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Alabama Department of Postsecondary Education

Representing Alabama's Public Two-Year College System

Jefferson State Community College

BIO	103	PRINCIPLES OF BIOLOGY I	REGULAR ADMISSION STATUS
Prefix	**No.**	**Course Title**	**Prerequisite**

Credit Hours: 4 Contact Hours: Lecture 3 Laboratory 2

I. COURSE DESCRIPTION

This is an introductory course for science majors. It covers physical, chemical, and biological principles common to all organisms. These principles are taught through the study of cell structure and function, cellular reproduction, basic biochemistry, cell energetics, the process of photosynthesis, and Mendelian and molecular genetics. Also included are the scientific method, basic principles of evolution, and an overview of the diversity of life with emphasis on viruses, prokaryotes and protists.

II. GENERAL COURSE COMPETENCIES

After having completed this course, the student will have learned the following basic concepts. He/she will:

A. Understand the application of the scientific method in biology.
B. Understand the principle differences that separate the biota and the abiota.
C. Understand the theories of origin of life on earth.
D. Know that all matter, including that making up living organisms, is composed of chemical units with characteristic structures and properties at each level of organization.
E. Know the general structures of the four groups of macromolecules and the major functions of each group in organisms and be able to give examples of each.
F. Recognize the role of cells in organisms and understand why and how a cell interacts with its environment, including other cells.
G. Differentiate between prokaryotic and eukaryotic cells.
H. Describe the intercellular structure of a eukaryotic cell.
I. Understand the diversity of life at the various levels of organization.
J. Understand how the energy required to drive various chemical reactions used in life functions and in maintaining organization is supplied.

K. Know that DNA, the genetic material, contains all of the information needed for cell function and that it duplicates prior to any cell division.
L. Understand how the information coded in DNA is used to produce both the proteins that form cellular structure and the enzymes that direct cellular metabolism, thus determining the phenotypic characteristics of the organism.
M. Know that mutations are alterations in DNA that result in new genetic information.
N. Understand how mitosis produces new cells with exactly the same chromosomal content as the parent cell and why this is important to development and growth.
O. Understand how meiosis reduces the number of chromosomes by one half to form gametes.
P. Be able to discuss some of the new developments in gene technology.
Q. Understand the physical basis for the inheritance of genetic traits.
S. Understand the necessity of nomenclature and classification systems in presenting an orderly study of diversity. Recognize the subcellular nature of viruses.
T. Recognize the general characteristics of all bacteria and distinguish among the principal types of bacteria.
U. Recognize the general characteristics of all protists and distinguish between each of the major protist groups.
V. Recognize the general characteristics of all fungi and distinguish between the major fungi groups. Recognize the subcellular nature of viruses.

III. COURSE OBJECTIVES

The student will be required to demonstrate that he has attained each general course competency by performing the objectives listed under each competency.

A. Understand the application of the scientific method in biology.
    1. List the steps in the scientific method.
    2. Describe experiments that exemplify the scientific method.
B. Understand the principle differences that separate the biota and the abiota.
    1. List the characteristics unique to life on planet earth
C. Understand the theories of origin of life on earth.
    1. List the various testable theories of origin of life; give the evidences which support these theories.
D. Know that all matter, including that making up living organisms, is composed of chemical units with characteristic structures and properties at each level of organization.
    1. Differentiate among atoms, elements, and molecules.
    2. Describe and sketch the Bohr model of an atom, using the terms proton, neutron, electron, nucleus, orbitals and energy level or shell.
    3. Using appropriate examples, explain how ionic, covalent and hydrogen bonds are formed; their relative energy requirements; and their biological importance.
    4. Interpret chemical equations using these terms; reactants, products, and direction of reaction.
    5. Explain the role of chemical reactions (metabolism) in living things.
    6. Describe the special properties of water that make it a suitable medium for life.
    7. Define the following terms: atom, atomic nucleus, proton, neutron, electron, atomic number, atomic weight, ion, ionic bond, electrostatic attraction, molecule, acid, base, pH, buffer, covalent bond (polar and non-polar), hydrogen bond.

E. Know the general structures of the four groups of macromolecules and the major functions of each group in organisms and be able to give examples of each.

