

BEMIDJI AREA SCHOOLS

GENETICS

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 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.

Activities: *History of Genetics Project*
 Electrophoresis Lab

2. 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: *History of Genetics Project*
 Electrophoresis Lab

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

Activities: *History of Genetics Project*
 Electrophoresis Lab

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

Activities: *History of Genetics Project*
 Electrophoresis Lab

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.

Activities: *Drosophila Crosses*

2. Distinguish between qualitative and quantitative data.
Activities: *Drosophila Crosses*
3. Apply mathematics and models to analyze data and support conclusions.
Activities: *Drosophila Crosses*
4. Identify possible sources of error and their effects on results.
Activities: *Drosophila Crosses*
Electrophoresis
PCR Activity

C. 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: *History of Genetics Project*
2. Provide examples of scientific advancements contributed by other civilizations and cultures.
Activities: *History of Genetics Project*
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.
Activities: *History of Genetics Project*

II. 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: *History of Genetics Project*
Introductory activities
Review of Cell Structure
Karyotyping activities
Time for Mitosis Activity
2. Compare and contrast the structures found in a typical plant, animal and bacterial cell.
Activities: *Review of Cell Structure*
Karyotyping activities
Time for Mitosis Activity
Genetic Mapping in Prokaryotes

- Describe the role of enzymes as catalysts in metabolism and cellular synthesis of new molecules.
Activities: *Genetic Controls*
- Describe and compare the processes of mitosis and meiosis and their roles in the cell cycle.
Activities: *Time for Mitosis Activity*

B. Heredity

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

The student will:

- Explain that the instructions for the characteristics of all organisms are carried in nucleic acids.
Activities: *Mendelian Genetics*
 Drosophila Crosses
 Genetic Controls
 Chromosome Mapping
 Sex Determination
 DNA Structure
 Transcription and Translation
- Define the relationship between DNA, genes and chromosomes.
Activities: *Chromosome Mapping*
 Sex Determination
 DNA Structure
- Describe the structure and function of DNA and distinguish between replication, transcription and translation.
Activities: *Transcription, Translation, and Replication*
- 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: *Genetics of Organisms and Populations*
 Sex Determination
- 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: *Sex Determination*
 Mendelian Genetics
 Punnett Squares
- Use Mendel's laws of segregation and independent assortment to determine the genotype and phenotype of a monohybrid cross.
Activities: *Punnett Squares*

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

Activities: *Sex Determination*
 Punnet Squares

C. 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: *Hardy-Weinberg Activity*
 Drosophila Crosses
 Population Genetics

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.

Activities: *Hardy-Weinberg Activity*
 Drosophila Crosses
 Population Genetics
 History of Genetics Project - Darwin

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: *Hardy-Weinberg Activity*
 Drosophila Crosses
 Population Genetics
 History of Genetics Project – Darwin

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

Activities: *Hardy-Weinberg Activity*
 Drosophila Crosses
 Population Genetics
 History of Genetics Project - Darwin

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

Activities: *Genetic Regulation activities*
 Human Genetics
 Cancer