1. Introductory Biology Competencies	
1.1. Scientific Investigation	
1.1.a. Define, describe, and implement the scientific method	BIOL 105; BIOL 107
1.1.b. Describe implications of scientific or technological developments on ethical questions in biology	BIOL 105; BIOL 107
1.2. Basic Biochemistry	
1.2.a. Describe the fundamental properties of water in biological systems.	BIOL 105
1.2.b. Describe the four major biomolecules: carbohydrate, lipid, nucleic acid, and protein; and explain their functions and importance in biological systems.	BIOL 105
1.2.c. Draw and describe basic synthesis and degradation reactions of the four major biomolecules.	BIOL 105
1.2.d. Describe basic enzyme structure and function.	BIOL 105
1.2.e. Describe how biological systems are constrained by chemical and physical processes	BIOL 105; BIOL 107
1.3. Cell Structure and Function	
1.3.a. Describe the basic structure of a cell and define the functions of the organelles.	BIOL 105
1.3.b. Describe the fluid mosaic model structure of biological membranes and the relationships between the membranes, the cytoskeleton, and the extracellular matrix.	BIOL 105
1.3.c. Describe the functions of biological membranes, including transport, signal transduction, cell-cell recognition, enzymatic activity, and intercellular joining.	BIOL 105
1.3.d. Explain the biochemistry of and factors involved in membrane transport.	BIOL 105
1.3.e. Describe the transfer of molecules within a cell and between cells.	BIOL 105
1.3.f. Describe the difference between prokaryotic and eukaryotic cell structure.	BIOL 105
1.3.g. Describe the structure and function of chromosomes and their role in cell division.	BIOL 105

1.3.h. Explain the concept of the cell cycle, how it is controlled, and how it relates to cell division.	BIOL 105
1.3.i. Describe and differentiate between the mechanisms of mitosis and meiosis.	BIOL 105; BIOL 107
1.3.j. Explain the concepts of independent assortment, crossing over, and random fertilization, and relate these to the production of genetic variation within a population.	BIOL 105; BIOL 107
1.4 Energy Transfer Within Biological Systems	
1.4.a Explain the first and second laws of thermodynamics.	BIOL 105
1.4.b Explain the concept of free energy.	BIOL 105
1.4.c Define chemical reaction and contrast exergonic and endergonic reactions.	BIOL 105
1.4.d Explain the concepts of oxidation and reduction.	BIOL 105
1.4.e Describe the structure of ATP and explain how it powers cellular work.	BIOL 105
1.4.f Describe the processes of glycolysis, the citric acid cycle, and electron transport.	BIOL 105
1.4.g Describe the processes of anaerobic respiration/fermentation.	BIOL 105
1.4.h Describe the processes of anaerobic respiration/fermentation.	BIOL 105
1.4.i Discuss the role and molecular details of photosystems and light-harvesting pigments.	BIOL 105
1.4.j Discuss the role of CO_2 metabolism during photosynthesis	BIOL 105
1.5 Introduction to Molecular Genetics	
1.5.a Explain the processes controlling gene expression: gene regulation, transcription, and translation.	BIOL 105
1.5.b Describe the process of DNA replication in prokaryotes and eukaryotes.	BIOL 105
1.5.c Describe the concept of mutation and explain the various kinds of mutations.	BIOL 105
1.6 Basic Principles of Inheritance	

	1.6.a	Explain Mendelian genetics and the expression of traits through the solution of simple monohybrid and dihybrid genetics problems.	BIOL 105
	1.6.b	Explain the concepts of complete dominance, incomplete dominance, and codominance, multiple alleles, pleiotropy, epistasis, and polygenic inheritance.	BIOL 105
1.7	**Evolution and Natural Selection**		
	1.7.a	Describe the sources of genetic variation within a population and explain why variation is essential for evolution.	BIOL 105; BIOL 107
	1.7.b	Describe and apply the postulates of Darwin's theory of evolution through natural selection.	BIOL 105; BIOL 107
	1.7.c	Define evolution and natural selection, mutation, sexual selection, gene flow and genetic drift.	BIOL 105; BIOL 107
	1.7.d	Explain the basic principles of population genetics.	BIOL 105; BIOL 107
	1.7.e	Discuss the biological, ecological, morphological, and phylogenetic species concepts, reproductive isolation mechanisms, and the process of speciation.	BIOL 105; BIOL 107
	1.7.f	Explain some of the mechanisms behind different scientific hypotheses concerning the origin of life forms.	BIOL 107
	1.7.g	Explain endosymbiosis and the origin of eukaryotic cells.	BIOL 105
	1.7.h	Discuss the advantages and disadvantages of multicellularity.	BIOL 105
	1.7.i	Describe the various lines of evidence for evolution including DNA and other molecular data, morphology and anatomy, developmental biology, biogeography, fossils, and radiometric dating.	BIOL 105; BIOL 107
1.8	**Hierarchical Organization of Life**		
	1.8.a	Describe the methods used in the classification of organisms.	BIOL 105; BIOL 107
	1.8.b	Explain how phylogenetic trees are constructed.	BIOL 105; BIOL 107
	1.8.c	Describe the principal characteristics of the major taxa such as Domains/Kingdoms	BIOL 105; BIOL 107

	1.8.d Describe basic ecological concepts in regards to the hierarchical organization of life.	BIOL 105; BIOL 107
1.9	**Unity and Diversity of Life**	
	1.9.a Describe the use of evolutionary theory in explaining the unity and diversity of life.	BIOL 107
	1.9.b Describe the use genetic evidence to establish evolutionary relationships between organisms.	BIOL 107
	1.9.c Describe the key characteristics and groups of viruses.	BIOL 107
	1.9.d Describe the biological diversity of plants, animals, fungi, protists, and prokaryotes at the levels of genes, cells, organs, individuals, and populations.	BIOL 107
	1.9.e Discuss the key distinguishing features of the prokaryotic domains, Archaea and Eubacteria, including similarities and differences in organisms from various taxonomic groups.	BIOL 107
	1.9.f Discuss the key distinguishing features of the eukaryotic clades, including similarities and differences in organisms from various taxonomic groups	BIOL 107
	1.9.g Discuss the key distinguishing features, including similarities and differences, between major groups of Protist clades	BIOL 107
	1.9.h Discuss the key distinguishing features, including similarities and differences, between major groups of fungal phyla, including morphology and reproductive biology	BIOL 107
	1.9.i Discuss the key distinguishing features, including similarities and differences, between plant taxa from bryophytes to angiosperms, including morphology, plant anatomy, plant development, and reproductive biology	BIOL 107
1.10	**Anatomy and Physiology of Plants**	
	1.10.a Describe and recognize plant cellular and subcellular structures.	BIOL 107
	1.10.b Describe basic comparative plant anatomy and morphology.	BIOL 107

