Butler County Community College
Behavioral Science, Math, Science, and
Physical Education Division

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COURSE OUTLINE
Critical Concepts in Biology

Course Description: BI 106. Critical Concepts in Biology. 2 hours credit. This course will enable the student to understand basic biological principles and apply these to topics covered in anatomy and physiology, and microbiology courses. This course is intended for the student who needs preparatory work before taking anatomy and physiology, or microbiology courses.

Course Relevance: Basic concepts of biology are fundamental to the understanding of more complex biological processes that are addressed in anatomy and physiology, and microbiology classes. Mastery of these concepts before taking these two courses will increase the student's success in these two classes. These concepts are also fundamental to the student's understanding biological issues relevant to personal health.

Required Materials:
Textbook:
Garrett, L., *Get Ready for A & P* (1st ed.)., Pearson

Learning Outcomes:
The intention is for the student to be able to:
1. Recognize component molecules and relate these to the structure of macromolecules
2. Describe the relationship of cell structure to specific cellular functions
3. Apply basic chemical concepts to enzymatic reactions
4. Understand the relationship between cell respiration and energy conversions in the cell
5. Describe the molecular basis of genetic information and expression
6. Demonstrate the basic principles of measurement

Primary Learning PACT Skills that will be DEVELOPED and/or documented in this course:
Through the student involvement in this course, he/she will develop his/her ability in the following primary PACT skill areas:
1. Critical thinking
   - Through the application of concepts to new situations the student will develop critical thinking skills.

Secondary skills (developed but not documented):

Time management

Major Summative Assessment Task(s):

These learning outcomes and primary Learning PACT skills will be demonstrated by:

1. Preparation of a document that shows the assembly of a series of organic molecules by bonding together smaller molecules using computer software that is on line. The student will have to recognize various organic molecules, apply concept of molecular synthesis and describe the relationship between structure and function at the molecular level.

Course Content:

I. Themes – Key recurring concepts that run throughout this course:
   A. Molecular basis of life
   A. Cellular basis of life
   B. Connection between structure and function
   C. Homeostasis feedback

II. Issues –Key issues that will be addressed in this course: area of conflict that must be understood in order to achieve the intended outcome:
   A. Balance between the reductionism (molecular/cellular/mechanical) view point and emergent properties as the level of complexity increases

III. Concepts – Key concepts that must be understood to address the issues:
   A. Structure and function at the cellular, individual and population levels
   B. Chemical basis of metabolism, physiological processes, cell respiration and protein synthesis

IV. Skills/Competencies – Actions that are essential to achieve the course outcomes:
   A. Explain basic chemistry principles
      1. Define these basic terms: atom, atomic number, atomic mass, element, ion, isotope, molecule
      2. Use the periodic table to identify the elements found in a living system
      3. Recognize energy levels, electron capacities of an energy level and how stability of atoms is determined
      4. Define and recognize examples of different types of bonds: ionic, covalent, polar covalent and hydrogen
      5. Describe the structure of water molecule and list the major properties of water
      6. Recognize the following functional groups: hydroxyl, methyl, ketone, aldehyde, carboxyl, amino, and phosphate
      7. Recognize important carbohydrate, lipid and protein molecules
      8. Explain the primary, secondary and tertiary structure of a protein and the importance of each
   B. Examine cell structure and function
      1. Compare prokaryotic and eukaryotic cells and eukaryotic plant and animal cells
      2. Identify the following cellular parts: cell membrane, nucleus, nucleolus, centriole, ribosome, endoplasmic (smooth and rough), Golgi body, mitochondrion, flagella, cilia and describe the major function of each
      3. Describe the difference between diffusion and active transport using various

solutions where differences in concentrations affect the direction of movement
4. Diagram and label the double phospholipid structure of the cell membrane
5. Compare polar versus non-polar molecules
6. Diagram the structure of double phospholipid membrane and explain how the membrane acts as a barrier to ions and large molecules
7. Describe how active transport occurs at the cell membrane level
8. Describe the other roles played by proteins in the cell membrane
9. Understand the process of cell division in prokaryotic and eukaryotic cells
10. Describe the major events that occur during G1, G2, S, mitosis and cytokinesis
11. Compare mitosis and meiosis

C. Explore principles of genetics
1. Compare genotype, phenotype, homozygous, heterozygous, dominant, recessive, allele
2. Describe the simple inheritance patterns
3. Describe the structure of a nucleotide
4. Compare the structure of RNA and DNA
5. Define the roles of nucleolus, ribosomes, codon, anticodon, amino acid, protein, messenger RNA, transfer RNA, and ribosome play in protein synthesis
6. Describe the important events that occur during transcription
7. Describe the important events that occur during translation
8. Relate protein synthesis to other cell activities

D. Understand the principles of chemical reactions
1. Describe the basis of chemical reaction
2. Diagram energy of reactants and products with and without an enzyme
3. Identify the characteristics of an enzyme
4. Factors limiting action of enzymes
5. Describe the roles of enzymes play in digestion

E. Describe principles of energy conversion and relate these to cell respiration
1. Relate the importance of the laws of thermodynamics to energy flow in living cells
2. Apply the principle of oxidation-reduction reactions to other reactions
3. Describe the ATP-ADP cycle
4. Outline the major events of glycolysis, Kreb’s cycle, and electron transport system
5. Compare anaerobic and aerobic cellular respiration
6. Explain how aerobic defaults into anaerobic respiration

F. Explain how electrolytes work
1. Define an electrolyte, acid, base and salt
2. Explain what a hydrogen ion represents and its importance
3. Describe the pH scale and what it represents
4. Explain how a buffer system works

G. Demonstrate measurement skills
1. Measure accurately volumes using a graduated cylinder or a pipet.

2. Measure accurately mass of a solid using the tare method
3. Convert measurements into different scale units
4. Calculate dilution estimates of various volumes
5. Show how to make a wet mount slide
6. Operate a microscope properly
7. Show proper stain procedures
8. Recognize important health and safety procedures

Learning Units

I. Chemistry principles
   A. Atoms and molecules
   B. Functional groups
   C. Carbohydrates
   D. Lipids
   E. Proteins

II. Cells
   A. Cell components
   B. Movement across cell membrane
   C. Polar and non-polar molecules
   D. Cell membrane structure
   E. Cell division

III. Molecular genetics
   A. Simple inheritance patterns
   B. Nucleotide structure
   C. Structure of DNA and RNA molecules
   D. Transcription
   E. Translation
   F. Protein synthesis

IV. Chemical reactions
   A. Basis of reactions
   B. Energy of reactions
   C. Characteristics of enzymes
   D. Digestive enzymes

V. Energy Conversions
   A. Flow of energy through living systems
   B. Oxidation-reduction reaction
   C. ATP cycle
   D. Aerobic respiration
   E. Anaerobic respiration
   F. Default relationship

VI. Electrolytes

A. Definitions
B. pH scale
C. Buffer systems

VII. Measurements
A. Volumes
B. Mass
C. Conversions
D. Dilutions
E. Microscopes
F. Staining procedures
G. Safety procedures

Learning Activities:
Learning activities will be geared toward mastery of course concepts, practice of critical thinking skills applied to other situations and study guide exercises. Independent and collaborative activities will be assigned in and outside of class. Examples of activities which contribute to the learning process include: instructor lecture, study guide assignments, presentations to class, analysis of activities which illustrate concepts, application of concepts to new situations, exams, quizzes and presentations.

Grade Determination:
The student will be graded on satisfactory performance of quizzes and exams that measure his/her achievement of mastery of concepts.