_2O + 6CO_2 \]

this is balanced, however it is bad form to have a fractional coefficient, so we multiply both sides of the equation by 2 and get

\[
2C_6H_6 + 15O_2 \rightarrow 6H_2O + 12CO_2
\]

Gas forming reactions are subcategories of acid/base reactions and thermal decomposition reactions, usually metal carbonates.

Redox reactions were studied in Chapter 6.

Return to the Textbook - Chemistry first Version for Chapter 10 work or to the Instructional Activities for Chapter 10.

balanced equation above (1)

\[
\text{___________________}\ 
\text{=} \\
\text{___________________}
\]

moles of NaOH given (3)

Coefficient of NaOH from the balanced equation above (2)

Next, solve this proportion for (?) moles of \( H_2SO_4 \) and you get 1.5 moles of sulfuric acid needed to react with the 3 moles of sodium hydroxide.

Or \( \frac{?}{3} = \frac{1}{2} \) which is \( ? = 3 \times \frac{1}{2} = 1.5 \) moles of sulfuric acid needed. Notice this ratio 3:1.5 is the same as the ratio of the coefficients from the balanced equation 2:1 or \( \frac{3}{1.5} = 2 \). This process uses stoichiometric coefficients to create stoichiometric factors to determine reactants needed for a reaction or amount of products that will be formed.

Don't forget to respond to the Discussion Question for Chapter 10 in the Discussion portion of the course to get class participation credit.

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Module/Week 11 / 1,2,4

1. Students understand

1. Instructional Activity

1. Complete the 6.7
## Objective: Chapter 11

This chapter's main goal is to explain to you how electrons are arranged around the nucleus of an atom in such a way as to bring order and predictability to the atomic world. We call the different ways of doing this;

- Spectroscopic Notation or Electron Configuration Notation
- Rare Gas or Noble Gas Core Configuration - Shorthand Notation for the above methods
- Aufbau Principle (German for the "Build Up" Principle)

They all explain the same process - how electrons are consecutively placed around the nucleus to represent each atom. We will focus on the first 38 atoms in our work. Every electron in an atom has a unique "address". This address has four numbers associated with it. They are in order of listing: n, l, m_l, m_s. This ordered quartet (n, l, m_l, m_s) uniquely locates every electron orbiting and atom. A brief description of each quantum number follows;

- **n** - the principle quantum number, tells you how much energy the electron has and therefore the distance it is from the nucleus. The more energy an electron has, the bigger the volume of space it can occupy and the further away it can get from the nucleus and the larger the "n" number becomes. The principle quantum number is always given first. It can have values from +1 to infinity. We will deal with values of n = 1,2,3,4,5 for the most part. For each value of n there are n^2 atomic orbitals at that energy level. Thus for n = 3 there are nine

## Chapter 11 Modern Atomic Theory

This chapter introduces the results of countless hours of calculations done over many years before modern computing technology was introduced. Scientists and Mathematicians studied what is called the one electron problem. They investigated the probability of locating a single electron around a hydrogen nucleus with energies agreeing with those found in nature. We know these energies from studying the emission and absorption spectra of excited state hydrogen atoms.

Any theory would have to produce results agreeing with these real world observations. Max Planck, James Maxwell, Heisenberg, Einstein and many others worked for years to try and explain the nature of light, its creation, absorption and emission.

2. Read Chapter 11 carefully. Use the Power Point Presentation and Audio Book to help with understanding this material. The recommended questions with selected answers begin on page 439 and include Review Questions.

2. Submit a response to the posted discussion question. **Due Date: End of Week 11.**
Each orbital can be empty (contain no electrons) or be half-full (contain 1 electron) or full (containing 2 electrons). An atomic orbital can hold a maximum of two electrons.

l - the "ell" quantum number tells you the shape of the volume of space the electron can be found in 90% of the time. We call it the electron probability density or contour map. The values of l can be \( l = 0, 1, 2, ..., n - 1 \). For example, if \( n = 2 \), then \( l = 0, 1 \). The shapes of atomic orbitals are fascinating. A l number of 0 is designated a "s" type atomic orbital and has the volume of a sphere centered at the nucleus of the atom.

