Syllabus

Chemistry 205

General, Organic, and Biochem

Spring 2018

3 Credit Hours

Instructor:

Dr. Gary D. Anderson
Department of Chemistry
Marshall University   **E-mail:**   mailto:anderson@marshall.edu
Huntington, WV 25755   **Web Page** http://www.science.marshall.edu/anderson

Prerequisites: There are no formal prerequisites for this course but if your math ACT score was below 18, I would strongly advise you to complete MTH 102 before attempting this course.

Course Description: Introductory course for health professions students and non-science majors covering basic chemical principles with applications in organic chemistry and biochemistry.

Note for students with visual impairments: This course contains a substantial number of graphics files that cannot be adequately described as text equivalents. If you contact the instructor arrangements can be made to provide the source files for the graphics and/or Braille embossed high resolution graphics.

  This syllabus is rather long so I have listed some headings that may help you navigate through it.

Required Materials:

Text: The text for this course is "The Basics of General, Organic, and Biological Chemistry" v. 1.0. by David W. Ball, John W. Hill, and Rhonda J. Scott. The book is published by Flat World. The text is available in printed form or in digital form. The eISBN number for the book is 978-1-4533-1110-3.

   The MU Bookstore has the printed version for approximately $100. If you buy the printed book from the MU Bookstore that is all you get - you do not get any of the digital materials.

   You can also order the book directly from the publisher by going to https://students.flatworldknowledge.com/course/2576820,

   For $30 you can get online access - this gives you internet access to the text materials but you can only use it while you are logged in to their web site. For $50 you can purchase a package that gives you online access plus Ebook downloads. If you get this digital version, you can access the book through the web or you can download it as PDF files which you can print or read from your computer. Files that can be loaded on an iPad, a Kindle reader, or some Android devices are also included. If you have really good eyesight you could even put the book on your smart phone. For $55 you can buy a package that gives you online access plus a color printed text book. For $75 you can get a package that includes online access, Ebook downloads and the color printed textbook. You get immediate access to the digital materials and the printed book is shipped about a week after you order it. The most cost effective option is the $75 package because it gives you multiple options for accessing the book at a reasonable price.

Calculator:
   You will need a basic scientific calculator. You should be able to find a suitable calculator for around $15 or less. I do not recommend that you buy an expensive calculator. You will be better off with an inexpensive calculator that you can learn to use easily instead of with an expensive calculator with so many capabilities that you have a hard time learning how to use it. The calculator that is installed as a part of Windows is a good example of what you need and, in fact, you may want to use it for the quizzes.

Return to Top of Page

Exam Target Dates and Deadlines

   Students in this course have a maximum of one semester to complete the course.

   At the beginning you will only see icons for lecture notes for one topic and a quiz for that topic. You must make a score of 8 or more on any quiz before you will be able to see the next topic in the course. When you achieve an 8 the icons for the next topic lecture notes and quiz will automatically appear. You are not eligible to take an exam until you have completed all the quizzes in that Part of the course. For example, you must complete quiz #19 before you can take Exam I.

   Each exam has a Bonus Date, a Penalty Date, and a Last Access Date. If you complete an exam on or before the Bonus Date for that exam I will reward you by adding 20 points to your overall grade. If you do not complete the exam on or before the Penalty Date, I will subtract 20 points from your overall grade. If you do not complete an exam on or before the Last Access Date for that exam you will not be able to take the exam and you will receive a score of zero

   If you receive a score of zero on any of the first three exams because you didn't take it before the last access date, you will be given access to the first topic in the next Part at that time.

Dates for Spring 2018 are:

Exam	Bonus Date	Penalty Date	Last Access Date
Exam I	Wednesday February 7, 2018	Wednesday February 14, 2018	Monday February 26, 2018
Exam II	Monday February 26, 2018	Monday March 5, 2018	Friday March 16, 2018
Exam III	Thursday April 5, 2018	Thursday April 12, 2018	Friday April 20, 2018
Exam IV	Friday April 27, 2018		Thursday May 3, 2018
Final Exam	Friday April 27, 2018		Thursday May 3, 2018

NOTE WELL. A score of zero will be recorded for any quiz or exam not completed on or before Thursday, May 3, 2018.