1.10.c Describe the characteristics and roles of plant cells and tissues.	BIOL 107
1.10.d Describe and recognize modes of plant reproduction and dispersal.	BIOL 107
1.10.e Describe the mechanism and pathways involved in the transport of water, minerals, and nutrients in plants.	BIOL 107
1.10.f Describe basic soil characteristics and plant mineral nutrition.	BIOL 107
1.10.g Describe the basic developmental processes in plants and the roles of plant hormones in growth and development.	BIOL 107
1.11 Anatomy and Physiology of Animals	
1.11.a Describe the characteristics and roles of epithelium, muscle, connective, and nervous tissue.	BIOL 107
1.11.b Describe examples of homeostatic mechanisms and their regulation.	BIOL 107
1.11.c Describe examples of invertebrate and vertebrate physiological systems	BIOL 107
1.11.d Describe and recognize a range of structures of invertebrate and vertebrate physiological systems, including but not limited to: exo- and endo- skeletal systems; the structure of skeletal muscle, the structure and function of a sarcomere, and the structure and interaction of actin and myosin myofilaments during relaxation and contraction; the structures and mechanisms involved in nervous signal transmission; the structures and functions of the endocrine system; the structures of the reproductive system; and how hormones affect cells and how cells regulate hormone reception and the response.	BIOL 107
1.12 Ecology	
1.12.a Describe the meaning and importance of ecology.	BIOL 107
1.12.b Describe the components of the biosphere.	BIOL 107
1.12.c Examine the role of physiological ecology in an organism's success.	BIOL 107

1.12.d	Explain the basic principles of population ecology.	BIOL 107
1.12.e	Describe several community-level interactions such as competition, predation/herbivory, and symbiosis.	BIOL 107
1.12.f	Explain the characteristics and functions of ecosystems.	BIOL 107
1.12.g	Apply knowledge of ecology to environmental and conservation problems.	BIOL 107
1.13	**Laboratory Skills**	
1.13.a	Develop, implement and evaluate an experimental problem through data collection and analysis.	BIOL 105; BIOL 107
1.13.b	Properly use a microscope, balance, pipette, micropipettes, and other basic laboratory equipment.	BIOL 105; BIOL 107
1.13.c	Demonstrate the use of basic computer applications such as excel for creating graphs and running simple statistical analyses.	BIOL 105; BIOL 107
1.13.d	Demonstrate the proper technique for weighing and measuring materials using the metric system.	BIOL 107; BIOL 107
1.13.e	Calculate concentrations and convert units.	BIOL 105
1.13.f	Demonstrate familiarity with basic biochemical analysis for organic molecule identification.	BIOL 105
1.13.g	Demonstrate the use of spectrophotometric assay for various applications	BIOL 105
1.13.h	Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific language.	BIOL 105; BIOL 107
1.13.i	Present scientific information orally, with graphical presentation of data using appropriate presentation technology.	BIOL 107; BIOL 107
1.14	**Scientific Literature**	
1.14.a	Locate and critically evaluate scientific information	BIOL 105; BIOL 107
1.14.b	Write literature reviews.	BIOL 105; BIOL 107
2. Molecular Biology Competencies		

2.1	**Introduction to Molecular Biology**	
2.1.a	Discuss the history and logic of molecular biology.	BIOL 221
2.1.b	Discuss the similarities and differences between molecular biology, biochemistry and genetics.	BIOL 221
2.1.c	Identify applications of molecular biology in a variety of fields.	BIOL 221
2.1.d	Discuss examples of standard model systems (phage*, Escherichia coli*, yeast, cultured cells) and why you would use them.	BIOL 221
2.2	**Protein Structure/Function**	
2.2.a	Define the structure of an amino acid as well as net charge at physiological pH	BIOL 221
2.2.b	Identify categories of amino acid side groups (hydrophobic, polar, charged) and which amino acids are in each category.	BIOL 221
2.2.c	Apply pKa to terminal groups and side groups on amino acids.	BIOL 221
2.2.d	Identify special amino acid properties (cysteine, proline).	BIOL 221
2.2.e	Describe the 1°, 2°, 3°, 4° structure of proteins.	BIOL 221
2.2.f	Compare biochemical and functional definitions of protein domains.	BIOL 221
2.2.g	Understand the role post-translational modifications have on protein functions such as proteolytic cleavage, phosphorylation by kinases, dephosphorylation by phosphatases, ubiquitination and glycosylation.	BIOL 221
2.2.h	Understand how allosteric regulation, competitive inhibition and cofactors are important for protein function and regulation.	BIOL 221
2.3	**Nucleic Acid Structure/Function**	
2.3.a	Explain nucleotide base-pairing rules and why only certain base pairs are possible.	BIOL 221
2.3.b	Describe why the double helix is thermodynamically favored.	BIOL 221

	2.3.c Examine properties of DNA and RNA in solution.	BIOL 221
	2.3.d Examine base composition and base distribution.	BIOL 221
	2.3.e Discuss the ways to denature DNA and why they cause strands to dissociate; describe A, B and Z helices.	BIOL 221
	2.3.f Examine hybridization kinetics including C0t curves, dependence of Tm on sequence and how to read a C0t curve	BIOL 221
2.4	**Evidence for DNA as the Genetic Material**	
	2.4.a Discuss the tetranucleotide model for the structure of DNA, and the importance of data or evidence in scientific reasoning.	BIOL 221
	2.4.b Understand the significance of the experiments of Griffith and Avery, Chargaff, and Hershey and Chase in how they relate to DNA's secondary structure and its role as the genetic material.	BIOL 221
	2.4.c Describe and identify DNA structures including chromatin and chromosomes, linear vs circular DNA, positive and negative supercoiling, DNA gyrase and Topo II, behavior of DNA of different topologies in gel electrophoresis	BIOL 221
2.5	**DNA Replication**	
	2.5.a Describe how the Meselsohn-Stahl experiment relates to semi-conservative replication.	BIOL 221
	2.5.b Discuss the role of Okazaki experiments, leading and lagging strands and requirements for DNA polymerase activity.	BIOL 221
	2.5.c Discuss the roles of helicase, supercoiling and the need for gyrase/topoisomerase II as well as single-strand binding proteins.	BIOL 221
	2.5.d Examine the mechanism of proofreading; 5' -> 3' exo/nick translation and strand displacement; differences between DNA pol I and DNA pol III.	BIOL 221
	2.5.e Discuss the roles of origins of replication and origin binding proteins, primase and primers, primer removal and ligase.	BIOL 221

	2.5.f	Discuss the differences between prokaryotic and eukaryotic DNA replication	BIOL 221
	2.5.g	Describe the function of telomerase.	BIOL 221
2.6	**Transcription**		
	2.6.a	Compare and contrast the similarities and differences between DNA replication and transcription.	BIOL 221
	2.6.b	Understand promoters and terminators, sigma factor and prokaryotic RNA polymerase, TATA boxes and -35/Pribnow boxes, formation of an open complex, elongation and termination.	BIOL 221
	2.6.c	Compare and contrast the 3 RNA polymerases in eukaryotes and which classes of RNA molecules each transcribes.	BIOL 221
	2.6.d	Describe TFII transcription factors, what each one does, and the order in which they bind to promoter/assembly of a basal transcription initiation complex for RNA pol II	BIOL 221
	2.6.e	Describe the activation of RNA pol II and the switch from initiation to elongation; lack of specificity in termination in eukaryotes; the role of transcription factors, silencers and enhancers.	BIOL 221
	2.6.f	Describe the processing of tRNA, rRNA, and mRNA.	BIOL 221
2.7	**Translation**		
	2.7.a	Understand the genetic code and how to read a codon table.	BIOL 221
	2.7.b	Describe the structure of tRNAs including charging/aminoacyl-tRNA synthetase	BIOL 221
	2.7.c	Describe the structure of a ribosome including ribosome binding sites.	BIOL 221
	2.7.d	Discuss translation initiation; A and P sites and the peptidyltransferase reaction; release factor and termination; polycistronic vs monocistronic mRNAs.	BIOL 221
	2.7.e	Describe –Translation: protein processing EF-Tu and the "proof-reading" function in translation; energetics of translation; polysomes.	BIOL 221
2.8	**Mutagenesis**		

