Curriculum Development
In the Fairfield Public Schools

**FAIRFIELD PUBLIC SCHOOLS**
FAIRFIELD, CONNECTICUT

# BIOLOGY 21

APPROVED 2/28/2006

# BIOLOGY 21

## Statement Of Purpose

Biology is the study of life in all its forms. It is concerned with the composition, structure and function of organisms and with their interdependence. An understanding of these concepts is essential for individuals to make informed choices with regard to the environment and advancing scientific technology.

## Audience

Biology 21 is a full-year, two-credit course designed for academically motivated, high achieving grade 9 or 10 students with an interest in science.

## Prerequisites

Recommendation by science teacher and guidance counselor

## Design and Description

Biology 21 is an honors level class. Biology 21 is one of the pre-requisites for advanced placement Biology. The course meets six periods per week including one double lab period. The Biology 21 course takes a molecular approach to the topics of evolution, structure and function, energy relationships, reproduction and inheritance, unity and diversity, interdependence in nature, techniques and applications in biotechnology, and stability and patterns of change. This course will provide students with the key concepts in first year biology and will prepare students for entry into the Advanced Placement program. Students in this course are capable of handling primary source material for reference and are highly motivated, self-directed learners. The course requires that students are already proficient in abstract reasoning.

## Course Objectives

Students will be able to:

- distinguish those characteristics that make life different from non-life.
- identify the themes of biology.
- differentiate science from other ways of knowing and from other bodies of knowledge.
- defend the way that scientists use empirical standards, logical arguments, and skepticism to strive for the best possible explanations about the natural world.
- draw diagrams of basic atomic structure.
- compare and contrast ionic and covalent bonding.
- identify characteristics of acids and bases.
- describe the central nature of the element carbon.
- analyze the 3-D structure and function of biological organic compounds i.e.: carbohydrates, lipids, proteins, nucleic acids.
- compare and contrast dehydration synthesis (condensation) and hydrolysis reaction.
- explain the relationship between the structure and function of enzymes.
- compare and contrast prokaryotic and eukaryotic cells.

- use digital microscopes to compare plant and animal cell structures.
- explain the structure of the nucleus and cytoplasmic structures and their functions.
- differentiate among the various structures that comprise the fluid mosaic model of the cell.
- summarize the flow of materials through the endo-membrane system.
- predict the outcome of the mechanisms of passive and active transport.
- explain and diagram the energy transformations of life (for example photosynthesis and respiration).
- identify the ATP cycle
- compare the structure and function of mitochondria and chloroplasts.
- distinguish between aerobic and anaerobic respiration at the molecular level.
- define light absorption and light reflection and relate them to pigments.
- interpret the relationship between the light-dependent and light-independent reactions of photosynthesis.
- compare and contrast the structure of a chromosome in both a prokaryotic and eukaryotic organisms.
- identify each phase of the cell cycle including the steps of mitosis and meiosis.
- compare and contrast the phases of mitosis in plant and animal cells.
- explain crossing over in meiosis and how it contributes to genetic variation.
- summarize the processes of oogenesis and spermatogenesis and predict the products.
- describe chromosome mutations.
- predict the outcome of various genetic crosses using Punnett squares.
- analyze inheritance patterns using pedigrees.
- apply rules of  probability is used to predict the results of genetic crosses.
- apply chromosome theory to genetic traits.
- explain the effect of crossing over on the inheritance of genes in linkage groups.
- explain the role of sex chromosomes in sex determination.
- describe DNA structure and replication including leading and lagging strands.
- analyze the structure and function of rRNA, mRNA, and tRNA.
- describe the near universal nature of the genetic code.
- interpret the relationship between transcription and translation in eukaryotes.
- categorize mutations at the molecular level in DNA.
- model how scientists use restriction enzymes in genetic engineering.
- explain how DNA technology can be used in medicine, pharmacology, criminology, agriculture, classification.
- describe the evidence to support the theory of evolution.
- investigate the development of evolutionary theory.
- compare and contrast rates of evolution.
- compare and contrast patterns of convergent, divergent, and co-evolution.
- explain the Hardy-Weinberg theory and relate it to changes in gene frequencies within populations.
- interpret taxonomic hierarchies.
- defend developments in higher classification systems.

- explain the structure and function of subcellular parasites to include viruses, prions, and viroids.
- relate lysogenic and lytic cycles in viruses.
- recognize variations in bacterial morphology, modes of respiration and modes of nutrition.
- distinguish among transformation, transduction, and conjugation in genetic recombination in bacteria.
- identify the role of microorganisms in our environment.
- compare and contrast the structure of viruses, bacteria, protista, and yeast.
- defend the use of microorganisms in medicine, pharmacology and agriculture.
- distinguish between the abiotic and biotic components in an ecosystem.
- trace the interactions among populations of different species within a community (food webs, trophic levels).
- summarize the steps in the major biogeochemical cycles (water and carbon-oxygen).
- identify the factors that effect population density and demographics.
- assess how technological advances have affected both human populations and the environment.