Return to Top of Page

Grading:

There will be four hour exams and a final exam in addition to the 80 quizzes. The 80 quizzes are worth 10 points each. The four hour exams are worth 300 points each and the final exam is worth 400 points.

So, it is possible to earn up to 800 points from the quizzes, up to 1200 points from the four exams and up to 400 points from the final for a total of 2400 possible points in the course.

Letter grades will be assigned based on the following scale for the total points

- 2160 points or higher = A
- 1920-2159 points = B
- 1680-1919 points = C
- 1440-1679 points = D
- Less than 1440 points = F

Since I want to encourage students to complete this course in a timely manner, I will add 20 points to your total if you take an hour exam on or before the Bonus Date for that exam. On the other side of the coin, I will deduct 20 points from your total if you take an hour exam after the Penalty Date for that exam. I will also add 20 points to your total if you complete the final exam before the Bonus Date for the final. If you take full advantage of this incentive, you can raise your grade by a close to half a letter grade. On the other hand, failure to complete the coursework on schedule can cost you severely. I will post reminders of the target dates on the bulletin board from time to time so be sure to check the bulletin board for this.

The hour exams will be given on-line. There is a time limit on the exams and it will be enforced by the computer -- no answers will be accepted after the time limit on an exam. You will get the graded exam back with your score and feedback on your errors. Exams are closed book, closed note. **You are on your honor to take the exams without any assistance and without referring to any materials other than a basic periodic table.**

The final exam will be handled the same way as the hour exams. You only get one attempt on each exam and the time limit is enforced..

The quizzes are all taken on-line and the scores and the correct answers are available to you as soon as you complete the quiz. Quizzes are designed as learning tools rather than as grading tools so there is no time limit on quizzes. You can retake quizzes as many times as you like and only the highest score will count so you can feel free to retake a quiz as a way of studying for exams without having to worry about it hurting your grade.

Return to Top of Page

Organization of the Course:

    Chemistry is a subject that builds on a foundation.   You cannot understand the later topics unless you understand the earlier topics. For this reason, I have used the "topic mastery" model for this course. You cannot go on to a new topic until you have mastered the current one. Each topic has a quiz associated with it and you must make a score of 8 (or higher) on the quiz before you can proceed. You may take the quiz as many times as necessary but only the highest score will count.

    When you first start the course, only one topic will be available to you. Whenever you complete a topic, a new one will become available. All of the older ones will stay available so that you can review them as needed.

    I divided the course into 80 topics -- essentially starting a new topic at the point where I would normally end a lecture session in a regular course. A normal one hour lecture would cover two or more of these topics so each topic would represent somewhere between 10 minutes and an hour of lecture time in a regular course. You should be able to complete some topics in a few minutes but a few may take an hour or more.

    The course is divided into four roughly equal sized parts. There is an hour exam after you complete each of these parts. You cannot take an exam until after you have completed all of the quizzes in that part of the course and you cannot take the final exam untlil you have completed Exam 4. Click here for a detailed list of the topics.

Return to Top of Page

Course Objectives:

Student Learning Outcomes (by chapter)	How students will practice each outcome in this course	How each outcome will be assessed in this course
Chapter 1 • Define chemistry in relation to other sciences. • Identify the general steps in the scientific method. • Use chemical and physical properties, including phase, to describe matter. • Identify a sample of matter as an element, a compound, or a mixture.	repeatable online quizzes	quizzes exams

• Express quantities properly, using a number and a unit. Express a large number or a small number in scientific notation. • Identify the number of significant figures in a reported value. • Use significant figures correctly in arithmetical operations. • Recognize the Sl base units and explain the system of prefixes used with them. • Convert a value reported in one unit to a corresponding value a different unit.		
Chapter 2 • Define a chemical element and give examples of the abundance of different elements. • Represent a chemical element with a chemical symbol. • Explain all matter is composed of atoms. • Describe the modern atomic theory. • Describe the three main subatomic particles. • State how the subatomic particles are arranged in atoms. • Define and differentiate between the atomic number and the mass number of an element. • Explain how isotopes differ from one another. • Define atomic mass and atomic mass unit. • Describe how electrons are grouped within atoms. • Explain how elements are organized into the periodic table. • Describe how some characteristics of elements relate to their positions on the periodic table.	repeatable online quizzes	quizzes exams
Chapter 3 • Define the octet rule. • Describe how ionic bonds are formed. • Define the two types of ions. • Use Lewis diagrams to illustrate ion formation. • Write the chemical formula for a simple ionic compound. • Recognize polyatomic ions in chemical formulas. • Use the rules for naming ionic compounds.	repeatable online quizzes	quizzes exams

