

# BEMIDJI AREA SCHOOLS

## ENVIRONMENTAL SCIENCE

### 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.

**Activity / ies:** *Lichen Studies*

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

**Activity / ies:** *Red Lake Fisheries Discussions*  
*Life Span Lab*  
*Hybrid Car Activities*

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

**Activity / ies:** *Hibernation Labs*  
*Overpopulation Labs*  
*Lichen Studies*

##### B. 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.

**Activity / ies:** *How Does Salt Effect Ice?*  
**Lab:** *How Does Salt Effect our Environment?*  
*Aluminum Animals*

2. Distinguish between qualitative and quantitative data.

**Activity / ies:** *Ice-Out Labs*  
*Aluminum Animal Lab*

3. Apply mathematics and models to analyze data and support conclusions.  
**Activity / ies:**                    *Ice-Out Labs*
  
4. Identify possible sources of error and their effects on results.  
**Activity / ies:**                    *Snow Collection Lab*  
  *Salt Labs*
  
5. Know that professional scientists and engineers have ethical codes.  
**Activity / ies:**                    *Fisheries/Hatchery Tour*  
  *Red Lake Fisheries Discussions & Activities*  
  *Invasive Species Activity*
  
6. Give examples of how different domains of science use different bodies of scientific knowledge and employ different methods to investigate questions.  
**Activity / ies:**                    *Contact Video Q's*  
  *Invasive Species Activity*  
  *Salt Labs*

### **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.  
**Activity / ies:**                    *Fisheries/Hatchery Tour*  
  *Hibernation Labs*  
  *Overpopulation Studies*
  
2. Know that technological changes and scientific advances are often accompanied by social, political, environmental and economic changes.  
**Activity / ies:**                    *Ice-Out Activities*  
  *Global Warming Discussion*  
  *Lichens Labs*
  
3. Recognize that science and technology are influenced by cultural backgrounds and beliefs and by social needs, attitudes, values and limitations.  
**Activity / ies:**                    *Red Lake Fisheries Discussions*  
  *Life Span Lab*

### **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. Be able to trace the development of a scientific advancement, invention or theory and its impact on society.
2. Provide examples of scientific advancements contributed by other civilizations and cultures.
3. Compare and contrast the differences between scientific theories and theories from other bodies of knowledge, and the importance of each in a science discussion.

## II. PHYSICAL SCIENCE

### A. Chemical Reactions

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

The student will:

1. Describe how combining acids and bases produce a neutral solution.

### B. Energy Transformations

Standard: The student will understand energy forms, transformations and transfers.

The student will:

1. Be able to describe physical and chemical changes in terms of the law of conservation of energy.

**Activity / ies:**                    *Hybrid Cars*  
    *Salt & Ice Labs*  
    *Hibernation Labs*

2. Describe the risks and benefits of fossil fuels, renewable sources and nuclear power as sources of usable energy.

**Activity / ies:**                    *Hybrid Cars*  
    *Global Warming Discussions*  
    *Lichen Lab*

### 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. Identify the internal and external sources of energy for the Earth.

2. Apply the laws of thermodynamics to explain the cycling of materials and transfer of energy in the Earth system.
3. Illustrate how biological processes have played significant roles in determining the character of the atmosphere, biosphere, hydrosphere and lithosphere over time.

#### **D. Earth Structure and Processes**

Standard: The student will investigate the impact humans have on the environment.

The student will:

1. Identify and research an environmental issue and evaluate its impact.

#### **E. The Water Cycle, Weather and Climate**

Standard: The student will explain the causes and effects of the Earth's atmospheric and hydrologic processes.

The student will:

1. Explain how the transfer of energy and motions of the Earth contribute to global climatic processes including wind, waves and ocean currents.
2. Trace the cyclical movement of carbon and water through the lithosphere, hydrosphere, atmosphere and biosphere.
3. Identify, predict and investigate the factors that influence the quality of water and how it can be reused, recycled and conserved.
4. Discuss the impact of the use of natural resources and other human activities on the Earth's climate.

#### **F. 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.

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

## **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.

## **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.
2. Explain how adaptations of species and co-evolution with other species are related to success in an ecosystem.
3. Identify examples of mutualism, commensalisms, and parasitism in a stable ecosystem.
4. Predict and analyze how a change in a 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.

## **D. 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.

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;
  - b. The genetic variability of offspring due to mutation and recombination of genes;
  - c. A finite supply of the resources required for life; and,
  - d. The ensuing selection based on environmental factors of those offspring better able to survive and produce reproductively successful offspring.
3. Describe how genetic variation between populations is due to different selective pressures acting on each population, which can lead to a new species.
4. Use biological evolution to explain the diversity of species.

#### **E. 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 non-living 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.
2. 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.
3. Explain that sunlight is transformed into chemical energy by photosynthetic organisms.
4. Explain that respiration releases chemical energy through the breakdown of molecules.
5. 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.