

*To facilitate lesson plan development, the Center for Educational and Training Technology (C.E.T.T.) at Mississippi State University has created a quick lesson planning resource by including MDE's Performance Level Descriptors (PLD's) in the 2010 Mississippi Science Framework. <http://cett.msstate.edu>*

# BIOLOGY I

- one credit -

## CONTENT STRANDS:

Inquiry      Physical Science      Life Science

## COMPETENCIES AND OBJECTIVES:

### INQUIRY

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations. **Blueprint: 7 OBJ/7 ITEMS**

**Proficient** - 1a. Conduct a scientific investigation with accuracy and precision demonstrating safe procedures and proper use and care of laboratory equipment.

**Basic** - 1a. Identify and recognize the following in a scientific investigation: safe procedures (safety rules, chemical use and symbols), proper use and care of laboratory equipment (goggles, aprons, compound light microscope, slides, balance, beaker, thermometers, graduated cylinders and rulers).

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
  - Safety rules and symbols
  - Proper use and care of the compound light microscope, slides, chemicals, etc.
  - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

**Proficient** - 1b. Formulate questions that can be answered through research and experimental design.

- b. Formulate questions that can be answered through research and experimental design. (DOK 3)

**Advanced - 1c.** Evaluate a question or hypothesis to develop an experimental design for a scientific investigation.

**Proficient - 1c.** Apply the components of scientific processes and methods in classroom and laboratory investigations.

**Basic - 1c.** Recognize the components of scientific processes and methods in classroom and laboratory investigations (e.g. hypothesis, experimental design, observations, data analyses, interpretations, theory development).

- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)

**Advanced - 1d.** Justify a prediction based upon the analysis of a graph or data.

**Proficient - 1d.** Analyze graphs.

**Basic - 1d.** Construct a graph.

- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)

**Proficient - 1e.** Analyze procedures, data, and conclusions to determine the scientific validity of research.

- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)

**Proficient - 1f.** Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge.

- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)

**Proficient - 1g.** Defend a scientific argument in oral, written, and graphic form.

**Basic - 1g.** Communicate conclusions based on experiments in oral, written, and graphic form using appropriate terminology.

- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

## PHYSICAL SCIENCE

### 2. Describe the biochemical basis of life and explain how energy flows within and between the living systems. **Blueprint: 7 OBJ/7 ITEMS**

**Proficient** - 2a. Explain and compare the types of bonds between atoms based on the subatomic particles and their arrangement; connect the importance of ions to biological process.

**Basic** - 2a. Identify types of bond formation (e.g. covalent, ionic, hydrogen, etc.)

- a. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
  - Subatomic particles and arrangement in atoms
  - Importance of ions in biological processes

**Proficient** - 2b. Utilize the properties of water to defend water as an essential component of living systems.

**Basic** - 2b. Identify the unique properties of water.

- b. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)

**Proficient** - 2c. Classify solutions as acidic, basic or neutral and relate the significance of an organism's pH to its survival.

- c. Classify solutions as acidic, basic, or neutral and relate the significance of the pH scale on an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)

**Proficient** - 2d. Compare and contrast the four major organic macromolecules in terms of structure, and function in living organisms.

**Basic** - 2d. Identify examples of carbohydrates, proteins, lipids, and nucleic acids.

- d. Compare and contrast the structure, properties, and principal functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
  - Basic chemical composition of each group
  - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
  - Basic functions (e.g., energy, storage, cellular, heredity) of each group

**Advanced** - 2e. Predict the effect of pH, temperature, and concentration on enzymatic reaction rates.

**Proficient** - 2e. Explain the role enzymes play in regulating biochemical reactions.

- e. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
  - Enzyme structure

- Enzyme function, including enzyme-substrate specificity and factors that effect enzyme function (pH and temperature)

**Advanced** - 2f. Explain how energy from ATP is made available for specific processes in an organism, such as in the sodium-potassium pump.

**Proficient** - 2f. Describe the structure and function of ATP and its role in making energy available to the cell.

- f. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
- ATP structure
  - ATP function

**Proficient** - 2g. Analyze and connect the roles of reactants and products in the biochemical process of photosynthesis and cellular respiration.

- g. Analyze and explain the biochemical process of photosynthesis and cellular respiration and draw conclusions about the roles of the reactant and products in each. (DOK 3)
- *Photosynthesis and respiration (reactants and products)*
  - *Light-dependent reactions and light independent reactions in photosynthesis, including requirements and products of each*
  - *Aerobic and anaerobic processes in cellular respiration, including products each and energy differences*

## LIFE SCIENCE

### 3. Investigate and evaluate the interaction between living organisms and their environment. **Blueprint: 3 OBJ/11 ITEMS**

**Advanced** - 3a. Evaluate the relationship between the adaptations of organisms to the biome in which they live.

**Proficient** - 3a. Compare and contrast plant and animal species, climate, and adaptations of organisms found in the world's major biomes.