• Determine the formula mass of an ionic compound.		
Chapter 4 • Describe how a covalent bond forms. • Determine the chemical formula of a simple covalent compound from its name. • Determine the name of a simple covalent compound from its chemical formula. • Recognize molecules that are likely to have multiple covalent bonds. • Compare covalent bonds in terms of bond length and bond polarity • Determine the molecular mass of a molecule. • Predict the general shape of a simple covalent molecule. • Define organic chemistry. • Identify organic molecules as alkanes, alkenes, alkynes, alcohols, or carboxylic acids.	repeatable online quizzes	quizzes exams
Chapter 5 • Correctly define a law as it pertains to science. • State the law of conservation of matter. • Define *chemical reaction.* • Use a balanced chemical equation to represent a chemical reaction. • Calculate the amount of one substance that will react with or be produced from a given amount ot another substance. • Classify a given chemical reaction into a variety of types. • Identify a chemical reaction as an oxidation-reduction reaction. • Identify oxidation-reduction reactions with organic compounds.	repeatable online quizzes	quizzes exams
Chapter 6 • Define the mole unit. • Learn how the masses of moles of atoms and molecules are expressed. • Convert quantities between mass units and mole units.	repeatable online quizzes	quizzes exams

• Use a balanced chemical reaction to determine molar relationships between the substances. • Convert from mass or moles of one substance to mass or moles of another substance in a chemical reaction.		
Chapter 7 • Define *energy* and *heat.* • Relate heat transfer to temperature change. • Determine the heat associated with a phase change. • Define *bond energy.* • Determine if a chemical process is exothermic or endothermic. • Relate the concept of energy change to chemical reactions that occur in the body.	repeatable online quizzes	quizzes exams
Chapter 8 • Define *phase.* • Identify the type of interactions between molecules. • Describe the solid and liquid phases. • Describe the gas phase. • Predict the propert1es of gases using the gas laws.	repeatable online quizzes	quizzes exams
Chapter 9 • Understand what causes solutions to form. • Express the amount of solute in a solution in various concentration units. • Use molarity to determine quantities in chemical reactions. • Determine the resulting concentration of a diluted solution. • Describe the dissolution process at the molecular level. • Describe how the properties of solutions differ from those of pure solvents.	repeatable online quizzes	quizzes exams
Chapter 10	repeatable online quizzes	quizzes exams

• Recognize a compound as an Arrhenius acid or an Arrhenius base. • Recognize a compound as a Brønsted-Lowry acid or a Brønsted-Lowry base. • Illustrate the proton transfer process that defines a Brønsted-Lowry acid-base reaction. • Write chemical equations for water acting as an acid and as a base. • Describe the difference between strong and weak acids and bases. • Describe how a chemical reaction reaches chemical equilibrium. • Define the pH scale and use it to describe acids and bases. • Define *buffer* and describe how it reacts with an acid or a base.		
Chapter 11 • Define and give examples of the major types of radioactivity • Define *half-life* • Determine the amount of radioactive substance remaining after a given number of half-lives. • Express amounts of radioactivity in a variety of units. • Learn some applications of radioactivity • Explain where nuclear energy comes from. • Describe the difference between fission and fusion	repeatable online quizzes	quizzes exams
Chapter 12 • Recognize the composition and properties typical of organic and inorganic compounds. • Identify and name simple (straight-chain) alkanes given formulas and write formulas for straight-chain alkanes given their names. • Learn how alkane molecules can have branched chains and recognize compounds that are isomers. • Write condensed structural formulas for alkanes given complete structural formulas. • Draw line-angle formulas given structural formulas.	repeatable online quizzes	quizzes exams

