Index #10-47
March 2, 2010

Normandale Community College
Chemistry 2921- Biochemistry
Common Course Outline

I. Effective Date: Spring 2011

II. Catalog Description:

CHEM 2921 Biochemistry: 3CR FALL and SPR. This is a one semester non-biochemistry major course designed for students who intend to complete a 4 year Biological Sciences major or enter a pre-professional program in Dentistry, Veterinary Medicine, or Pharmacology. Introduction to the fundamentals of biochemistry: structure and function of biological macromolecules , including the study of enzyme catalysis, metabolism and the regulation of metabolism (carbohydrates, lipids, amino acids and nucleotides), comprehensive, quantitative analysis of chemical equilibria, bioenergetics and the chemical foundation of genetic information.

III. Course Prerequisite:

The prerequisites are CHEM 2061 and BIOL 1105.

IV. Outline of Major Content Areas:

A. Introduction and Background
    1. Chemical bonding.
    2. Units of scale
    3. Aqueous solutions: water as a solvent, review of basic chemical concepts.
        a. Acid-base reactions
        b. Henderson-Hasselbalch equation
        c. Buffers
        d. pH
        e. Dissociation of water
        f. organic acids

B. Biomolecules
    1. Amino Acids.
        a. Peptide bonds
        b. Classification and characteristics
        c. Acid-base properties
        d. Titration curves
        e. Charge on peptides
        f. Peptides and protein structure
        g. Purification and x-ray crystallograohy
        h. Mass spectrometry
    2. Enzymes
        a. Substrate specificity
        b. Coenzymes
        c. Regulation of enzymatic activity

d. Enzyme kinetics
e. Enzymatic catalysis
f. Classification of enzymes

3. Carbohydrates
   a. Classification of carbohydrates
   b. Configuration and conformation
   c. Polysaccharides
      1. Structure
      2. Storage
      3. Glycoproteins
4. Lipids and Membranes
   a. Lipid classification
      1. Fatty acids
      2. Triacylglycerols
      3. Glycerophospholipids
      4. Sphingolipids
      5. Cholesterol
   b. Biological Membranes
      1. Membrane proteins
      2. Fluid mosaic model of membrane structure
      3. Erythrocyte membrane
5. Nucleic acids: DNA and RNA
   a. Chemical structure and base composition
      1. C:\Documents and Settings\johannjl\Local Settings\Temporary Internet Files\Content.Outlook\CD Folder 2006\QTLects06\Mar06\QT\default.html3', 5'-phosphodiester bond
      2. Double helical structures
      3. Messelson Stahl experiment

C. Metabolism
   1. Glycolysis
   2. Krebs cycle
      a. Coenzymes
      b. Galactose metabolism
      c. Carbon path through Krebs cycle
   3. Electron transport and oxidative phosphorylation
      a. Summing up ATP yield
      b. Muscle contraction
   4. Gluconeogenesis and glycogen metabolism
      a. Regulation of glycolysis vs gluconeogenesis
      b. Glycogen degradation and synthesis
      c. Hormones: adrenaline cascade
   5. Pentose phosphate pathway
   6. Lipid metabolism
      a. Lipid catabolism
      b. Beta-oxidation

c. ATP yield
d. Oxidation of unsaturated fatty acids; synthesis of fatty acids
e. Glycoxylate cycle
f. Cholesterol biosynthesis

7. Amino acid metabolism
a. C:\Documents and Settings\johannjl\Local Settings\Temporary Internet Files\Content.Outlook\CD Folder 2006\QTLects06\Apr12\QT\default.htmlTransamination reaction
b. Oxidation of amino acid carbon chains
c. Urea cycle

8. Photosynthesis
a. Light reactions
b. Calvin cycle
c. C:\Documents and Settings\johannjl\Local Settings\Temporary Internet Files\Content.Outlook\CD Folder 2006\QTLects06\Apr19\QT\default.htmlCalvin cycle stoichiometry

D. Molecular Biology
1. Central dogma of molecular biology
2. C:\Documents and Settings\johannjl\Local Settings\Temporary Internet Files\Content.Outlook\CD Folder 2006\QTLects06\Apr21\QT\default.htmlBiosynthesis of pyrimidine and purine nucletides
3. Formation of deoxyribonucleotides
4. Replication of DNA
5. Sequencing of DNA and recombinant DNA
a. PCR, restriction endonucleases, recombinant DNA formation, screening for recombinant DNA
6. Transcription
a. DNA-dependent RNA polymerase
b. C:\Documents and Settings\johannjl\Local Settings\Temporary Internet Files\Content.Outlook\CD Folder 2006\QTLects06\May01\QT\default.htmlGenetic code
6. Translation
a. Ribosomes
b. Transfer RNA
c. Amino acid activation
d. Initiation of protein synthesis
e. Protein synthesis
f. Peptide bond formation, wobble hypothesis, and mutations.

V. Student Learning Outcomes

1. The student will learn the structures of the following classes of bio-molecules: amino acids, carbohydrates, lipids and nucleic acids.
2. The student will learn the reactions or behaviors of these molecules under differing conditions (2 a, b, c, and d).

3. The student will learn key metabolic pathways, including the structures of the molecules involved, the enzymes associated with the pathways and the points at which energy is released or consumed during the process (2 a, b, c, and d).
4. The student will solve problems related to pH, enzyme kinetics, and amino acid behavior under varied pH conditions.
5. The student will learn the chemical basis of the flow of genetic information (2 a, b, c, and d).
6. The student will learn the concepts and techniques that are used to study biochemistry and molecular biology.

VI. Sample Methods for Evaluation of Student Learning

A. Lecture (100 % of total points)
   1. Lecture exams will be about 50% multiple choice and 50% short answer. There will be three lecture exams and one comprehensive final, worth 70% of the course grade.
   2. Pop quizzes and homework assignments will total about 20% of the possible points.
   3. The remaining points (10% of total points) will be allotted to one short paper (3-5 pages) that will require additional reading and research. Topics will range from semester to semester, but will be directed toward innovations in research techniques and new knowledge in the field of biochemistry.

B. Grading: A = 90% of total points, B = 80% of total points, C = 70% of total points, D = 55% of total points, F = less than 55%.