	2.8.a	Describe types of mutations including: single base substitutions; frameshifts caused by insertions and deletions; silent mutations; point mutations; nonsense mutations; spontaneous deamination of cytosine; spontaneous depurination; thymine dimers; and base tautomerization.	BIOL 221
	2.8.b	Discuss types of mutagens and how they cause mutations.	BIOL 221
	2.8.c	Explain mechanisms of reversion and repair.	BIOL 221
2.9	**Gene Regulation in Prokaryotes**		
	2.9.a	Compare and contrast positive and negative regulation and the role of an inducer.	BIOL 221
	2.9.b	Understand regulation of the lac operon, the lac repressor and the concept of allosteric regulation.	BIOL 221
	2.9.c	Understand the trp operon regulation at the levels of transcription initiation and attenuation.	BIOL 221
2.10	**Gene Regulation in Eukaryotes**		
	2.10.a	Describe histones and their interaction with DNA, understand basic structure of a nucleosome, compare and contrast heterochromatin and euchromatin, and discuss the general role of histone modification in regulation of gene expression.	BIOL 221
	2.10.b	Discuss higher-order packing of eukaryotic DNA, including the structure and function of centromeres and telomeres.	BIOL 221
	2.10.c	Describe transcriptional regulation in the context of heterochromatin, euchromatin, histone modifications and chromatin structure.	BIOL 221
	2.10.d	Understand HDACs, cancer, hypermethylation of promoters, and transcribability.	BIOL 221

	2.10.e Describe types of eukaryotic transcription factors (Zn fingers, homeobox genes, basic-helix-loop-helix proteins) and the importance of relative concentration and relative affinity of multiple factors.	BIOL 221
	2.10.f Explain mechanisms of post-transcriptional regulation including alternative splicing and the effects of different splice variants.	BIOL 221
2.11	**Biotechnology**	
	2.11.a Demonstrate an understanding of current applications in biotechnology, such as recombinant and transgenic methods in plants, animals, and microorganisms.	BIOL 221
	2.11.b Describe the role of selectable markers, DNA ligase, and transformation in recombinant DNA experiments.	BIOL 221
	2.11.c Describe recombinant DNA techniques and their uses, including Southern blot, Northern blot, Western blot, in situ hybridization, Sanger sequencing, PCR, and site directed mutagenesis.	BIOL 221
2.12	**Molecular Techniques**	
	2.12.a Describe basic molecular biological techniques including chromatography, electrophoresis and how size, shape and charge play a role.	BIOL 221
	2.12.b Explain acrylamide electrophoresis of proteins including denaturing vs non-denaturing gels.	BIOL 221
	2.12.c Describe isoelectric focusing and 2-D gels.	BIOL 221
	2.12.d Explain PCR, DNA sequencing, dideoxy sequencing and acrylamide gels.	BIOL 221
	2.12.e Understand how to read a sequencing gel including fluorescent tagged ddNTPs/automated sequencing and capillary gel electrophoresis; PCR; the importance of Taq polymerase and the thermal cycler; sources of thermostable polymerases.	BIOL 221
2.13	**Laboratory Skills**	

2.13.a Apply investigative laboratory skills relevant to molecular biology, including the microscopic study of chromosomes, electrophoresis, DNA isolation, the handling and genetic analysis of microbes, basic recombinant DNA techniques such as restriction digests and bacterial transformation in data analysis and in the simulation of biological systems.	BIOL 221
2.13.b Describe molecular exclusion chromatography, ion exchange chromatography, TLC, HPLC, affinity chromatography.	BIOL 221
2.13.c Apply principles of electrophoresis including agarose gel electrophoresis of DNA	BIOL 221
2.13.d Prepare and analyze Southern and Northern blots.	BIOL 221
2.13.e Prepare and analyze PCR, DNA sequencing, dideoxy sequencing and acrylamide gels.	BIOL 221
2.13.f Design, conduct, statistically evaluate, and interpret the results of a genetic experiment, expanding on one, or more, of the laboratory techniques listed in the previous competency.	BIOL 221
2.13.g Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific language.	BIOL 221
2.13.h Present scientific information orally, with graphical presentation of data using appropriate presentation technology.	BIOL 221
3. Genetics Competencies	
3.1. Inheritance	
3.1.a. Demonstrate understanding of Mendelian and non-Mendelian inheritance principles.	BIOL 222
3.1.b. Use current terminology to explain the modern understanding of eukaryotic chromosome structure.	BIOL 222
3.1.c. Apply an understanding of genetic principles to the analysis of genetic problems and systems.	BIOL 222

3.1.d. Apply basic probability theory and statistical hypothesis testing techniques to the analysis of genetics problems including linkage analysis.	BIOL 222
3.1.e. Explain and discuss the importance of genetics to Biology as a whole and to certain human concerns such as medical and technological innovations including recombinant DNA technology, genetic engineering, and genetic testing.	BIOL 222
3.1.f. Discuss how genes and the environment interact to produce a specific phenotype.	BIOL 222
3.1.g. Explain the cellular activities of mitosis and meiosis as they relate to genetics.	BIOL 222
3.1.h. Analyze pedigrees to determine patterns of inheritance in families.	BIOL 222
3.1.i. Describe common genetic disorders.	BIOL 222
3.2 Population Genetics and Evolution	
3.2.a Explain evolution in terms of molecular genetics and population genetics.	BIOL 222
3.2.b Demonstrate understanding of population statistics, including Hardy-Weinberg equilibrium.	BIOL 222
3.2.c Explain perturbations to and deviations from Hardy-Weinberg equilibria and what they mean for the evolution of species.	BIOL 222
3.3 Linkage and Mapping	
3.3.a Describe genetic linkage, genetic linkage mapping, syntenic genes, complete genetic linkage, incomplete genetic linkage.	BIOL 222
3.3.b Calculate recombination frequency and discuss how recombination frequency correlates with gene distance.	BIOL 222
3.3.c Describe biological factors that affect accuracy of genetic maps and recombination.	BIOL 222
3.4 DNA Replication and Repair	
3.4.a Review DNA structure and function.	BIOL 222
3.4.b Review the evidence of DNA as the genetic material.	BIOL 222

