

BEMIDJI AREA SCHOOLS

ADVANCED PLACEMENT BIOLOGY

Grades 9-12

I. ADVANCED PLACEMENT BIOLOGY

Note: The labs included in the Advanced Placement Biology Course at Bemidji High School are listed below. Where all labs apply to a given standard, the activities are listed as “all labs” meaning the entire set of twelve. Where only individual labs apply, these labs are listed separately.

Advanced Placement Laboratory Exercises:

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| Lab #1: | Osmosis and diffusion |
| Lab #2: | Enzyme Catalysis |
| Lab #3: | Mitosis and Meiosis |
| Lab #4: | Photosynthesis |
| Lab #5: | Cell Respiration |
| Lab #6: | Molecular Biology |
| Lab #7: | Genetics of Organisms |
| Lab #8: | Populations Genetics and Evolution |
| Lab #9: | Transpiration |
| Lab #10: | Physiology of the Circulatory System |
| Lab #11: | Animal Behavior |
| Lab #12: | Dissolved Oxygen and Aquatic Primary Productivity |

A. Scientific Inquiry

Standard: The student will design and conduct a scientific investigation.

The student will:

1. Design and complete a scientific experiment using scientific methods by determining a testable question, making a hypothesis, designing a scientific investigation with appropriate controls, analyzing data, making conclusions based on evidence and comparing conclusions to the original hypothesis and prior knowledge.
Activities: *Lab #11: Animal Behavior*
2. Distinguish between qualitative and quantitative data.
Activities: *All Labs*
3. Apply mathematics and models to analyze data and support conclusions.
Activities: *Lab #1: Osmosis and diffusion*
 Lab #7: Genetics of Organisms
 Lab #8: Populations Genetics and Evolution
 Lab #10: Physiology of the Circulatory System

4. Identify possible sources of error and their effects on results.

Activities: *All Labs*

B. Historic Perspectives

Standard: The student will recognize the historical and cultural context of scientific endeavors and how they influence each other.

The student will:

1. Be able to trace the development of a scientific advancement, invention or theory and its impact on society.

Activities: *Lab #8: Populations Genetics and Evolution*
Lecture and discussion of Evolution as a Scientific Theory

II. PHYSICAL SCIENCE

A. Structure of Matter

Standards: The student will understand the nature of matter including its forms, properties and interactions.

The student will:

1. Be able to explain how atoms form compounds through bonding.

Activities: *Lab #2: Enzyme Catalysis*
Lab #4: Photosynthesis
Lab #5: Cell Respiration
Lab #6: Molecular Biology

B. Chemical Reactions

Standards: The student will describe chemical reactions and the factors that influence them.

The student will:

1. Describe chemical reactions using words and symbolic equations.

Activities: *Lab #4: Photosynthesis*
Lab #5: Cell Respiration

2. Explain the influence of temperature, surface area, agitation and catalysts on the rate of a reaction.

Activities: *Lab #2: Enzyme Catalysis*

3. Explain how the rearrangement of atoms and molecules in a chemical reaction illustrates conservation of mass.

Activities: *Lab #2: Enzyme Catalysis*
Lab #4: Photosynthesis
Lab #5: Cell Respiration

C. Earth Structure and Processes

Standard: The student will understand that the interactions of the atmosphere, biosphere, lithosphere, hydrosphere and space have resulted in ongoing change of the Earth system over geologic time.

The student will:

1. Apply the laws of thermodynamics to explain the cycling of materials and transfer of energy in the Earth system.

Activities: *Lab #4: Photosynthesis*
 Lab #5: Cell Respiration

III. LIFE SCIENCE

A. Cells

Standard: The student will comprehend that all living things are composed of cells, and that the life processes in a cell are based on molecular interactions.

The student will:

1. Relate cellular structures to their functions.

Activities: *Lab #1: Osmosis and Diffusion*
 Lab #2: Enzyme Catalysis
 Lab #4: Photosynthesis
 Lab #5: Cell Respiration

2. Compare and contrast the structures found in a typical plant, animal and bacterial cell.

Activities: *Discussion/Lecture on Kingdoms of Living Things*

3. Explain the role of the cell membrane as a highly selective barrier in diffusion, osmosis and active transport.

Activities: *Lab #1: Osmosis and diffusion*
 Lab #4: Photosynthesis
 Lab #5: Cell Respiration

4. Describe the role of enzymes as catalysts in metabolism and cellular synthesis of new molecules.

Activities: *Lab #2: Enzyme Catalysis*

5. Differentiate between the processes of photosynthesis and respiration in terms of energy flow, reactants and products.

