

BEMIDJI AREA SCHOOLS

BIOLOGY

Grades 9-12

I. HISTORY AND NATURE OF SCIENCE

A. Scientific World View

Standard: The student will understand the nature of scientific ways of thinking and that scientific knowledge changes and accumulates over time.

The student will:

1. Be able to distinguish among hypothesis, theory and law as scientific terms and how they are used to answer a specific question.

Activities: *PowerPoint Review of Earth Science*
Plant Growth vs. Light Lab
Plant Hormone Lab
Mars Landing Project

2. Be able to explain how scientific and technological innovations as well as new evidence can challenge portions of or entire accepted theories and models including but not limited to atomic theory.

Discussions of: *Evolution*
Germ Theory
Cell Theory
Genetics Origin of Life

3. Recognize that in order to be valid, scientific knowledge must meet certain criteria including that it: be consistent with experimental, observational and inferential evidence about nature; follow rules of logic and reporting both methods and procedures; and, be falsifiable and open to criticism.

Activities: *Mean to the Bean Lab*
“Life is Impossible” Video

4. Explain how traditions of ethics, peer review, conflict and general consensus influences the conduct of science.

Discussions of: *Evolution*
Germ Theory
Cell Theory
Genetics Origin of Life

5. Recognize that some scientific ideas are incomplete, and opportunity exists in these areas for new advances.

Discussions of: *Evolution*
Germ Theory
Cell Theory
Genetics Origin of Life

B. Scientific Inquiry

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

The student will:

1. Distinguish between qualitative and quantitative data.
Activities: *Plant Labs*
Fish Respiration Lab
2. Apply mathematics and models to analyze data and support conclusions.
Activities: *Cell Campaign*
Day in the Life on an Insect
3. Identify possible sources of error and their effects on results.
Activities: *Plant Labs*
Fish Respiration Lab
Conclusion Questions to Dissection
4. Know that professional scientists and engineers have ethical codes.
Discussions of: *Evolution*
Germ Theory
Cell Theory
Genetics Origin of Life
5. Give examples of how different domains of science use different bodies of scientific knowledge and employ different methods to investigate questions.
Discussions of: *Cell Biology*
Properties of Water
Taxonomy
Anatomy and Physiology
Ecology

C. Scientific Enterprise

Standard: The student will understand the relationship between science and technology and how both are used.

The student will:

1. Provide an example of how technology facilitates new discoveries and the development of scientific knowledge.
Activities: *Cork Cell Lab*
Cell Campaign
Structure of DNA (isolation of DNA, models)
Bacteria Collection and Observations
2. Know that technological changes and scientific advances are often accompanied by social, political, environmental and economic changes.
Activities: *Zebra Mussel Internet Activity*
Lamprey Internet Activity
Discussion of Invasive Species

D. 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. Compare and contrast the differences between scientific theories and theories from other bodies of knowledge, and the importance of each in a science discussion.

Activities: *PowerPoint Review of Earth Science*
Plant Growth vs. Light Lab
Plant Hormone Lab
Mars Landing Project

II. PHYSICAL SCIENCE

A. Structure of Matter

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

The student will:

1. Be able to explain the relationship of an element's position on the periodic table to its atomic number and atomic mass.

Discussion of: *Cell Chemistry*
Review of: *General Chemistry*

B. Chemical Reactions

Standard: 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: *Leaf Activity/Lab*
Photosynthesis/Respiration video
Various Activities Involving Photosynthesis and/or Respiration

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

Activities: *Amylase Lab*
Osmosis Lab
Fish Respiration Lab

III. EARTH AND SPACE SCIENCE

A. 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. Identify the internal and external sources of energy for the Earth.
Activities: *Why is Life Possible on Earth – PowerPoint*
Photosynthesis Lab
2. Apply the laws of thermodynamics to explain the cycling of materials and transfer of energy in the Earth system.
Activity: *Why is Life Possible on Earth – PowerPoint*
Discussions of: *Rainforest*
Photosynthesis and Respiration

B. The Universe

Standard: The student will relate the formation and components of our solar system to the conditions necessary for life.

The student will:

1. Compare and contrast the environmental parameters that make life possible on Earth with conditions found on the other planets of our solar system.
Activities: *Why is Life Possible on Earth – PowerPoint*
Mars Landing Activity

IV. 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: *Cell Campaign*
Cell Internet Activity
2. Compare and contrast the structures found in a typical plant, animal and bacterial cell.
Activities: *Cell Campaign*
Cell Internet Activity
Plant Model Activities
3. Explain the role of the cell membrane as a highly selective barrier in diffusion, osmosis and active transport.
Activities: *Osmosis Lab*
Diffusion Demonstration
Anatomy/Physiology CD Activity

4. Describe the role of enzymes as catalysts in metabolism and cellular synthesis of new molecules.
Activities: *Amylase Lab*
Beano Lab

5. Differentiate between the processes of photosynthesis and respiration in terms of energy flow, reactants and products.
Activities: *Photosynthesis Lab*
Photosynthesis/Respiration Video
Discussions of Photosynthesis/Respiration