3.4.c	Describe why replication is semiconservative, bidirectional, and discontinuous.	BIOL 222
3.4.d	Describe the process of DNA replication in prokaryotes and eukaryotes.	BIOL 222
3.4.e	Explain the role of telomeres in the completion of lagging strand replication.	BIOL 222
3.4.f	Describe how mutations arise and how they generate different phenotypes.	BIOL 222
3.4.g	Describe the features of base excision repair, nucleotide excision repair, mismatch repair, double strand break repair (single strand annealing, homologous recombination, non-homologous end joining).	BIOL 222
3.5	**Gene Regulation**	
3.5.a	Describe negative versus positive control and the role of activator and repressor proteins.	BIOL 222
3.5.b	Describe the regulation of prokaryotic genes such as the lac, trp, and araC operons.	BIOL 222
3.5.c	Discuss eukaryotic gene regulation mechanisms.	BIOL 222
3.6	**Protein Synthesis**	
3.6.a	Describe differences between viral, prokaryotic, and eukaryotic chromosomes.	BIOL 222
3.6.b	Describe RNA nucleotide structure, RNA assembly, and RNA structure.	BIOL 222
3.6.c	Compare and contrast prokaryotic and eukaryotic gene structure and transcription processes.	BIOL 222
3.6.d	Compare and contrast structure and composition of prokaryotic and eukaryotic ribosomes.	BIOL 222
3.6.e	Compare and contrast prokaryotic and eukaryotic translation, including the molecular factors involved.	BIOL 222
3.7	**Genetic Basis of Disease**	
3.7.a	Examine examples of monogenic disease and compare autosomal dominant versus autosomal recessive genes as well as sex-linked recessive genes.	BIOL 222

	3.7.b	Understand the mechanism of chromosomal nondisjunction and its contribution to disease such as Down syndrome and sex chromosome disorders.	BIOL 222
	3.7.c	Understand the role of variation in chromosome number, such as polyploidy and aneuploidy, in the development of human disease.	BIOL 222
	3.7.d	Understand the mechanism of chromosomal translocations and their contribution to disease.	BIOL 222
	3.7.e	Solve pedigree analysis to determine dominant and recessive traits and examine their use in predicting human disease.	BIOL 222
	3.7.f	Examine the role of mitochondrial genes and their role in human disease.	BIOL 222
	3.7.g	Understand the function of proto-oncogenes and tumor suppressors in the development of human cancer.	BIOL 222
	3.7.h	Examine the role viruses have in contributing to genetic disease such as cancer.	BIOL 222
	3.7.i	Recognize other mechanisms that contribute to or prevent human disease such as DNA repair, telomeres and telomerase, control of apoptosis and transposable elements.	BIOL 222
	3.7.j	Understand the effect of various mutagens and their effect on DNA structure and role they play in mutagenesis.	BIOL 222
3.8	**Biotechnology**		
	3.8.a	Demonstrate an understanding of current application in biotechnology such as recombinant and transgeneic methods in plants, animals and microorganisms.	BIOL 222
	3.8.b	Describe the role of selectable markers, DNA ligase, and transformation in recombinant DNA experiments.	BIOL 222
	3.8.c	Describe recombinant DNA techniques and their uses, including Southern blot, Northern blot, Western blot, in situ hybridization, Sanger sequencing, PCR, and site directed mutagenesis.	BIOL 222

3.8.d	Demonstrate an understanding of genomics, including genome mapping strategies such as cytogenic, linkage, and physical mapping. Describe possible applications for data gained through genome.	BIOL 222
3.9	**Laboratory Skills**	
3.9.a	Apply investigative laboratory skills relevant to basic genetics, including the production and analysis of genetic crosses, the microscopic study of chromosomes, electrophoresis, DNA isolation, the handling and genetic analysis of microbes, basic recombinant DNA techniques such as restriction digests and bacterial transformation, and the use of computers to access information from online databases, in data analysis and in the simulation of biological systems.	BIOL 222
3.9.b	Design, conduct, statistically evaluate, and interpret the results of a genetic experiment, expanding on one, or more, of the laboratory techniques listed in the previous competency.	BIOL 222
3.9.c	Apply the use of bioinformatics for DNA/protein sequence analysis, genomics, and proteomics.	BIOL 222
3.9.d	Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific language.	BIOL 222
3.9.e	Present scientific information orally, with graphical presentation of data using appropriate presentation technology.	BIOL 222
4. Ecology Competencies		
4.1.	**Importance**	
4.1.a.	Explain the historical importance of ecology to human society.	BIOL 240
4.1.b.	Describe examples of early ecological studies.	BIOL 240
4.2	**Biosphere**	
4.2.a	Describe the effects of the Earth's axial tilt, solar radiation, moisture, and ocean circulation on climate.	BIOL 240

4.2.b	Discuss examples of atmospheric circulations and geographic landforms on regional climate.	BIOL 240
4.1.c.	Examine the relationship between temperature & precipitation with vegetation distribution.	BIOL 240
4.1.d.	Describe the processes of soil formation, physical and chemical weathering, and biological decomposition.	BIOL 240
4.1.e.	Describe and compare the geographic locations, geological features, and dominant organisms that are common to the major terrestrial biomes on the Earth.	BIOL 240
4.1.f.	Describe and compare the physical, chemical, and biological characteristics of freshwater and marine biomes.	BIOL 240
4.1.g.	Diagram lentic temperature stratification in the summer and winter.	BIOL 240
4.1.h.	Discuss the influence of climate change on coral bleaching and eutrophication.	BIOL 240
4.3	**Physiological Ecology**	
4.3.a	Describe the physical, biological and behavioral factors that influence and organism's ability to grow and reproduce in its habitat and range distribution.	BIOL 240
4.3.b	Discuss the importance of tradeoffs as organisms adapt to their environments.	BIOL 240
4.3.c	Describe the challenges organisms have adapting to terrestrial, freshwater, and marine environments.	BIOL 240
4.4	**Evolution and Population Genetics**	
4.4.a	Review Darwin's theory of natural selection.	BIOL 240
4.4.b	Describe several examples and mechanisms of natural selection.	BIOL 240
4.4.c	Describe the mechanisms of speciation and extinction; identify the causes of speciation.	BIOL 240
4.4.d	Explain coevolution, how it occurs, and what its effects are.	BIOL 240
4.4.e	Describe examples of bottleneck effect, founder effect, Allee effect and inbreeding depression.	BIOL 240

	4.4.f	Describe the mechanisms of adaptive radiation.	BIOL 240
	4.4.g	Identify and describe some examples of animal behavior or sexual dimorphism that increase reproductive success.	BIOL 240
	4.4.h	Explain and describe the importance of the environment to evolution, natural selection and the maintenance of biodiversity.	BIOL 240
4.5	**Populations**		
	4.5.a	Describe and compare logistic and exponential growth models.	BIOL 240
	4.5.b	Explain the role of carrying capacity.	BIOL 240
	4.5.c	Discuss the future impact of human population growth.	BIOL 240
	4.5.d	Discuss how survivorship and fecundity are used to predict the future growth and distribution of a population.	BIOL 240
	4.5.e	Discuss the influence of life history strategies on the growth and distribution of a population.	BIOL 240
	4.5.f	Explain the effects of density independent and density dependent factors on population growth.	BIOL 240
	4.5.g	Explain what intraspecific competition is; provide examples of intraspecific competition.	BIOL 240
4.6	**Communities**		
	4.6.a	Discuss factors that influence the form, structure or appearance of a plant community.	BIOL 240
	4.6.b	Discuss the concept of species diversity and the indices used to calculate species diversity.	BIOL 240
	4.6.c	Compare and contrast intraspecific and interspecific competition.	BIOL 240
	4.6.d	Explain the principles of competitive exclusion, resource partitioning, and character displacement and their relationship to competition.	BIOL 240
	4.6.e	Examine predation, herbivory, and symbiosis.	BIOL 240