A l number of 1 is designated a "p" type atomic orbital. P - type atomic orbitals always come in groups of 3 because when you solve the wave equations for an electron with this energy you get three equally likely results. P orbitals are shaped like dumbbells.

\( m_l \) (read m sub ell) - As mentioned above, you get multiple solutions to the wave equations for any value of \( n \) greater than 0. These equally likely solutions account for how the orbitals are oriented in a three dimensional space. For example, the three p-type orbitals are oriented so that one lies along the "x" axis, one along the "y" axis and one along the "z" axis. The \( m_l \) quantum number can have all values of \( l \) from \(-l\) to \(+l\). Thus if \( l = 1 \), then \( m_l = -1, 0, +1 \), accounting for the three p-type atomic orbitals. Earlier we mentioned that atomic orbitals can hold a maximum of two electrons. Solutions to the wave equations forbid these two electrons to have the same "spin". This leads to the fourth and final quantum number, the spin quantum number, \( m_s \) (read
m, the spin quantum number can have only two values ±1/2 or -1/2, this means one electron in the orbital has a positive spin direction and the other in the same atomic orbital has a negative spin direction. This minimizes the repulsion they feel for each other and allows spin pairing to occur.

We now have a brief introduction to the outcome of quantum physics or quantum mechanics as applied to the one electron problem. The address of any electron can be specified using this ordered quartet of quantum numbers.

For the "ground state" (lowest energy) hydrogen atom electron that address is (0,0,0,+1/2).

Module/Week 12 / 1,2,4

Objective: Chapter 12

Learning Objectives Chapter 12 - Molecular Structure

The Learning Objectives for Chapter 12 can be found on page 475 of the Chemistry First Version of the textbook.

The major objective of this chapter is to teach you a method of drawing and predicting the structures of simple molecules.

You will become proficient at drawing Lewis dot structures. These structures show where each valance electron is around every atom of the molecule. In Chapter 11 you learned about valence electrons, their locations around the nucleus of an atom and the meaning of the four quantum numbers that uniquely locate each electron in the atom.

1. Skilled at drawing Lewis dot structures and using the rule of Eight.
2. Able to apply the VSEPR model to predict structures of molecules.

1. Instructional Activities Chapter 12 Molecular Structure

After becoming familiar with the Chapter 12 Objectives read the chapter carefully. On page 465, in the right hand margin, click on the web molecule link to view some ball and stick models of selected compounds. Remember, if you need a break from reading, the Power Point Presentation and the Audio Book are available as tabs on the textbook navigation bar.

2. Work on the recommended Review

1. Complete recommended problems at the end of Chapter 12
2. Submit a response to the posted Discussion question. Due Date: End of Week 12.
We will now use that knowledge to work on a process, the Linear Combination of Atomic Orbits (LCAO) Theory and Lewis Dot structures to predict shapes of molecules. The combination of these two approaches comprises the Valence Shell Electron Pair Repulsion Theory (VSEPR).

Carbon is a great element to begin with because it always has four pairs of electrons surrounding it when the final compound is formed. The Ground State carbon atom has an electron configuration of $1s^22s^22p^2$. When carbon prepares to react as it feels the approach of other atoms, it receives added energy from these atoms and changes electron configuration as it gets ready to hybridize (combine its pure atomic orbitals into a new shape called molecular orbitals).

The new configuration looks like this, $1s^22s^12p^3$. The LCAO Theory says these four valance electrons will now combine in a linear fashion to add the s-orbital shape to the three 2p-orbitals to give a new hybridized shape called tetrahedral or Td, also represented by sp$^3$. You always have the same number of molecular orbitals in the end as you had atomic orbitals in the beginning. In this case there are four of each.

<table>
<thead>
<tr>
<th>Module/Week 13 / 1,2,4</th>
<th>Objective: Chapter 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Learning Objectives for Chapter 13 are given on page 516 of the textbook - An Introduction to Chemistry, Chemistry First version. These objectives will lead you to an</td>
<td>1. Students can apply the gas law equations to problems involving the changes in state of a gas. 2. Submit a response to the chapter Discussion to get credit for class participation.</td>
</tr>
<tr>
<td></td>
<td>1. Instructional Activity Chapter 13</td>
</tr>
<tr>
<td></td>
<td>Read the chapter objectives carefully before proceeding with the new content. Chapter 13 introduces the topic of the Behavior of Gases with</td>
</tr>
<tr>
<td></td>
<td>1. Work the recommended problems involving the laws that describe the behavior of gases.</td>
</tr>
</tbody>
</table>

Due Date: End of 6.7
appreciation of everyday occurrences. There are two natural relationships between gases and their responses to changes in state around them (change in temperature and/or change in pressure).