6. Describe and compare the processes of mitosis and meiosis and their roles in the cell cycle.
Activities: *Mitosis and Meiosis Microscope Lab*
Time for Mitosis Activity
Discussion of the Role of Meiosis in Genetics, Heredity, and Evolution

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: *Organ System Project*
Organism Comparison Sheet
Various Dissections

2. Recognize that organisms have both innate and learned behavioral responses to internal and external stimuli, including the tropic responses in plants.
Activities: *Plant Hormone Lab*
Flatworm Video
Discussion of Nervous System in Animal Kingdom

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: *Shapes, Shoes, and Candy Taxonomy Labs*
Winter Twig/Leaf Dichotomous Keys
Why is There Life on Earth – PowerPoint
Evolutionary Arms Race Video

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. Explain how adaptations of species and co-evolution with other species are related to success in an ecosystem.
Activities: *Organism Comparison Activity*
 Birds and Bees Video
 Living Together Video
 Fungi CD Activity
2. Identify examples of mutualism, commensalisms, and parasitism in a stable ecosystem.
Activities: *Internet Parasite Activity*
 Living Together Video
 Fungi CD Activity
3. Predict and analyze how a change in an ecosystem, resulting from natural causes, changes in climate, human activity or introduction of invasive species, can affect both the number of organisms in a population and the biodiversity of species in the ecosystem.
Activities: *Zebra Mussel Internet Activity*
 Lamprey Internet Activity
 Discussion of Invasive Species

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: *Transcription/Translation Activity*
 DNA Model
 Codon Bingo
2. Define the relationship between DNA, genes and chromosomes.
Activities: *Transcription/Translation Activity*
 DNA Model
 Codon Bingo
 Marshan Genetics
3. Describe the structure and function of DNA and distinguish between replication, transcription and translation.
Activities: *Transcription/Translation Activity*
 DNA Model
 Codon Bingo
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.
Activity: *Chromosome Activity*

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: *Mitosis and Meiosis Microscope Lab*
Time for Mitosis Activity
Classroom/Family/PTC Activity

Discussion of: *Role of Meiosis in Genetics, Heredity, and Evolution*

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

Activities: *Marshan Genetics Lab*
Family Genetics Activity
Punnett Square Activity
PTC Tasting Lab

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

Activities: *Marshan Genetics*
Family Genetics
Punnett Square Activity
GATTACA Video

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: *Evolutionary Arms Race Video*
Discussion of Darwin's Theories
Analysis of Jurassic Park Video

2. Use the principles of natural selection to explain the differential survival of groups of organisms as a consequence of:

- a. The potential for a species to increase its numbers;

Discussion of: *Reproduction in Various Organisms*

- b. The genetic variability of offspring due to mutation and recombination of genes;

Discussions of: *Meiosis*
Genetic Disorders
Potential Mutagens

- c. A finite supply of the resources required for life; and,

Discussion of: *Carrying Capacity*

- d. The ensuing selection based on environmental factors of those offspring better able to survive and produce reproductively successful offspring.

Activity: *Evolutionary Arms Race Video*

Discussion of: *Antibiotic Resistance*

3. Describe how genetic variation between populations is due to different selective pressures acting on each population, which can lead to a new species.

Activities: *Evolutionary Arms Race Video*
Black Death Video and Journal Article

Discussions of: *Isolationism (Australia)*
Climate Change and Population Shifts

4. Use biological evolution to explain the diversity of species.

Activities: *Evolutionary Arms Race Video*
Black Death Video and Journal Article

Discussions of: *Isolationism (Australia)*
Climate Change and Population Shifts

F. Flow of Matter and Energy

Standard: The student will describe and explain the cycling of matter and flow of energy through an ecosystem's living and nonliving components.

The student will:

1. Explain the relationship between abiotic and biotic components of an ecosystem in terms of the cycling of water, carbon, oxygen and nitrogen.

Activities: *Why is Life on Earth Possible – PowerPoint*
Photosynthesis/Respiration Discussion and Activities

Know that all matter tends to become more disorganized over time, and that living systems require a continuous input of energy in order to maintain their chemical and physical organizations and prevent death.

Activities: *Cell Campaign*
Photosynthesis/Respiration

Discussions of: *The Characteristics of Life*
Photosynthesis/Respiration

2. Explain that sunlight is transformed into chemical energy through the breakdown of molecules.

Activity: *Photosynthesis Activities*

3. Explain that respiration releases chemical energy through the breakdown of molecules.

Activity: *Respiration Activities*

4. Understand that matter and energy flow through different levels of organization of living systems, from cells to communities, as well as between living systems and the physical environment as chemical elements are recombined in different ways. Each recombination results in both storage and dissipation of energy.

Activity: *Why is Life on Earth Possible PowerPoint*

Discussion of: *Biological Energy Transfer Models (food chain, food web, and food pyramid)*

G. Human Organism

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

The student will:

1. The student will understand and describe the basic anatomy and physiology of the nervous system and sense organs.

Activities: *Comparative Anatomy (pig dissection)*
*Taste, Sight, and Sound Lab**

2. The student will describe how the functions of individual organ systems are integrated to maintain a homeostatic balance in the body.

Activities: *Comparative Anatomy (pig dissection)*
*Human System Activity**

*** To be developed**