**Basic** - 3a. Identify the major biomes and their characteristics.

- a. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, tropical rainforest). (DOK 2)
- Plant and animal species
  - Climate (temperature and rainfall)
  - Adaptations of organisms

**Proficient** - 3b. Provide examples that demonstrate the interdependence of organisms and their environment (biotic and abiotic).

- b. Provide examples to justify the interdependence among environmental elements. (DOK 2)
- Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, leaves)
  - Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
  - Roles of beneficial bacteria
  - Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)

**Advanced** - 3c. Predict possible adaptations and impacts that will occur when an organism is introduced in a new environment.

**Proficient** - 3c. Evaluate the significance of natural events and human activities on the biosphere.

- c. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, consumption of resources). (DOK 2)

**4. Analyze and explain the structures and function of the levels of biological organization. Blueprint: 4 OBJ/14 ITEMS**

**Proficient** - 4a. Differentiate among types of cells and describe the functions and structures of major cell organelles including cell parts for mobility.

**Basic** - 4a. Identify the function of basic cell organelles.

- a. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)
- Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules, microfilaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], cytosol)
  - Components of mobility (e.g., cilia, flagella, pseudopodia)

**Proficient** - 4b. Differentiate between the types of cellular reproduction and the results of each type.

- b. Differentiate between types of cellular reproduction. (DOK 1)
- Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions)
  - Binary fission (e.g., budding, vegetative propagation, etc.)
  - Significance of meiosis in sexual reproduction
  - Significance of crossing over

**Proficient** - 4c. Differentiate among the organizational levels of organisms.

- c. Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, types of tissues.) (DOK 1)

**Advanced** - 4d. Analyze how plant structures and cellular functions are related to survival of plants.

**Proficient** - 4d. Explain and describe how vascular and nonvascular plant structures and cellular functions are related to the survival of plants.

- d. Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials, plant reproduction). (DOK 1)

## 5. Demonstrate an understanding of the molecular basis of heredity.

**Blueprint: 4 OBJ/14 ITEMS**

**Proficient** - 5a. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations using the Central Dogma of Molecular Biology.

**Basic** - 5a. Label the structure of DNA and explain the differences between DNA and RNA.

- a. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)
- Structures of DNA and RNA
  - Processes of replication, transcription, and translation
  - Messenger RNA codon charts

**Advanced** - 5b. Predict the results of a given parental dihybrid cross.

**Proficient** - 5b. Utilize Mendel's laws and Punnett squares to evaluate results and predict percentage outcomes of monohybrid crosses involving complete dominance, incomplete dominance, codominance, sex-linked, and multiple alleles.

- b. Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes.) (DOK 2)

**Advanced** - 5c. Analyze a pedigree to determine unknown traits and genotypes in past or future generations.

**Proficient** - 5c. Examine inheritance patterns using current technology.

- c. Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, gel electrophoresis). (DOK 2)

**Proficient** - 5d. Describe the characteristics and implications of both chromosomal and gene mutations.

**Basic** - 5d. Identify types of chromosomal and gene mutations.

- d. Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
- Significance of nondisjunction, deletion, substitutions, translocation, frame shift mutation in animals
  - Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Downs Syndrome, color blindness

**6. Demonstrate an understanding of principles that explain the diversity of life and biological evolution. Blueprint: 5 OBJ/7 ITEMS**

**Advanced** - 6a. Given an organism, predict its evolutionary relationship to other given species.

**Proficient** - 6a. Draw conclusions about how organisms are classified into hierarchy of groups and sub groups based on similarities that reflect their evolutionary relationships (including body plans and methods of reproduction).

**Basic** - 6a. List the taxonomic levels from broadest to specific and place organisms into the correct kingdom based on characteristics.

- a. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
- Characteristics of the six kingdoms
  - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
  - Body plans (symmetry)
  - Methods of sexual reproduction (e.g., conjugation, fertilization, pollination)
  - Methods of asexual reproduction (e.g., budding, binary fission, regeneration, spore formation)

**Proficient** - 6b. Critique data used by scientists (e.g. Redi, Needham, Spallanzani, and Pasteur) to explain evolutionary processes and patterns.

- b. Critique data (e.g., comparative anatomy, Biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3)

**Proficient** - 6c. Analyze research in relation to the contributions of scientists whose work led to the development of the theory of evolution.

**Basic** - 6c. Summarize the contributions of scientists whose work led to the development of the theory of evolution.

- c. Research and summarize the contributions of scientists, (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2)

**Proficient** - 6d. Analyze and explain the role of natural selection in speciation and applications of speciation.

**Basic** - 6d. Identify examples that demonstrate the role that natural selection, speciation, diversity, adaptation, and extinction play in evolution.

- d. Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3)

**Proficient** - 6e. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs.

- e. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs. (DOK 2)