1. **Boyle's Law** - At constant temperature and constant number of moles the volume of a gas is inversely proportional to its pressure, \( V = \frac{k}{P} \), where \( k \) is the constant of proportionality that makes the statement an equation. As pressure increases the volume decreases and, conversely, as the pressure decreases the volume increases.

When working with gas law equations always make a table, no matter how simple, to describe the starting conditions, State 1, and the new conditions or any changes, State 2. For example:

<table>
<thead>
<tr>
<th>State 1</th>
<th>State 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature 1</td>
<td>Temperature 2</td>
</tr>
<tr>
<td>Temperature 2</td>
<td>Temperature 1</td>
</tr>
<tr>
<td>Moles 1</td>
<td>Moles 2</td>
</tr>
<tr>
<td>Pressure 1</td>
<td>Pressure 2</td>
</tr>
<tr>
<td>Volume 1</td>
<td>Volume 2</td>
</tr>
</tbody>
</table>

Let's work a problem. A gas occupies a volume of 5.00 Liters (L) at constant temperature and a pressure of 2.03 atmospheres (atm). There is no change in the number of gas molecules (constant Moles, \( n \)) and the temperature (degrees Kelvin, \( K^\circ \)) remains constant. What is the new volume the gas will occupy if the pressure is changed to 1.55 atm?

<table>
<thead>
<tr>
<th>State 1</th>
<th>State 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>T - constant</td>
<td>( T_1 = T_2 )</td>
</tr>
</tbody>
</table>

changes in state. This means the temperature and/or the pressure may change from an initial set of conditions.

2. Units of measure that you should use are as follows:

   - for pressure use atmospheres - one atmosphere is equal to the weight of a column of mercury 760 mm in height at 0 °C. You may also find values for pressure with the unit "torr". This unit was introduced to honor the inventor of the Hg barometer, Torricelli. One mm of Hg = one torr, so 760 mm of Hg = 760 torr = 1 atm. Always change pressure to atm units.

   - for temperature use degrees Kelvin - the Kelvin scale starts at absolute zero where all molecular motion is said to cease. The Kelvin scale and the Centigrade scale each contain the same amount of heat in one degree. They just start at different places. 0 °C = 273.14 °K. So a gas at 25 °C should be considered at a temperature of 298.14 °K when a gas law equation is applied.

   - for volume always use Liters.

   - for number of moles always use the small
Moles - constant  \( n_1 = n_2 \)

\[ P_1 = 2.03 \text{ atm} \quad \quad P_2 = 1.55 \text{ atm} \]

\[ V_1 = 5 \text{ L} \quad \quad V_2 = ? \]

The working form of Boyle's law, and an equation you should learn, is

\[ V_1 P_1 = V_2 P_2 \]

**Boyle's Law at constant T and n**

In this case we are looking for \( V_2 \), so rearrange the equation to isolate \( V_2 \) by itself and substitute the know values for the variables.

\[ V_2 = \frac{V_1 P_1}{P_2} \quad \text{or} \quad V_2 = \frac{(5.00 \text{ L} \times 2.03 \text{ atm})}{1.55 \text{ atm}} = 6.55 \text{ L} \]

Thus our new volume \( V_2 = 6.55 \text{ L} \). Does this make sense? The pressure decreased so the original volume should increase and that is what we found using Boyle's Law.

2. **Charles's Law** - It was found by Charles that at constant moles and constant pressure the volume of a gas was directly proportional to the temperature of the gas. Going through a process much like that demonstrated above, you arrive at the working form of Charles's Law;

\[ \frac{V_1}{T_1} = \frac{V_2}{T_2} \]

**Charles's Law at constant P and n**

3. **Avogadro's Law** - Gay-Lussac and Avogadro discovered that at constant temperature and pressure the volume of a gas was directly proportional to the number of molecules of the gas. This discovery led to the concept of a mole. They determined that at standard temperature and pressure, **S.T.P.**, (0°C, 1 atm) that one mole of any gas occupies a volume of 22.42 L. This number is known as the letter ”n” followed by the unit moles.