**Science Standards**

***Scientific Inquiry (used in all units)***

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

***Scientific Literacy (used in all units)***

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.
- Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.

***Scientific Numeracy***

**Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.**

Students will identify questions that can be answered through scientific investigation.

Students will read, interpret and examine the credibility and validity of scientific claims in different sources of information.

Students will formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

Students will design and conduct appropriate types of scientific investigations to answer different questions.

Students will identify independent and dependent variables, including those that are kept constant and those used as controls.

Students will assess the reliability of the data that was generated in the investigation.

***Chemical Structures and Properties – Properties of Matter***
**Atoms react with one another to form new molecules.**

Students will describe the general structure of the atom, and explain how the properties of the first 20 elements in the Periodic Table are related to their atomic structures.

Students will describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).

Students will explain the chemical composition of acids and bases, and explain the change of pH in neutralization reactions.

**Due to its unique chemical structure, carbon forms many organic and inorganic compounds.**

Students will explain how the structure of the carbon atom affects the type of bonds it forms in organic and inorganic molecules.

Students will explain the general formation and structure of carbon-based polymers, including synthetic polymers, such as polyethylene, and biopolymers, such as carbohydrate.

***Cell Chemistry and Biotechnology – Structure and Function***
**Fundamental life processes depend on the physical structure and the chemical activities of the cell.**

Students will describe significant similarities and differences in the basic structure of plant and animal cells.

Students will describe the general role of DNA and RNA in protein synthesis.

Students will describe the general role of enzymes in metabolic cell processes.

Students will explain the role of the cell membrane in supporting cell functions.

***Cell Chemistry and Biotechnology – Science and Technology in Society***
**Microorganisms have an essential role in life processes and cycles on Earth.**

Students will describe the similarities and differences between bacteria and viruses.

Students will describe how bacterial and viral infectious diseases are transmitted, and explain the roles of sanitation, vaccination and antibiotic medications in the prevention and treatment of infectious diseases.

Students will explain how bacteria and yeasts are used to produce foods for human consumption.

**Similarities in the chemical and structural properties of DNA in all living organisms allow the transfer of genes from one organism to another.**

Students will describe, in general terms, how the genetic information of organisms can be altered to make them produce new materials.

Students will explain the risks and benefits of altering the genetic composition and cell products of existing organisms.

***Genetics, Evolution and Biodiversity – Heredity and Evolution***
**In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.**

Students will explain how meiosis contributes to the genetic variability of organisms.

Students will use the Punnett Square technique to predict the distribution of traits in mono- and di-hybrid crossings.

Students will deduce the probable mode of inheritance of traits (e.g., recessive/dominant, sex-linked) from pedigree diagrams showing phenotypes.

Students will describe the difference between genetic disorders and infectious diseases.

**Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.**

Students will explain how the processes of genetic mutation and natural selection are related to the evolution of species.

Students will explain how the current theory of evolution provides a scientific explanation for fossil records of ancient life forms.

Students will describe how structural and behavioral adaptations increase the chances for organisms to survive in their environments.

***Genetics, Evolution and Biodiversity - Science and Technology in Society***
**Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.**

Students will describe the factors that affect the carrying capacity of the environment.

Students will explain how change in population density is affected by emigration, immigration, birth rate and death rate, and relate these factors to the exponential growth of human populations.

Students will explain how technological advances have affected the size and growth rate of human populations throughout history.

**Information and Technology Standards (to be added)**

**Essential Questions**

- How is scientific knowledge created and communicated?
- How does the structure of matter affect the properties and uses of materials?
- How are organisms structured to ensure efficiency and survival?
- What is the role of energy in our world?
- What are the processes responsible for life's unity and diversity?
- How do science and technology affect the quality of our lives?
- How do materials cycle through Earth's systems?

**Focus Questions**

- What are the distinguishing features of life?
- How does science function as a process?
- What are the major themes of Biology?
- How do biologists use scientific inquiry in a search for biological knowledge?
- How are the principles of chemistry applied in biology?
- What is the structure of an atom?
- What types of bonds hold atoms together?
- What are organic compounds and how do they form the basis of life?
- What is the difference between dehydration and hydrolysis?
- How is the structure of a biomolecule related to its function?
- How does the cell function as a basic building block of life?
- How do living things maintain homeostasis?
- What is the difference between prokaryotic and eukaryotic cells?
- How do materials go in and out of cells?
- What are the similarities and differences between autotrophs and heterotrophs?
- How do organisms obtain, use and transfer energy to maintain homeostasis?
- What are the similarities and differences between photosynthesis and cell respiration?