• Name alkanes by the IUPAC system and write formulas for alkanes given IUPAC names. • Identify the physical properties of alkanes and describe trends in these properties. • Identify the main chemical properties of alkanes. • Name halogenated hydrocarbons given formulas and write formulas for these compounds given names. • Name cycloalkanes given their formulas and write formulas for these compounds given their names.		
Chapter 13 • Name alkenes given formulas and write formulas for alkenes given names. • Recognize alkenes that *can* exist as *cis-trans* isomers. • Classify isomers as *cis* or *trans*. • Draw structures for *cis-trans* isomers given their names. • Identify the physical properties of alkenes and describe trends in these properties. • Write equations for the addition reactions of alkenes with hydrogen, halogens, and water. • Draw structures for monomers that can undergo addition polymerization and for four-monomer-unit sections of an addition polymer. • Describe the general physical and chemical properties of alkynes. • Name alkynes given formulas and write formulas for alkynes given names • Describe the bonding in benzene and the way typical reactions of benzene differ from those of the alkenes • Recognize aromatic compounds from structural formulas. • Name aromatic compounds given formulas. • Write formulas for aromatic compounds given their names.	repeatable online quizzes	quizzes exams
Chapter 14 • Describe functional groups and explain why they are useful in the study of organic chemistry. • Identify the general structure for an alcohol.	repeatable online quizzes	quizzes exams

- Identify the structural feature that classifies alcohols as primary, secondary, tertiary
- Name alcohols with both common names and IUPAC names.
- Explain why the boiling points of alcohols are higher than those of ethers and alkanes of similar molar masses.
- Explain why alcohols. and ethers of four or fewer carbon atoms are soluble in water while comparable alkanes are not soluble.
- Describe how to prepare alcohols from alkenes.
- Give two major types of reactions of alcohols.
- Describe the result of the oxidation of a primary alcohol.
- Describe the result of the oxidation of a secondary alcohol.
- Describe the structure and uses of some common polyhydric alcohols.
- Describe the structure and uses of some phenols.
- Describe the structure differences between an alcohol and an ether that affects physical characteristics and reactivity of each.
- Name simple ethers.
- Describe the structure and uses of some ethers
- Identify the general structure for an aldehyde and a ketone.
- Use common names to name aldehydes and ketones
- Use the IUPAC system to name aldehydes and ketones.
- Explain why the boiling points of aldehydes and ketones are higher than those of ethers and alkanes of similar molar masses but lower than those of comparable alcohols.
- Compare the solubilities in water of aldehydes and ketones of four or fewer carbon atoms with the solubilities of comparable alkanes and alcohols.
- Recognize the typical reactions that take place with aldehydes and ketones.
- Describe some of the uses of common aldehydes and ketones.
- Identify thiols (mercaptans) by the presence of an SH group

| **Chapter 15**

• Identify the general structure for a carboxylic add, an ester, an amine, and an amide.
• Identify the functional group for a carboxylic acid, an ester, an amine, and an amide.
• Name carboxylic acids with common names.
• Name carboxylic acids according to IUPAC nomenclature.
• Describe the preparation of carboxylic acids.
• Compare the boiling points of carboxylic acids with alcohols of similar molar mass.
• Compare the so!ubi!ities of carboxylic acids in water with the solubilities of comparable alkanes and alcohols in water.
• Name the typical reactions that take place with carboxylic acids.
• Describe how carboxylic acids react with basic compounds.
• Identify the general structure of an ester.
• Use common names to name esters.
• Name esters according to the IUPAC system.
• Compare the boiling points of esters with alcohols of similar molar mass
• Compare the solubilities of esters in water with the solubilities of comparable alkanes and alcohols in water.
• Identify and describe the substances from which most esters are prepared.
• Describe the typical reactions that take place with esters.
• Identify the products of an acidic hydrolysis of an ester.
• Identify the products of a basic hydrolysis of an ester.
• Describe phosphate esters.
• Understand why phosphate esters are important in living cells.
• Identify the general structure for an amine.
• Identify the functional group for amines.
• Determine the structural feature that classifies amines as primary, secondary, or tertiary
• Use nomenclature systems to name amines.
• Explain why the boiling point of primary and secondary amines are higher than those of alkanes | repeatable online quizzes | quizzes