1. By labeling diagrams of each of the four classes of biologically important organic molecules; identify their general structures; identify the building blocks of each group and identify the major bond types in each.
2. Identify the basic structural differences among the molecules in each of the following groups: fatty acids, amino acids, nucleotides.
3. Differentiate among the various levels of protein structure–primary, secondary, and tertiary.
4. Given 8-12 nucleotides, construct a molecule of DNA and label the hydrogen bonds, complementary base pairs, and sugar phosphate linkages.
5. Compare RNA nucleotides to DNA nucleotides and DNA molecules to RNA molecules on the basis of composition and structure.
6. Identify a reaction as degredation or synthesis (dehydration or hydrolysis); anabolic or catabolic.
7. Explain the importance of the above reaction types to organismal metabolism.
8. Define the following terms: functional group, amino group, fatty acid, disaccharide, carboxyl group, polysaccharide, amino acid, protein, polypeptide, carbohydrates, DNA, peptide bond, nucleic acids, glycerol, nucleotide, lipids, RNA and monosaccharide.

F. Recognize the role of cells in organisms and understand why and how a cell interacts with its environment, including other cells.

1. State the cell theory.
2. Use specific examples to describe the active and passive regulation of the passage of materials by a plasma membrane, including both the mechanisms and the structures involved in that regulation.
3. Draw a diagram of the fluid-mosaic model of the cell membrane, labeling the hydrophobic and hydrophilic portions of the phosopholipids, the proteins and the carbohydrates.
4. Predict what will happen when a cell is placed in solutions of varying concentrations of solutes.
5. Define the following terms: diffusion, osmosis, dialysis, facilitated diffusion, osmotic pressure and potential, hypertonic, hypotonic, isotonic, transmembane channel proteins, endocytosis, exocytosis, phagocytosis, pinocytosis and receptor mediated endocytosis.
6. Identify and define proteins of plasma membranes which are used as cell surface receptors, self identify markers, adhesion proteins and anchoring proteins.
7. What is meant by turgor pressure and which type of cells have turgor pressure?
8. Define the following types of active transport: uniport, cotransport, symport and antiport.
9. Define the following types of cell signals autocrine, paracrine, endocrine and synaptic (neurotransmitters).
10. How are G-protein linked molecules used within cell membranes and how are Ca^{++} and CAMP used within the cytoplasm of cells?

11. Be able to describe the following types of cell to cell junctions and give the function of each: anchoring junctions, desmosomes, tight junctions, adherens junctions, gap junctions and plasmodesmata.

G. Differentiate between prokaryotic and eukaryotic cells.

1. List the differences between prokaryotic and eukaryotic cells.

H. Describe the intercellular structure of a eukaryotic cell.

1. Define the following terms: plasma membrane, organelles, cell wall, cytoplasma,chromosomes, nucleus, eukaryotic cell, chromatin, prokaryotic cell, nucleolus, ribosome, genes, endoplasmic reticulum, mitochondria, nuclear membrane, lysosomes, chloroplasts, Golgi apparatus, chlorophyll, flagella, plastids, vacuoles, cilia and microtubule

I. Understand the diversity of life at the various levels of organization.

1. Discuss basic differences among organisms in the six major Kingdoms of life.

J. Understand how the energy required to drive various chemical reactions used in life functions and in maintaining organization is supplied.

1. Be able to state and explain the first and second laws of thermodynamics.
2. Be able to define entropy.
3. Use labeled diagrams to explain the ADP-ATP cycle's role in supplying energy for cells.
4. Explain why the 3 dimensional structure of an enzyme is the key to its activity. Use the terms active site, and substrate.
5. Explain the role an enzyme plays in speeding up a chemical reaction.
6. Relate the importance of changes in temperature, pH and concentrations to enzyme function.
7. Be able to define a metabolic pathway.
8. Be able to define the following: substrate, cofactor, coenzyme, active site, allosteric site noncompetitive and competitive inhibitions and substrate-enzyme complex.
9. Given a list of photosynthetic or cellular respiration events, order them from original energy source (sun) to useful cellular energy (ATP).
10. Explain why organisms depend directly or indirectly on photosynthesis to satisfy their energy needs.
11. Explain the role of the following in photosynthesis: water, electrons, CO_2, H_2O, energy.
12. Follow the movement of the following through noncyclic photophosphorylation and the Calvin-Benson cycle: electrons CO_2, H_2O energy.
13. Name the products and describe their fate in noncyclic photophosphorylation and the Calvin-Benson cycle.
14. Write the summary equations for the light reactions, the dark reactions, and photosynthesis.
15. Indicate what happens to a substance when it is oxidized or reduced.
16. Explain why organisms depend upon cellular respiration for energy.
17. Explain the role of the following in respiration: glucose, O_2, redox reactions, oxidative phosphorylation, ATP.
18. Write summary equations for fermentation, glycolysis, bridge step, Krebs cycle and the ETC cellular respiration and be able to trace carbon, hydrogen and oxygen through each stage.
19. Know the importance of biological catalysts in the overall transfer of energy in living things.