These units insure that we have the correct units of measure for any and all of the gas law equations. The units of Pascals are not widely used in chemistry and will not be emphasized by your instructor.

3. After reading the chapter carefully, work on the recommended questions with answers that start on page 517. Be sure to work the following Review Questions, Key Ideas, and Chapter Problems; 1-3, 4-32 even, 53, 55, 59, 69, 77, 80, and 93.

4. After completing the Instructional Activities for Chapter 13, move on the Discussion section in the course material and post an answer to the questions to receive class participation credit.

2.
the **Standard Molar Gas Volume**. This secret of nature led to the discovery that the number of atoms or molecules in one mole of anything is equal to 6.02 x 10^{23}. We call this **Avogadro's Number**. This number is used throughout chemistry to do Stoichiometric calculations. Be sure to learn it.

\[ \frac{V_1}{n_1} = \frac{V_2}{n_2} \quad \text{Avogadro's Law at constant T and P} \]

These three laws are combined to give the Ideal Gas Law equation. The most powerful of all the gas laws.

\[ PV = nRT \]

- \( P \) = Pressure in atmospheres
- \( V \) = Volume in Liters
- \( n \) = number of moles of gas
- \( R \) = Ideal Gas Law Constant (0.08206 L x atm/K°x n)
- \( T \) = Temperature in K°

The final law that is derived from the Ideal gas law equation, when the number of moles is constant but the temperature and pressure change, is called the **Combined Gas Law Equation**.

\[ \frac{V_1P_1}{T_1} = \frac{V_2P_2}{T_2} \]

Learn the five equations (laws) above and you will have very little trouble with problems dealing with the behavior of gases as discussed in Chapter 13. Use the trick of filling out the State 1 and State 2 table and pick the law that
One of the most important concepts in solution chemistry is understanding the role of the solvent (the liquid that is present in the largest amount or the liquid that does the dissolving) in forming a solution. There are two main categories of solvents. These categories are Polar and Non-polar solvents. Polar solvents contain one or more of the atoms, Oxygen, Nitrogen, or a member of the Halogen family (F, Cl, Br, I). Non-polar solvents usually contain only Carbon and Hydrogen.

The choice of a solvent has tremendous effects on the solubility of the reactants. Thus, increasing or decreasing the reactive surface area exposed to the reactants. The rule of thumb is to choose a solvent with characteristics as close as possible to the solute (the substance being dissolved). The process of dissolving something is called dissolution. Dissolution is promoted by using the "like dissolves like" concept. If you need to dissolve a polar substance, use a polar solvent. If you need to dissolve a non-polar substance, use a non-polar solvent.

Controlling the rate of a reaction (the amount of product formed per
A unit of time) is paramount to being a successful chemist. Graphite turns to diamond spontaneously, but the rate is so slow this takes billions of years. I don't know about you but I don't have that much time to wait. Scientists have learned to control this rate by using extreme pressures and temperatures with carbon and excess hydrogen.

So it is with a choice of solvent. One solvent may retard the rate of reaction while another will increase the rate. Some experimentation is usually needed to find the right solvent for the reaction. But it is worth the effort once the right one is found.

Module/Week 15 / 1,2,4

Objective: Chapter 17

Chapter 17 is a brief introduction to three major areas of chemistry. The Learning objectives begin on page 697 of the textbook. Our main goal is an introduction to the Chemistry of Carbon – the element of life.

Organic chemistry is the study of molecules containing Carbon, Hydrogen and other elements. These compounds are called organic because the majority of them have to do with natural occurrences. The simplest are the hydrocarbons, compounds containing only hydrogen and carbon. The simplest Hydrocarbon is methane, CH₄. There are four categories of hydrocarbons; the alkanes (general formula CₙH₂ₙ₊₂), the alkenes (general formula CₙH₂ₙ), the alkynes (general formula CₙH₂ₙ₋₂), and the arenes or aromatic hydrocarbons.