exams |

or ethers of similar molar mass but are lower than those of alcohols. • Compare the boiling points of tertiary amines with alcohols, alkanes, and ethers of similar molar mass. • Compare the solubilities in water of amines of five or fewer carbon atoms with the solubilities of comparable alkanes and alcohols in water. • Name the typical reactions that take place with amines. • Describe heterocyclic amines. • Identify the general structure for an amide. • Identify the functions group of an amide. • Name amides with common names. • Name amides according to the IUPAC system. • Compare the boiling points of amides with alcohols of similar molar mass. • Compare the solubilities in water of amides of five or fewer carbon atoms with the solubilities of comparable alkanes and alcohols in water. • Describe the preparation procedure for amides. • Identify the typical reactions that amides undergo		
Chapter 16 • Recognize carbohydrates and classify them as mono-, di-, or polysaccharides. • Classify monosaccharides as aldoses or ketoses and as trioses, tetroses, pentoses, or hexoses. • Distinguish between a D sugar and an L sugar. • Identify the structures of D-glucose, D-galactose, and D-fructose and describe how they differ from each other. • Define what is meant by anomers and describe how they are formed. • Explain what is meant by mutarotation • Identify the physical and chemical properties of monosaccharides • Identify the structures of sucrose, lactose, and maltose • Identify the monosaccharides that are needed to form sucrose. lactose, and maltose • Compare and contrast the structures and uses of starch, glycogen, and cellulose	repeatable online quizzes	quizzes exams

Chapter 17		
• Recognize the structures of common fatty acids and classify them as saturated, monounsaturated, or polyunsaturated. • Explain why fats and oils are referred to as triglycerides. • Explain how the fatty acid composition of the triglycerides determines whether a substance is a fat or oil. • Describe the importance of key reactions of triglycerides, such as hydrolysis, hydrogenation, and oxidation. • Identify the distinguishing characteristics of membrane lipids. • Describe membrane components and how they are arranged. • Identify the function of steroids produced in mammals.	repeatable online quizzes	quizzes exams
Chapter 18		
• Recognize amino acids and classify them based on the characteristics of their side chains. • Explain how an amino acid can act as both an acid and a base. • Explain how a peptide is formed from individual amino acids. • Explain why the sequence of amino acids in a protein is important. • Describe the four levels of protein structure. • Identify the types of attractive interactions that hold proteins in their most stable three-dimensional structure. • Explain what happens when proteins are denatured. • Identify how a protein can be denatured. • Explain the functions of enzymes. • Explain how enzymes are classified and named. • Describe the interaction between an enzyme and its substrate. • Describe how pH, temperature, and the concentration of an enzyme and its substrate influence enzyme activity. • Explain what an enzyme inhibitor is.	repeatable online quizzes	quizzes exams

• Distinguish between reversible and irreversible inhibitors. • Distinguish between competitive and noncompetitive inhibitors. • Explain why vitamins are necessary in the diet.		
Chapter 19 • Identify the different molecules that combine to form nucleotides. • Identify the two types of nucleic acids and the function of each type. • Describe how nucleotides are linked together to form nucleic acids. • Describe the secondary structure of DNA and the importance of complementary base pairing. • Describe how a new copy of DNA is synthesized. • Describe how RNA is synthesized from DNA. • Identify the different types of RNA and the function of each type of RNA. • Describe the characteristics of the genetic code. • Describe how a protein is synthesized from mRNA. • Describe the causes of genetic mutations and how they lead to genetic diseases. • Explain how viruses reproduce in cells.	repeatable online quizzes	quizzes exams

Time Requirement

   NOTE WELL: In a normal classroom setting for this course you would be expected to attend approximately 45 hours of lectures. You would also be expected to spend roughly double that amount of time studying for the course outside of class. The e-course format does not work magic -- you should expect to spend at least the same number of hours completing this course. Do not put off working on the course and then expect to be able to complete it in a couple of days. Be sure to try to meet the target dates so that you can successfully complete the course.