K. Know that DNA, the genetic material, contains all of the information needed for cell function and

1. Given a sequence of bases on one DNA strand, give the sequence on the complementary strand.
2. Given a molecule of DNA, show replication into two new molecules, indicating the original strands and newly synthesized strands. Identify nucleosomes.

L. Understand how the information coded in DNA is used to produce both the proteins that form cellular structure and the enzymes that direct cellular metabolism, thus determining the phenotypic characteristics of the organism.

1. List the bases in DNA and RNA as complementary pairs and explain the chemical basis for the pairing.
2. Identify the following DNA polymerase, ligase, primase, RNA primer, okazaki fragments and initiator proteins.
3. List three types of RNA and indicate the function of each.
4. Given a sequence of bases on DNA, transcribe RNA from them, translate this into a polypeptide chain and, using a codon dictionary, identify the amino acids in the polypeptide.
5. Describe in detail by using a diagram or by listing events in order, the process of protein synthesis, using the terms: translation, transcription, codon, anticodon, mRNA, rRNA, tRNA, amino acids, peptide bonds and polypeptide.
6. Tell where the events listed above (replication, transcription, and translation) occur, and explain the purpose of each.
7. Define the following terms: introns, exons and spliceosomes.

M. Know that mutations are alterations in DNA that result in new genetic information.

1. List examples of several types of mutations and possible causes of mutations or mutagenic agents.

N. Understand how mitosis produces new cells with exactly the same chromosomal content as the parent cell and why this is important to development and growth.

1. Distinguish between the following: mitosis and cytokinesis, plant and animal cell mitosis, chromatid and chromosome.
2. Given the chromosome number of a cell, specify the number of
3. chromatids and centromeres in each stage of mitosis.
4. Given a chromosome with genes on it, sketch the dyad that it forms, labeling chromatids, centromere, and the genes on the chromatids.
5. Identify the following time periods during the cell cycle and tell what events occur during each: G, S, G2 M and C.

O. Understand how meiosis reduces the number of chromosomes by one half to form gametes.

1. Describe the principal events that occur during each stage of mitosis. Use a diagram to illustrate your description, naming each stage and labeling the poles, equator, spindle fibers, dyads, and daughter cells.
2. Given a list of alleles, sketch a tetrad and place the following alleles in a correct relative position on the tetrad.
3. List the stages of meiosis and describe the principal events that occur during each stage.
4. Given a cell with four chromosomes (two homologous pairs: A,a; B,b:), diagram meiosis.
5. Define gametogenesis and differentiate between oogenesis and spermatogenesis.
6. Compare mitosis and meiosis on the basis of the following:
    a. role in the life cycle of an organism.
    b. the behavior of chromosomes in meiosis I and in mitosis.
    c. the behavior of chromosomes in meiosis II and in mitosis.
    d. the end products of each.

7. Know that sexual reproduction increases variation in the population by making possible genetic recombination.
8. Given the cell above, explain how randomness in chromosome segregation during Anaphase I will result in four different possible combinations of chromosomes in the haploid gametes.
9. Discuss variation as the major advantage of sexual reproduction. Relate crossing-over and recombination to variation.

P. Be able to discuss some of the new developments in gene technology.

1. Define recombinant DNA. Discuss the role of restriction enzymes and plasmids in recombinant DNA technology.
2. Be able to define the following: DNA techniques Gel electrophoresis, polymerase chain reactions, southern blotting, northern blotting and RFLPs.