	4.6.f	Describe models of succession for aquatic and terrestrial communities.	BIOL 240
	4.6.g	Recognize similarities among ecological communities inhabiting similar types of environments and the diverse evolutionary adaptions that influence and species' range, dispersal and ability to survive in its environment.	BIOL 240
4.7	**Ecosystems**		
	4.7.a	Describe the major biotic and abiotic ecological characteristics that identify a given ecosystem.	BIOL 240
	4.7.b	Describe the biogeochemistry of an ecosystem and explain the cycles of nitrogen, carbon, phosphorous, and water.	BIOL 240
	4.7.c	Explain energy flow in ecosystems, photosynthesis, trophic levels, and biomass pyramids from an ecological perspective.	BIOL 240
	4.7.d	Discuss diverse adaptations for nutrient acquisition in ecosystems, the conversion of these nutrients into biologically useful forms, cycling of nutrients, and the indispensable roles of producers and decomposers.	BIOL 240
	4.7.e	Evaluate the impact of human behavior on earth's ecosystems, particularly as it relates to biological diversity, global climate change, and the ability of ecosystems to sustain life.	BIOL 240
	4.7.f	Recognize the continually changing nature of ecosystems, and discuss factors that impact ecosystems and the evolution of resident species through natural selection.	BIOL 240
4.8	**Environmental Biology**		
	4.8.a	Describe and explain the causes and consequences of pollution on the biosphere and the survival of all organisms.	BIOL 240
	4.8.b	Analyze a variety of timely environmental issues in light of their ecological, social, economic, ethical, or cultural implications.	BIOL 240
	4.8.c	Discuss the impacts of conductivity and fragmentation on ecosystem function and biogeography.	BIOL 240

4.9	**Lab/Field Experiences**	
4.9.a	Collect data and formulate valid scientific conclusions of an ecological nature.	BIOL 240
4.9.b	Work as part of a team in field and laboratory investigations of ecological phenomena.	BIOL 240
4.9.c	Collect ecological data and apply basic statistical skills for analyzing and presenting quantitative and qualitative data to formulate conclusions.	BIOL 240
4.9.d	Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific language.	BIOL 240
4.9.e	Present scientific information orally, with graphical presentation of data using appropriate presentation technology.	BIOL 240
5. General Chemistry Competencies		
5.1.	**Chemical Toolbox**	
5.1.a.	Use theory to predict, graph, and interpret experiment observations.	CHEM 105; CHEM 106
5.1.b.	Use math and critical reasoning to organize and manipulate data for meaningful interpretations of data and results, use statistics to judge limitations of error, and discern causes of error. Distinguish between precision and accuracy.	CHEM 105; CHEM 106
5.1.c.	Apply relevant fundamental mathematical relationships in order to carry out accurate calculations related to the specific topics covered.	CHEM 105; CHEM 106
5.1.d.	Apply rules of significant figures and rounding, converting among units, and using dimensional analysis to solve numerical problems.	CHEM 105; CHEM 106
5.1.e.	Use problem-solving skills to reduce complex problems into simpler components, identifying principle objectives.	CHEM 105; CHEM 106
5.1.f.	Integrate knowledge of two or more traditional subfields of chemistry to solve complex chemical problems.	CHEM 105; CHEM 106

	5.1.g. Demonstrate computer literacy to use multiple programming, computational, online and database tools. Utilize computational tools to organize, process, store, and retrieve data.	CHEM 105; CHEM 106
	5.1.h. Understand the major systems of nomenclature used in chemistry for inorganic and organic compounds, including stereochemistry (R/S and E/Z).	CHEM 105; CHEM 106
5.2.	**Matter**	
	5.2.a. Recognize the atomic symbols of the elements and use the periodic table to extract valuable information about atoms and ions especially concerning bonding.	CHEM 105; CHEM 106
	5.2.b. Classify matter: pure substances (elements and compounds) or mixtures (homogeneous or heterogeneous).	CHEM 105; CHEM 106
	5.2.c. Understand the differences between physical and chemical changes, physical properties and chemical properties.	CHEM 105; CHEM 106
	5.2.d. Describe matter in terms of its physical properties (both intensive and extensive) and chemical properties.	CHEM 105
	5.2.e. Compare and contrast the three forms of matter: solid, liquids and gas. Compare a gas, a liquid, and a solid using a kinetic-molecular theory description.	CHEM 105; CHEM 106
	5.2.f. Use mathematical relationships (including Boyle's Law, Charles's Law, Avogadro's Law, ideal gas law, and van der Waals equation) to describe gases.	CHEM 105
	5.2.g. Describe gases with respect to density, vapor pressure, partial pressures, diffusion, effusion, molecular speed distributions.	CHEM 105
	5.2.h. Define changes of state physically and pictorially (heating curves and phase diagrams). Apply the Clausius-Clapeyron equation.	CHEM 105
	5.2.i. Describe liquids with respect to surface tension, viscosity, capillary action, and vapor pressure.	CHEM 105

5.2.j.	Identify types of solids: molecular solids, metallic solids, ionic solids, and covalent network solids. Identify coordination number, common unit cells (simple cubic, body-centered cubic, and face-centered cubic unit cell) , and properties that relate to its structure.	CHEM 105; CHEM 106
5.3	**Atomic Structure**	
5.3.a	Demonstrate a comprehensive knowledge of the structure of the nucleus (including nucleons), atoms, isotopes, ions, and molecules.	CHEM 105
5.3.b	Apply a fundamental knowledge of atomic orbitals (s, p, d, and f) to electronic configurations and the explanation of electronic spectroscopy.	CHEM 105
5.3.c	Apply the Pauli exclusion principle, Hund's rule, Aufbau principle to write the electron~~ic~~ configurations for the elements, identifying diamagnetic and paramagnetic species. Explain how electron~~ic~~ configurations relate to electronegativities and bonding properties of these elements. Distinguish between core and valence electrons.	CHEM 105
5.3.d	Employ periodic trends (including successive ionization energies, electron affinities, atomic radii, ionic radii, shielding and effective nuclear charge) to atoms and ions.	CHEM 105
5.3.e	Understand the basic mathematical relationships underpinning quantum mechanics, such as the wave function, de Broglie wavelength, and the Heisenberg uncertainty principle, and other physical properties of a particle.	CHEM 105
5.3.f	Understand the interaction of light with matter. Relate energy of a photon to wavelength, frequency, and to emission and absorption spectroscopy. Understand the relative regions of the electromagnetic radiation.	CHEM 105