Activities: *Lab #1: Osmosis and Diffusion*
 Lab #4: Photosynthesis

6. Describe and compare the processes of mitosis and meiosis and their roles in the cell cycle.

Activities: *Lab #3: Mitosis and Meiosis*
 Lab #6: Molecular Biology
 Lab #7: Genetics of Organisms

B. Diversity of Organisms

Standard: The student will classify, compare and contrast the diversity of organisms on Earth and their modes of accommodating the requirements for life.

The student will:

1. Relate the structure, complexity and organization of organ systems to the methods of obtaining, transforming, releasing and eliminating the matter and energy used to sustain the organism.

Activities: *Discussions and Lectures regarding Kingdoms*

2. Recognize that organisms have both innate and learned behavioral responses to internal and external stimuli, including the tropic responses in plants.

Activities: *Lab #9: Transpiration*

Lab #10: Physiology of the Circulatory System

Lab #11: Animal Behavior

3. Use scientific evidence, including the fossil record, homologous structures, embryological development or biochemical similarities, to classify organisms in order to show probable evolutionary relationships and common ancestry.

Activities: *Lab #8: Populations Genetics and Evolution*

Discussion and Lecture regarding Evolution, both micro and macro

C. Interdependence of Life

Standard: The student will describe how the environment and interactions between organisms can affect the number of species and the diversity of species in an ecosystem.

The student will:

1. Describe the factors related to matter and energy in an ecosystem that both influence fluctuations in population size and determine the carrying capacity of a population.

Activities: *Lab #12: Dissolved Oxygen and Aquatic Primary Productivity*

2. Explain how adaptations of species and co-evolution with other species are related to success in an ecosystem.

Activities: *Lab #12: Dissolved Oxygen and Aquatic Primary Productivity*

Lab #4: Photosynthesis

Discussion and Lecture regarding CAM, C₃ and C₄ photosynthesis

3. Identify examples of mutualism, commensalisms, and parasitism in a stable ecosystem.

Activities: *General Discussion and Lecture regarding ecology*

D. Heredity

Standard: The student will explain how inherited characteristics are encoded by genes.

The student will:

1. Explain that the instructions for the characteristics of all organisms are carried in nucleic acids.

Activities: *Lab #3: Mitosis and Meiosis*
 Lab #6: Molecular Biology
 Lab #7: Genetics of Organisms

2. Define the relationship between DNA, genes and chromosomes.

Activities: *Lab #3: Mitosis and Meiosis*
 Lab #6: Molecular Biology
 Lab #7: Genetics of Organisms

3. Describe the structure and function of DNA and distinguish between replication, transcription and translation.

Activities: *Lab #6: Molecular Biology*

4. Know that different species of multicellular organisms have a characteristic number of chromosomes and that in typical humans there are 22 autosomal pairs and 2 sex chromosomes.

Activities: *Lab #3: Mitosis and Meiosis*
 Lab #6: Molecular Biology
 Lab #7: Genetics of Organisms

5. Describe how genetic information is transmitted from parents to offspring through the process of meiosis and fertilization as they relate to chromosome recombination and sexual reproduction.

Activities: *Lab #3: Mitosis and Meiosis*
 Lab #7: Genetics of Organisms

6. Use Mendel's laws of segregation and independent assortment to determine the genotype and phenotype of a monohybrid cross.

Activities: *Lab #3: Mitosis and Meiosis*
 Lab #7: Genetics of Organisms

7. Differentiate between dominant, recessive, co-dominant, incompletely dominant, polygenic and sex-linked traits.

Activities: *Lab #7: Genetics of Organisms*

E. Biological Populations Change Over Time

Standard: The student will understand how biological evolution provides a scientific explanation for the fossil record of ancient life forms, as well as for the striking molecular similarities observed among the diverse species of living organisms.

The student will:

1. Understand that species change over time and the term biological evolution is used to describe this process.

Activities: *Lab #8: Populations Genetics and Evolution*
 Discussion and Lecture regarding Evolution, both micro and macro

G. Human Organism

Standard: The student will understand how all organ systems, including the nervous system, interact to maintain homeostasis.

The student will:

1. Understand and describe the basic anatomy and physiology of the nervous system and sense organs.

Activities: *Lab #10: Physiology of the Circulatory System*

2. Describe how the functions of individual organ systems are integrated to maintain a homeostatic balance in the body.

Activities: *Lab #10: Physiology of the Circulatory System*