Marshall University Course Policies

By enrolling in this course, you agree to all Marshall University policies published in the current undergraduate catalog. The full text of these policies can be found on-line at www.marshall.edu/academic-affairs/policies

Computer and Software Requirements:

- You will need ready access to the internet. Home access is highly recommmended. Your computer should meet the minimum requirements listed in the link to Computer Hardware / Software Check and Minimum Requirements in the Student Support and Resources box in the opening page for the course in Blackboard. Broadband access such as DSL or cable modem is desirable but modem dialup access at 56K will work. There are very few files that will take more than a minute to download even at 56K.
- You will need a web browser. Blackboard says that you can use Explorer 11 or Edge or Firefox or Chrome on Windows based systems. If you use a Macintosh running OSX you can use Safari 6, 7, or 8
- You may need to download and install Sun Java. Then you need to enable Java and enable cookies. Then turn off anonymous login. You will also need to disable any popup ad killer software since they will interfere with quizzes and other features in Blackboard. Some firewall software and antivirus programs will also block popup windows so you may need to adjust settings on those. If you click on the "Blackboard Help" button in the left side menu of the main course page you will find a link to "Browser Support". Click on that and you will find a link for "Browser Checker" and if you click on that you will get a page showing information about your browser setup. If there are any items that do not have a green check mark then you may need to makes some adjustments in your browser setup.

Contacting the Instructor:

Whenever you need help with the course or just want to ask a question about anything, you should feel free to contact me. I am semiretired and do not teach any classes other than online courses. I do not keep regular office hours on

campus and I do not have a campus phone. The only reliable method for contacting me is by e-mail. I tend to check my e-mail about twice a day (even on weekends) and I tend to reply to e-mail as I receive it. I am sometimes out of town for a long weekend from time to time but will normally have access to e-mail. If I am going to be out of town and out of e-mail contact for more than a couple of days at a time I will warn you ahead of time.

You may use the e-mail that is internal to the course by clicking on the Messages button in the menu on the left side of the page. If you select Create Message, then click on the "TO" button, the instructor will listed as Gary Anderson (Instructor) and will normally be on the first page of the list.

Alternately, you may send e-mail to anderson@marshall.edu by any of the standard internet mail protocols. I will normally respond by whichever method you used to send your message. If you do not receive a response to an e-mail message within 48 hours you should assume that either your original message or my reply has gone astray in the e-mail system and you should resend the message. If you have reason to believe that the Marshall email server is not working properly you may want to try sending the message to me at wv.alchemist@comcast.net but I only check mail at that address about once a week unless the MU server is down.

Please note that while we tend to think of e-mail as being a nearly instantaneous means of communication there are times that there are significant delays in e-mail transmissions. Under certain circumstances it has been known to take as much as 48 hours for an e-mail message to get between a Marshall University account and an account at a local internet service provider. In fact, I had one case where a student sent me an e-mail message from a Marshall address and it did not arrive until 33 <u>days</u> later.   If either server is especially busy or if the network is particularly busy you will see these delays. So, be sure to plan ahead and send e-mail messages as early as possible to avoid problems from unpredicted delays.

General announcements are posted on the course bulletin board and a copy of them is emailed to every student in the course at the time they are posted.

Topics to Be Covered in This Course

Part I

Chapter 1

01-Introduction
02-Scientific Notation
03-Significant Figures

Chapter 8

29-Intermolecular Forces
30-Gases and Pressure Units
31-PVT Relationships
32-Ideal Gas Law

Chapter 9

33-Solutions
34-Concentrations
35-Colligative Properties

Chapter 10

36-Arrhenius Acids and Bases
37-Bronsted-Lowery Acids and Bases
38-Acid and Base Strengths and Buffers

Chapter 11

39-Radioactivity
40-Radiation Units and Half Life
41-Uses of Radiation and Nuclear
Chemistry

Part III

Chapter 12

42-Alkanes
44-IUPAC Nomenclature
45-Cycloalkanes
46-Chemical and Physical Properties of
Alkanes

Chapter 13

46-Alkenes and Alkynes
47-Geometric Isomers
48-Properties of Alkenes and Alkynes
49-Polymers
50-Aromatic Compounds

Chapter 14

77-Nucleotides
78-Nucleic Acids
79-Replication and Transcription
80-Mutations and Viruses