	5.3.g Describe the shapes of s, p, and d orbitals and apply the rules of quantum numbers to electrons residing in these orbitals.	CHEM 105
5.4	**Chemical Bonding**	
	5.4.a Predict, compare and contrast the different types of intramolecular (covalent, ionic, and metallic) and intermolecular bonding (London forces (induced dipole), dipole-dipole, hydrogen-bonding, and ion-dipole) demonstrated in substances? Predict the consequences of these types of bonds on physical properties.	CHEM 105
	5.4.b Apply valence bond theory (hybridization, $\sigma + \pi$ bonds), and molecular orbital bonding models to describe bonding at the molecular level.	CHEM 105
	5.4.c Develop a fundamental understanding of the behavior and properties of phases of matter (gases, liquids, and solids).	CHEM 105
	5.4.d Define and identify ionic and covalent bonding, energetics of bonding, lattice energy through the Born-Haber cycle.	CHEM 105
	5.4.e Describe bonds using single, double, and triple bond notation, coordinate covalent bond, valence bond descriptions (hybrid orbitals), and sigma and pi bond descriptions.	CHEM 105
	5.4.f Relate bonding properties (such as delocalized electrons, formal charge, bond length, bond order, bond enthalpy) and its consequences to molecular structure and reactivity.	CHEM 105
	5.4.g Define bonding in metals and metal compounds, metallic bonding, band theory, magnetic properties, conductivity, semiconductors, insulators, and defects.	CHEM 105
	5.4.h Describe diatomic molecules using molecular orbital theory, identifying bonding, antibonding orbitals, and bond order.	CHEM 105
5.5	**Molecular Structure & Function**	
	5.5.a Distinguish between structure/reactivity and structure/property relationships.	CHEM 105; CHEM 106

	5.5.b	Relate bond polarity and molecular dipole moment to identify polar and non-polar molecules.	CHEM 105
	5.5.c	Predict general trends in the boiling points and solubilities of compounds, based on their size, polarity, and ability to form hydrogen bonds.	CHEM 105
	5.5.d	Distinguish between angle strain, torsional strain, steric strain, and understand their significance to reactivity.	CHEM 105
	5.5.e	Identify resonance-stabilized structures and compare the relative importance of their resonance forms. Calculate formal charges for different bonding modes.	CHEM 105
	5.5.f	Relate the dependence of structure and reactivity on context, particularly solvent effects and other non-covalent interactions.	CHEM 105
	5.5.g	Relate the interplay between electronic, steric, and orbital interactions in the behavior and properties of molecules.	CHEM 105
5.6	**Reactions**		
	5.6.a	Write accurate, balanced equations for chemical (including redox) and nuclear reactions, including deducing stable products in a nuclear reaction based on the stability of radionuclides. Predict the type of radioactive emission for a nuclear reaction. Distinguish the different classes of nuclear reactions (fission, fusion, artificial vs. Natural radioactivity)	CHEM 105; CHEM 106
	5.6.b	Employ the detailed quantitative relationships (moles, molar mass, and molarity) governing chemical reactions, including the ability to perform a variety of stoichiometry calculations (such as limiting reagent, dilutions, theoretical yield, percent yield).	CHEM 105
	5.6.c	Demonstrate a basic understanding of reaction chemistry, including oxidation-reduction (both inorganic and organic, half reactions and net ionic equations), acid-base, neutralization, precipitation, substitution (both inorganic and organic), elimination, rearrangements, and addition.	CHEM 105

	5.6.d	Identify nucleophiles (Lewis bases) and electrophiles (Lewis acids), and write equations for Lewis acid-base reactions using curved arrows to show the flow of electrons.	CHEM 106
5.7	**Energy & Thermodynamics**		
	5.7.a	Define a system (versus surroundings) in terms of kinetic and potential energy, internal energy, work and heat.	CHEM 105; CHEM 106
	5.7.b	Define chemical and physical processes as exothermic or endothermic processes, calculating ΔH^o and ΔS^o for a reaction based on stoichiometry. Calculate ΔG^o from both ΔH^o and ΔS^o, and from ΔG values of formation.	CHEM 105; CHEM 106
	5.7.c	Manipulate common thermochemical calculations and relationships (including calorimetry; heats of reaction; Hess's Law and standard enthalpies or entropies of formation; calculating for reactions and phase changes).	CHEM 105; CHEM 106
	5.7.d	Manipulate common calculations and relationships to solutions (such as Henry's Law; calculating solution concentration and converting between the various forms of concentration expression; applying Raoult's Law; calculating colligative properties.)	CHEM 105; CHEM 106
	5.7.e	Calculate and relate E_{cell}, equilibrium constant, ΔG at various conditions.	CHEM 106
	5.7.f	Calculate the binding energy in a nuclear reaction.	CHEM 106
5.8	**Kinetics**		
	5.8.a	Calculate reaction rates, determining reaction orders and rate constants.	CHEM 106
	5.8.b	Calculate concentrations given the rate law, time, and initial reactant concentrations; relating a reaction half-life to a rate constant.	CHEM 106
	5.8.c	Use the Arrhenius equation to determine a reaction's activation energy or rate constant at a different temperature.	CHEM 106
	5.8.d	Determine the molecularity and rate law for an elementary reaction.	CHEM 106

	5.8.e	Write the overall chemical reaction and rate law for a given mechanism.	CHEM 106
	5.8.f	Understand the effect of a catalyst. Employing methods of activation, including Brønsted or Lewis acid/base, free radical chemistry, and organometallic catalysis.	CHEM 106
5.9	**Equilibrium**		
	5.9.a	Calculate and interpret values of equilibrium constants. Writing equilibrium constant expressions and using them to calculate equilibrium constant values.	CHEM 106
	5.9.b	Calculate free-energy changes from equilibrium constants, and calculate the position of reaction equilibrium from the free-energy changes.	CHEM 106
	5.9.c	Predict reaction direction based on comparing Q and K.	CHEM 106
	5.9.d	Describe and employ the reversibility of reactions. Apply Le Châtélier's principle for changes in equilibrium concentrations, temperature and pressure.	CHEM 106
5.10	**Experimentation**		
	5.10.a	Demonstrate a basic ability to define problems clearly, develop testable hypotheses, design and execute experiments, analyze data using appropriate statistical methods, understand the fundamental uncertainties in experimental measurements, and draw appropriate conclusions.	CHEM 105; CHEM 106
	5.10.b	Apply major concepts, theoretical principles and experimental findings in general and organic chemistry lectures to the solution of laboratory problems.	CHEM 105; CHEM 106
	5.10.c	Demonstrate creative and independent thinking in a laboratory setting.	CHEM 105; CHEM 106
	5.10.d	Demonstrate knowledge of chemical, instrumental and workplace safety. Know and follow the proper safety procedures and regulations for safe handling and use of chemicals.	CHEM 105; CHEM 106

5.10.e	Employ appropriate, safe, and ethical research methodologies to collect, analyze and interpret data critically (error analysis) toward the solution of a problem.	CHEM 105; CHEM 106
5.10.f	Critically evaluate methodologies, data and conclusions of one's own and other's technical work.	CHEM 105; CHEM 106
5.10.g	Use technology for computations, data acquisition, and data base searching.	CHEM 105; CHEM 106
5.10.h	Students will be able to maintain an organized and well-documented laboratory notebook.	CHEM 105; CHEM 106
5.10.i	Interact effectively in a group to solve scientific problems and work productively with a diverse group of peers.	CHEM 105; CHEM 106
5.10.j	Present information in a clear and organized manner, write well-organized and concise reports in a scientifically appropriate style, and use relevant technology in their communications.	CHEM 105; CHEM 106
5.10.k	Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific formalisms.	CHEM 105; CHEM 106
5.10.l	Demonstrate the responsible treatment of data, proper citation of others' work, and the standards related to plagiarism and the publication of scientific results.	CHEM 105; CHEM 106
5.10.m	Find and evaluate the validity and usefulness of chemistry information in the scientific literature.	CHEM 106
5.10.n	Demonstrate proper conceptual and mathematical knowledge upon which chemical instrumentation is based.	CHEM 106
5.10.o	Collect empirical data through the safe and effective physical manipulation of materials, equipment, and instrumentation in a face-to-face instructional setting.	CHEM 105; CHEM 106
5.11	**Visualization**	
5.11.a	Understand the relationship between symbolic and particulate representations.	CHEM 105