1. Have a basic knowledge of what comprises an organic compound and their sources.
2. Students are aware of the organic and chemical nature of Biological systems.
3. Now have a knowledge of how synthetic polymers are made and their importance to a technologically advanced society.

1. Instructional Activities - Chapter 17 - An Introduction to Organic Chemistry, Biochemistry, and Synthetic Polymers

Seventeen is a great chapter if you are interested in the life or health sciences. The vast majority of molecules around us are related to life sources. The oxygen we breathe reacts with organic molecules in the Krebs’s cycle to produce energy in the body. Water is essential for all life as we know it. Water combines with food to help produce all the

1. Complete the recommended problems for the Chapter.
2. Submit a response to the Chapter Discussion question. Due Date: End of Week 15.
3. Take and submit Exam III over chapters 11, 12, 13, 15, and 17. Due Date: Should be completed by the end of Week 15.

106.7
Biochemistry is the study of organic molecules in life processes. Biochemistry deals with biological cycles such as photosynthesis, respiration and many others. It involves the study of vitamins, aminoacids, proteins, fats, oils and carbohydrates. All of these, a fascinating subcategory of organic chemistry.

Synthetic polymers are man-made molecules. Many times they have been discovered by accident. Polyethylene, nylon, rayon, Kevlar, and Mylar are some of the very important discoveries in the field of polymerization chemistry. The plastics and fabric industries depend heavily on the bulk production of these and other synthetic polymers. The idea is to take a single molecule, called a monomer in the industry, and fine a way to combine it with many of its own kind or other monomers to create a large macromolecule with vastly different properties.

Exam III will be made available at the beginning of week 15. Try to find some time to work on Chapter 18 Nuclear Chemistry 715. You will not be tested on the material in Chapter 18.

WEEK 16 – End of term. Complete any missed Discussions or Exams.
VII Course Method: The D2L based format is for those students that are well motivated and self-governing. All students should purchase a copy of the required textbook from the bookstore. This is a totally on-line course.

VIII Method of Student Evaluation: There will be three major exams of equal weight contributing 100% points each and Discussion questions worth 100% points to give a course total of 400% points possible. Letter grades will be assigned according to the following levels of performance:

- A = 90 - 100%
- B = 80 - 89%
- C = 70 - 79%
- D = 60 - 69%
- F = Below 59%

IX Policy for Class Attendance and Make-up of Assignments: Online students are responsible for staying current in the course work and posting materials and submitting exams on time. The student is entirely responsible for governing his/her studies and making sure that any missed assigned work is made up.

In general, reasons that may be acceptable for lack of participation include: illness, serious family emergency, special curricular requirements (e.g., field trips, professional conferences), military conferences, severe weather conditions, religious holidays and participation in official college-sponsored activities. The student may offer other sound reasons for consideration.

X Course Outline: Rely heavily on the Learning Objectives and Instructional Activities sections in the Course Content to highlight the material considered to be the most important for course content. Generally, the student will be responsible for reading one chapter per week, on the average, and being prepared to ask questions over any material that still needs clarification.

IX. Class Policies

Communications:

All class communications should be conducted via D2L.

The online format of this class puts a premium on communications. The prime responsibility for timely communications rests with you - the student. We will use the following methods:

- DISCUSSION FORUMS: I have created several discussion forums within the D2L online classroom to organize the messages by category. Most questions
about class policies and subject matter should be posted here to allow the entire class to benefit from the question and the answer. Feel free to answer questions posed by other students. I have taken online classes and this ‘give and take’ between students makes it feel more like a traditional class and results in a better exchange of information. Your class participation grade will be determined by your participation in the discussion forums. There will often be important information published to the class via the Discussion Forums, such as changes in due dates, exam information, etc. You are responsible for all information published here.

Occasionally, time-sensitive announcements will be posted on Discussion Boards. You should logon to D2L 2-3 times each week to check for time-sensitive messages. Before you post a question, look through the Discussion Board. That same question may have already been asked and answered.

Also be sure to check the Course News every time you log in.

- **D2L EMAIL**: The email utility within D2L should be used for personal items that are not appropriate to share with the entire class.