Q. Understand the physical basis for the inheritance of genetic traits.

1. Define gene and describe its chemical composition.
2. Explain the relationship of DNA to genes, genes to chromosomes and chromosomes to meiosis.
3. Know the laws governing the inheritance of traits which follow Mendelian inheritance patterns and use the principles of meiosis to explain them.
4. State Mendel's Law of Segregation and explain its meaning by relating it to the formation of gametes in a mitotic example.
5. State Mendel's Law of Independent Assortment and explain its meaning by relating it to the formation of gametes in a meiotic example using at least two gene pairs.
6. Solve problems involving one factor crosses with: complete dominance, incomplete dominance, sex-linkage and multiple alleles.
7. Explain how partial dominance differs from complete dominance and compare the results when one allele is dominant over another with the results when there is partial dominance (incomplete dominance).
8. Explain how sex is determined genetically in humans and use your explanation to explain why recessive sex-linked characters are expressed more often in males than in females.
9. Define the following terms: dominant allele, recessive allele, parents, F1, F2, P, locus (loci), gene, homozygous, heterozygous, allele, monohybrid cross, test cross, phenotype, somatic cells, dihybrid cross, partial (incomplete) dominance, X chromosome, multiple alleles, Punnet square, genotype, Y chromosome, sex chromosome, autosome and sex-linked characteristics.

R. Understand the necessity of nomenclature and classification systems in presenting an orderly study of diversity.

1. Explain the advantage of binomial nomenclature.
2. State the order of the classification hierarchy.
3. Characterize the six kingdoms.

S. Recognize the subcellular nature of viruses.

1. Describe the structure and reproductive cycles of viruses. (lytic vs lysogenic)
2. List some major viral diseases.
3. Describe the classification of viral groups based on their type of nucleic acid.

T. Recognize the general characteristics of all bacteria and distinguish among the principal types of bacteria.

1. Explain bacterial growth rate.
2. Name the different bacterial shapes and arrangements.
3. Give examples of beneficial and detrimental activities of bacteria on humans.
4. Define the following terms: taxonomy, binomial nomenclature, phylogeny, microorganism, pathogen, Gram stain, pili, plasmid, endospores, cell wall, capsule, methanogens, halophiles, bacteriophage, capsid.

U. Recognize the general characteristics of all protists and distinguish each of the major groups of protists..

1. List the ways protists differ from bacteria.
2. Compare protists with other eukaryotes.
3. List the major intestinal and blood protozoan pathogens and the diseases they cause.
4. Describe the different patterns of reproduction found among the protists.

V. Recognize the general characteristics of all fungi and know the major groups of fungi.

1. Describe the various types of fungal body plans and patterns of reproduction.
2. Name one specific example of each of the major groups of true fungi.
3. Name the two organisms which form the mutualistic relationship known as lichens.
4. Define the following terms: mycelium, hypha, spore, sporangium, saprobe, parasite, symbiosis, mutualism, lichen.

IV. CLASS ACTIVITIES

A. Lecture.
B. A-V self instruction.
C. A-V classroom instruction.
D. Weekly laboratory exercises.

V. CRITERIA FOR EVALUATION

The student will have demonstrated attainment of the general course competencies if he accumulates a total of 70 percent of the points possible from the following criteria:

A. Scheduled lecture examinations.
B. Laboratory examinations.
C. The student will pass course with 60% accuracy.

VI. ATTENDANCE

Students are expected to attend all classes for which they are registered. Students who are unable to attend class regularly, regardless of the reason or circumstance, should withdraw from that class before poor attendance interferes with the student's ability to achieve the objectives required in the course. Withdrawal from class can affect eligibility for federal financial aid.

VII. STATEMENT ON DISCRIMINATION/HARASSMENT

The College and the Alabama State Board of Education are committed to providing both employment and educational environments free of harassment or discrimination related to an individual's race, color, gender, religion, national origin, age, or disability. Such harassment is a violation of State Board of Education policy. Any practice or behavior that constitutes harassment or discrimination will not be tolerated.

VIII. AMERICANS WITH DISABILITIES

The Rehabilitation Act of 1973 (Section 504) and the Americans with Disabilities Act of 1990 state that qualified students with disabilities who meet the essential functions and academic requirements are entitled to reasonable accommodations. It is the student's responsibility to provide appropriate disability documentation to the College. The ADA Accommodations office is located in FSC 300 (205-856-7731).