5.11.b Predict molecular geometry, shape and ideal bond angles at the molecular level using VSEPR theory.	CHEM 105
5.11.c Employ the concept of the mole to relate the macroscopic and microscopic views of chemical reactions.	CHEM 105
5.11.d Use mathematical equations to provide a tool to visualize chemical and physical processes.	CHEM 105
5.11.e Draw and interpret Lewis, condensed, and line-angle structural formulas. Convert these drawings to accurate Newman projections, Fisher projections, Haworth projections, chair conformations as appropriate, envisioning these representations as space filling diagrams.	CHEM 105
5.11.f Visualize the movements of the microscopic world using a qualitative description of the gas laws based on the kinetic molecular theory.	CHEM 105
5.11.g Develop a basic understanding of the microscopic point of view, especially for thermodynamic quantities such as entropy.	CHEM 106
6. Organic Chemistry Competencies	
6.1 Chemical Toolbox	
6.1.a. Use theory to predict, graph, and interpret experiment observations.	CHEM 211
6.1.b. Use math and critical reasoning to organize and manipulate data for meaningful interpretations of data and results, use statistics to judge limitations of error, and discern causes of error. Distinguish between precision and accuracy.	CHEM 211
6.1.c. Apply relevant fundamental mathematical relationships in order to carry out accurate calculations related to the specific topics covered.	CHEM 211
6.1.d. Apply rules of significant figures and rounding, converting among units, and using dimensional analysis to solve numerical problems.	CHEM 211

6.1.e.	Use problem-solving skills to reduce complex problems into simpler components, identifying principle objectives.	CHEM 211
6.1.f.	Integrate knowledge of two or more traditional subfields of chemistry to solve complex chemical problems.	CHEM 211
6.1.g.	Demonstrate computer literacy to use multiple programming, computational, online and database tools. Utilize computational tools to organize, process, store, and retrieve data.	CHEM 211
6.1.h.	Understand the major systems of nomenclature used in chemistry for inorganic and organic compounds, including stereochemistry (R/S and E/Z).	CHEM 211
6.2.	**Matter**	
6.2.a.	Recognize the atomic symbols of the elements and use the periodic table to extract valuable information about atoms and ions especially concerning bonding.	CHEM 211
6.2.b.	Classify matter: pure substances (elements and compounds) or mixtures (homogeneous or heterogeneous).	CHEM 211
6.2.c.	Understand the differences between physical and chemical changes, physical properties and chemical properties.	CHEM 211
6.3	**Chemical Bonding**	
6.3.a	Predict, compare and contrast the different types of intramolecular (covalent, ionic, and metallic) and intermolecular bonding (London forces (induced dipole), dipole-dipole, hydrogen-bonding, and ion-dipole) demonstrated in substances? Predict the consequences of these types of bonds on physical properties.	CHEM 211
6.3.b	Apply valence bond theory (hybridization, $\sigma + \pi$ bonds), and molecular orbital bonding models to describe bonding at the molecular level.	CHEM 211

	6.3.c	Describe bonds using single, double, and triple bond notation, coordinate covalent bond, valence bond descriptions (hybrid orbitals), and sigma and pi bond descriptions.	CHEM 211
	6.3.d	Relate bonding properties (such as delocalized electrons, formal charge, bond length, bond order, bond enthalpy) and its consequences to molecular structure and reactivity.	CHEM 211
	6.3.e	Describe diatomic molecules using molecular orbital theory, identifying bonding, antibonding orbitals, and bond order.	CHEM 211
6.4	**Molecular Structure & Function**		
	6.4.a	Distinguish between structure/reactivity and structure/property relationships.	CHEM 211
	6.4.b	Identify constitutional isomers, stereoisomers, and diastereomers, including cis-trans (geometric) isomers.	CHEM 211
	6.4.c	Distinguish between angle strain, torsional strain, steric strain, and understand their significance to reactivity.	CHEM 211
	6.4.d	Identify resonance-stabilized structures and compare the relative importance of their resonance forms. Calculate formal charges for different bonding modes.	CHEM 211
	6.4.e	Draw and describe reactive intermediate structures of carbocations, carbanions, free radicals, and carbenes and the structural features that stabilize them. Explain which are electrophilic and which are nucleophilic.	CHEM 211
6.5	**Reactions**		
	6.5.a	Demonstrate a basic understanding of reaction chemistry, including oxidation-reduction (both inorganic and organic, half reactions and net ionic equations), acid-base, neutralization, precipitation, substitution (both inorganic and organic), elimination, rearrangements, and addition.	CHEM 211

	6.5.b	Identify nucleophiles (Lewis bases) and electrophiles (Lewis acids), and write equations for Lewis acid-base reactions using curved arrows to show the flow of electrons.	CHEM 211
6.6	**Experimentation**		
	6.6.a	Demonstrate a basic ability to define problems clearly, develop testable hypotheses, design and execute experiments, analyze data using appropriate statistical methods, understand the fundamental uncertainties in experimental measurements, and draw appropriate conclusions.	CHEM 105; CHEM 106, CHEM 211
	6.6.b	Apply major concepts, theoretical principles and experimental findings in general and organic chemistry lectures to the solution of laboratory problems.	CHEM 105; CHEM 106, CHEM 211
	6.6.c	Demonstrate creative and independent thinking in a laboratory setting.	CHEM 105; CHEM 106; CHEM 211
	6.6.d	Demonstrate knowledge of chemical, instrumental and workplace safety. Know and follow the proper safety procedures and regulations for safe handling and use of chemicals.	CHEM 105; CHEM 106; CHEM 211
	6.6.e	Employ appropriate, safe, and ethical research methodologies to collect, analyze and interpret data critically (error analysis) toward the solution of a problem.	CHEM 105; CHEM 106; CHEM 211
	6.6.f	Critically evaluate methodologies, data and conclusions of one's own and other's technical work.	CHEM 105; CHEM 106; CHEM 211
	6.6.g	Use technology for computations, data acquisition, and data base searching.	CHEM 105; CHEM 106; CHEM 211
	6.6.h	Students will be able to maintain an organized and well-documented laboratory notebook.	CHEM 105; CHEM 106; CHEM 211
	6.6.i	Interact effectively in a group to solve scientific problems and work productively with a diverse group of peers.	CHEM 105; CHEM 106; CHEM 211