- **TELEPHONE**: 305-296-9081 ex. 212

**What you can expect from me:**

I normally log into D2L and check for messages at least once per day, including weekends and holidays. If you have an urgent message for me, do not post the same message both on a Discussion Forum and in an email. Doing both will waste your time and will not result in my getting the message any faster. If I expect to be out of contact for more than a couple of days, I will inform the class via the Discussion Forum.

**Important Note**: If I have not responded to your email or voicemail message by the end of the day after you left the message, you should assume that I did not receive it and leave another message.

Policy for Class Attendance and Make-up of Assignments: Students are expected to respond by e-mail to the lecture assignments and view all video lessons. The student is entirely responsible for informing the instructor of record for the course if he/she cannot take a scheduled exam and immediately arrange for a make-up time.

**Withdrawal Policy**

1. Students may withdraw without academic penalty from any course by the established deadline published in the College’s calendar. This will result in a grade of 'W' for the course and will not count against the student's GPA.
2. Students will be permitted a maximum of two withdrawals per course. Upon the third attempt, the student WILL NOT be permitted to withdraw in accordance with State of Florida regulations and will receive an earned grade for that course.

3. It is the responsibility of the student wishing to withdraw from the course to do so by the date published in the College Academic Calendar.

4. Students who abandon the course or do not withdraw themselves by the published deadline are subject to receiving a grade of F.

Exams and Quizzes
1. I recommend the following general process for studying each chapter:
   a. Read each chapter once to get an idea of its contents.
   b. Read the chapter carefully, ensuring you understand each concept.
   c. Post any questions you have in the appropriate discussion forum. Myself or a classmate will be sure to help you.

2. Exams and quizzes may be taken any time during the period listed in the Schedule of Assignments. They will be available beginning on the Monday prior to the due date, unless otherwise specified.

3. All exams and quizzes will be given online via D2L. There is no requirement to take tests on campus.

4. All exams and quizzes are open book and open notes. Calculators may be used.

5. All exams and quizzes will have a 10 hour time limit with one attempt. Every test should automatically submit itself at the end of the scheduled time.

6. Question types will be a combination of multiple choice, matching, true/false, fill in the blank.

Extra Credit Work
1. In general, I do not permit students to complete extra credit assignments to improve their grade. To earn the grade you desire, work hard all semester.

How Much Study Time You Should Expect To Devote To This Course
1. Most educators recommend that students spend 1-2 hours outside of class studying and completing assignments for every hour spent in class. For a typical 3 credit hour class, this translates into a total of 6-9 hours every week per course. This same guideline applies to online courses. You should expect
to spend a total of 6-9 hours each week studying and completing assignments for each course you take.

2. This is a guideline. Some classes will require more time and effort than this guideline and some will require less, and the time any individual student will need to spend will vary. You should expect that the study time you will need in any class will be toward the high side of the guideline until at least after the first exam or quiz. Then you can compare the effort you expended with the results you earned and make any adjustments necessary.

3. This class covers a lot of material, and like most physical science courses there are some concepts that may be difficult to grasp. Experience has shown that students who are successful in this class generally have study time totals on the higher of the scale.

**Academic Honesty & Plagiarism**

1. Students are expected to respect and uphold the standards of honesty in submitting written work to instructors. Though occurring in many forms, plagiarism in essence involves the presentation of another person’s work as if it were the work of the presenter. Any cheating or plagiarism will result in disciplinary action to be determined by the instructor based on the severity and nature of the offense. It is the student’s responsibility to review the College’s policy on Academic Honesty with it.

2. Collaboration and discussion is encouraged in all course aspects other than actually completing the assigned work (quizzes, exams, homework, projects, etc). Indeed, collaboration often leads to increased understanding of the material being covered. If you have questions about an assignment, I encourage you to speak up and ask questions about it.

3. It should, but will not, go without saying that plagiarism is a form of fraud and will not be tolerated. You are expected to do your own work. Copying text or images from any source and claiming it as your own is considered plagiarism. Submitting copied text as most or all of your answer on a homework or project is also a form of dishonesty, even if you cite the source. I want to read YOUR words, not someone else’s words. Using quoted text to support your answer will not usually be necessary in this class.

4. If I catch you in any form of academic dishonesty, you will receive a grade of zero for that assignment. If I catch you a second time, you will earn a failing grade for this class and be reported to the College.