	6.6.j	Present information in a clear and organized manner, write well-organized and concise reports in a scientifically appropriate style, and use relevant technology in their communications.	CHEM 105; CHEM 106, CHEM 211
	6.6.k	Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific formalisms.	CHEM 105; CHEM 106, CHEM 211
	6.6.l	Demonstrate the responsible treatment of data, proper citation of others' work, and the standards related to plagiarism and the publication of scientific results.	CHEM 105; CHEM 106, CHEM 211
	6.6.m	Find and evaluate the validity and usefulness of chemistry information in the scientific literature.	CHEM 106; CHEM 211
	6.6.n	Demonstrate proper conceptual and mathematical knowledge upon which chemical instrumentation is based.	CHEM 106; CHEM 211
	6.6.o	Collect empirical data through the safe and effective physical manipulation of materials, equipment, and instrumentation in a face-to-face instructional setting.	CHEM 105; CHEM 106, CHEM 211
6.7	**Visualization**		
	6.7.a	Draw and interpret Lewis, condensed, and line-angle structural formulas. Convert these drawings to accurate Newman projections, Fisher projections, Haworth projections, chair conformations as appropriate, envisioning these representations as space filling diagrams.	CHEM 211
	6.7.b	Draw and identify the types of stereoisomers for a molecule, identifying the relationship between stereoisomers, identifying each carbon with the R/S nomenclature.	CHEM 211
	6.7.c	Draw a reaction-energy diagram for a mechanism, and point out the corresponding transition states, activation energies, intermediates, and rate-limiting steps.	CHEM 211

6.7.d	Cultivate the understanding that the way to molecular knowledge is through experimentation; correlating structure with reactivity and function through wet chemical methods, spectroscopy (notably NMR, FTIR, and MS), and use of computational simulations.	CHEM 211
7. General Physics (Algebra Based) Competencies		
7.1.	**Mechanical Sciences**	
7.1.a.	Understand and convert physical quantities and measurements in the SI and UCSC systems.	PHYS 101
7.1.b.	Define and compute vector and scalar quantities, such as speed and velocity, and analyze physical systems using the concepts of translational and rotational equilibrium, and kinetic and static friction.	PHYS 101
7.1.c.	Solve problems using the concepts of moment arm, torque, and center of gravity.	PHYS 101
7.1.d.	Solve problems that require an ability to apply Newton's Three Laws of Motion and describe the interaction of force, mass, weight, and acceleration due to gravity.	PHYS 101
7.1.e.	Demonstrate the ability to apply conservation principles (work, energy, linear-momentum, and angular momentum).	PHYS 101
7.1.f.	Compute the rotational motion, centripetal force and acceleration, moment of inertia and rotational energy for rotating physical systems.	PHYS 101
7.1.g.	Measure and/or compute temperature and thermal expansion.	PHYS 101
7.1.h.	Compute the quantity of heat transferred using the concepts of specific heat capacity and latent heats of fusion and vaporization.	PHYS 101
7.1.i.	Compute the quantity of heat transferred using the concepts and mathematics of thermal conductivity, convection, and radiation.	PHYS 101
7.1.j.	Use the gas laws to compute values for volume, temperature, pressure, and amount of a gas.	PHYS 101

7.1.k. Use laboratory equipment to demonstrate scientific principles.	PHYS 101
7.1.l. Recognize uncertainties in data.	PHYS 101
7.1.m. Tabulate and graph data and compute results.	PHYS 101
7.1.n. Draw reasonable conclusions from quantitative data and communicate results to others.	PHYS 101
8. General Calculus I Competencies	
8.1. General Calculus I	
8.1.a. Examine limits and their properties. Specifically, defining the limit and using this definition to evaluate a limit. Identify limits of functions graphically, numerically, and analytically. Use theorems on limits and find limits at infinity. Determine the continuity of a function and a combination of functions, including at a particular point or a removable discontinuity.	MATH 211
8.1.b. Use differentiation to evaluate a derivative. Study includes the definition of a derivative, average and instantaneous rates of change and average and instantaneous velocity. Find derivatives to various functions by product, quotient, power, chain, and implicit rules. Find tangent and normal lines to curves.	MATH 211
8.1.c. Study applications of differentiation. Related rates and optimization problems will be worked as well as differentials and linear approximations. Intervals of increasing and decreasing, concavity, extrema, inflection points, and horizontal tangents will all be used.	MATH 211

Secondary Education Competencies

1.1 Beginning secondary education teacher candidates have an emerging understanding of adolescent development and diversity.	
1.1.1 Demonstrate an emerging understanding of adolescent cognitive, social, emotional, physical and moral development.	EDUC 250, EDUC 121
1.1.2 Demonstrate an emerging understanding of how culture, economic background, linguistics background, gender, religion and family structure impact adolescents.	EDUC 250, EDUC 121, EDUC 255
2.1 Beginning secondary education teacher candidates demonstrate an understanding of software and educational technologies associated with operations and concepts for instruction and use of technology to enhance productivity, efficiency and professional practice.	
2.1.1 Demonstrate an understanding, evaluate and select information, sources, and digital tools based on the appropriateness to specific tools.	EDUC 201
2.1.2 Apply instructional technology to generate ideas, products or processes.	EDUC 201
3.1 Beginning secondary education teacher candidates demonstrate understanding and awareness of diverse adolescent abilities and their influence on instructional needs.	
3.2 Beginning secondary education teacher candidates demonstrate an understanding of how culture, economic background, linguistics background,	EDUC 255

gender, religion and family structure influence the learning of adolescents.	
3.2 Beginning secondary education teacher candidates demonstrate sensitivity to varying adolescent abilities and diversity.	EDUC 255
4.1 Beginning secondary education teacher candidates have an emerging understanding of professional roles and responsibilities.	
4.1.1 Demonstrate an understanding of the ethics of the profession, e.g. confidentiality, plagiarism.	EDUC 101
4.1.2 Demonstrate ability to collaborate and communicate with peers, students and education professionals.	EDUC 201
4.1.3 Understand the appropriate use of social networking and/or electronic communication with peers, students, and education professionals.	EDUC 201
4.1.4 Recognize varying roles of teachers in schools and community.	EDUC 121
5.1 Beginning secondary education teacher candidates will demonstrate an emerging understanding of contemporary learning theories and theories of motivation and how development occurs according to these theories.	
5.1.1 Demonstrate an emerging understanding of how adolescents construct meaning based on different learning theories.	EDUC 250
5.1.2 Demonstrate an emerging understanding of how adolescents respond to instructional strategies and learning environments based on different motivation theories.	EDUC 250
6.1 Beginning secondary education teacher candidates will acquire an emerging understanding of the historical, philosophical, ethical, and legal foundations of the field.	

6.1.1 Demonstrate an emerging understanding of key historical events that have influenced American public education.	EDUC 101
6.1.2 Demonstrate an emerging understanding of key philosophical orientations that have influences American public education.	EDUC 101
6.1.3 Demonstrate an emerging understanding of legal influences of American public education.	EDUC 101
6.1.4 Demonstrate and emerging understanding of the inherent value of equity in American public education.	EDUC 101
7.1 Beginning secondary education teacher candidates will demonstrate sensitivity to varying adolescent abilities and diversity through experiences in both community and school settings.	EDUC 101
7.2 Beginning secondary education teacher candidates will acquire a familiarity with current secondary school settings.	EDUC 101
7.3 Beginning secondary education teacher candidates will demonstrate appropriate professional dispositions, presentation and behaviors, e.g., collegiality, ability to self-assess accurately.	EDUC 101