**Attendance Policy**

1. I will monitor student attendance and participation in educational activities on a weekly basis. Students are required to participate in their online course
each week as verified by activity within the D2L Learning Management System.

2. There will be at least one assignment in this course that is due every week of the semester, unless the College is officially closed for the entire week. These may include discussion forum posts for class participation, exams and quizzes, homework, projects, or a combination of these. I will take attendance each week based on your submission of the assignments that are due that week, so it is important that you submit every assignment on time. If you submit all of the week’s assignments late, you will be marked as absent from class for that week. If at least one assignment is submitted on time each week, you will be marked as present.

3. Simply logging into the online classroom without submitting any of the assignments due is not sufficient to count for attendance purposes.

4. Students who do not regularly participate in class by submitting the assignments that are due each week, or are considered absent for more than two weeks during the semester, are subject to administrative withdrawal at any time without notice.

Delays in Getting The Textbook

Having regular access to the textbook is a requirement for this class. Whenever possible students should have the text in hand before the first day of class each semester, but there will be times that students are unable to get the text until after the class begins. If you are in this situation, follow the guidelines below. These guidelines are intended to be general enough to apply to all classes you take, and they may not all apply to this class. **Not having the text is not an acceptable excuse for doing no work at all in this class.**

1. During the first week of the semester, complete all of the administrative items. This includes printing the Syllabus and the Schedule of Assignments, posting an introduction to the class by filling out your personal profile. The text is not needed for any of these tasks.

2. Use any resources that are available in the online classroom. This includes links to web sites, review activities, handouts, PowerPoint slide shows, and anything else that may be available.

3. Reading all messages posted in the discussion forums may be the best way to keep up until you have the book in hand.

4. Look at the publisher’s web site for the text. Most publisher text sites have student resources that can help you, and many of these are available even if you do not have the text. As a minimum, the web sites usually have a Table of Contents, which can also help you get an idea what topics we will cover.
5. Please let me know if you don’t have the text by the end of the first week of class. I will not be sympathetic if you wait until after the first week of the semester to tell me you don’t have the text.

The above guidelines will probably not be enough to replace the text entirely, but they will allow you to learn enough to participate in the discussion forums each week. This participation is critical to your grade and also for attendance purposes.

Sources Of Technical Assistance

If you are having any technical difficulties (e.g., logging in, accessing the discussion board, etc.) please contact the Office of Distance Learning helpline at 305-809-3177 Monday—Friday 8:00AM to 4:00PM or email your question to FKCC.helpdesk@online.fkcc.edu.

Special Needs

If you have any special needs or requirements pertaining to this course, please discuss them with the instructor early in the term. If you have special needs as addressed by the Americans with Disabilities Act (ADA) and need assistance, please notify the Office for Students with Disabilities at 305-809-3504 via email at: dinkel_j@popmail.firn.edu or the course instructor immediately. Reasonable efforts will be made to accommodate your special needs.

Community Decorum

A positive learning experience depends upon respect among all members of this classroom community. Disregard or disrespect for the process, the group or toward any individual will result in removal from the class and may result in you being dropped from the course. Respectful discourse in discussion and email areas is expected and anonymous posting will not be tolerated.

Sexual Predators

Federal and State law requires a person designated as a “sexual predator or offender” to register with the Florida Department of Law Enforcement (FDLE). The FDLE then is required to notify the local law enforcement agency where the registrant resides, attends or is employed by an institution of higher learning. Information regarding sexual predators or offenders attending or employed by an institution of higher learning may be obtained from the local law enforcement agency with jurisdiction for the particular campus, by calling
the FDLE hotline (1-888-FL-PREDATOR) or (1-888-357-7332), or by visiting the FDLE website at www.fdle.state.fl.us/sexual_predators. If there are questions or concerns regarding personal safety, please contact the Campus Security Officer on your campus.

Conflict Resolution

Conflict Resolution – Should you have a personal or technical problem or grievance with the course or the instructor, follow this procedure:

1. Make a clear statement verbally or in writing to your instructor about the situation. Your instructor will respond.

2. If your instructor’s response does not resolve the situation, forward your initial statement and your instructor’s response to the Instructor’s Supervisor.

Revised: August 2011