- How are aerobic and anaerobic respiration different?
- How is life perpetuated from generation to generation?
- What types of cells are produced by mitosis and meiosis?
- What are the differences in chromosomes in prokaryotic and eukaryotic cells?
- What problems can occur in meiosis to cause mutations?
- How does genetic inheritance explain both the diversity and similarity of organisms?
- How do Punnett squares predict probability?
- What is a pedigree and how is it used?
- How is sex determined?
- How are prokaryotes and eukaryotes regulated on a molecular level?
- How is DNA replicated?
- What is the "genetic code"?
- How do we use biotechnology to enhance our lives?
- How do genes explain both the diversity and similarity of organisms?
- What causes organisms to change over time?
- What is evolution and what is the scientific evidence to support it?
- Are there different types of evolution?
- How long does evolution take to change organisms?
- What impacts the survival of organisms?
- How do scientists classify organisms using "relatedness"?
- Why are microbes important?
- How does the structure and function of microbes influence their role in nature?
- What impacts, both positive and negative, do microorganisms have on human society?)
- How are viruses, bacteria, protista and yeast different?
- How do bacteria mutate?
- Why are all of parts of an ecosystem dependent on each other?
- How do organisms interact with the biotic and abiotic components in the biosphere?
- How do the water cycle and carbon-oxygen cycle affect the Earth?
- What is a food web?
- What is a trophic level?
- Why do populations change size?
- What are the effects of water on the evolution of plants and animals?
- How does natural selection contribute to the success or demise of a new species?
- How did organisms meet the challenges of moving to land?

# UNITS OF STUDY
# (MOLECULAR APPROACH)

## 1. INTRODUCTION

**Science Standards**

***Scientific Inquiry***

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

***Scientific Literacy***

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.
- Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.

***Scientific Numeracy***

**Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.**

Students will identify questions that can be answered through scientific investigation.

Students will read, interpret and examine the credibility and validity of scientific claims in different sources of information.

Students will formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

Students will design and conduct appropriate types of scientific investigations to answer different questions.

Students will identify independent and dependent variables, including those that are kept constant and those used as controls.

Students will assess the reliability of the data that was generated in the investigation.

**Essential Question**

- How is scientific knowledge created and communicated?

**Focus Questions**

- What are the distinguishing features of life?
- How does science function as a process?

- What are the major themes of Biology?
- How do biologists use scientific inquiry in a search for biological knowledge?

**Core Topics**

Major themes of biology:

- Genetics and evolution
- Interdependence of organisms
- Stability and homeostasis
- Reproduction and inheritance
- Cell structure and function
- Matter, energy and organization

Objective thinking vs. subjective thinking
Controlled experimentation

**Unit Objectives**

Students will be able to:

- distinguish those characteristics that make life different from non-life.
- identify the themes of biology.
- differentiate science from other ways of knowing and from other bodies of knowledge.
- defend the way that scientists use empirical standards, logical arguments, and skepticism to strive for the best possible explanations about the natural world.

**Sample Assessment**

Termite Navigation

**Pacing**

1 week

## 2. CHEMISTRY

**Science Standards**

***Chemical Structures and Properties – Properties of Matter***

**Atoms react with one another to form new molecules.**

Students will describe the general structure of the atom, and explain how the properties of the first 20 elements in the Periodic Table are related to their atomic structures.

Students will describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).

Students will explain the chemical composition of acids and bases, and explain the change of pH in neutralization reactions.

**Essential Question**

- How does the structure of matter affect the properties and uses of materials?

**Focus Questions**

- How are the principles of chemistry applied in biology?
- What is the structure of an atom?
- What types of bonds hold atoms together?

**Core Topics**

- Atomic structure-nucleus and electron cloud including sub-atomic particles and charge
- Bonding
- Acids and bases
- Neutralization

**Unit Objectives**

Students will be able to:

- draw diagrams of basic atomic structure.
- compare and contrast ionic and covalent bonding.
- identify characteristics of acids and bases.

**Sample Assessment**

Acid Indigestion?

**Pacing**

3 weeks

## 3. BIOCHEMISTRY

**Science Standards**

***Chemical Structures and Properties – Properties of Matter***

**Due to its unique chemical structure, carbon forms many organic and inorganic compounds.**

Students will explain how the structure of the carbon atom affects the type of bonds it forms in organic and inorganic molecules.

Students will explain the general formation and structure of carbon-based polymers, including synthetic polymers, such as polyethylene, and biopolymers, such as carbohydrate.

***Cell Chemistry and Biotechnology – Structure and Function***

**Fundamental life processes depend on the physical structure and the chemical activities of the cell.**

Students will describe the general role of enzymes in metabolic cell processes.

**Essential Questions**

- How are organisms structured to ensure efficiency and survival?
- How does the structure of matter affect the properties and uses of materials?

**Focus Questions**

- What are organic compounds and how do they form the basis of life?
- What is the difference between dehydration and hydrolysis?
- How is the structure of a biomolecule related to its function?

**Core Topics**

- Properties of carbon bonding
- Differences in carbohydrates, lipids, proteins
- Condensation vs. dehydration
- Enzyme structure and function

**Unit Objectives**

Students will be able to:

- describe the central nature of the element carbon.
- analyze the 3-D structure and function of biological organic compounds i.e.: carbohydrates, lipids, proteins, nucleic acids.
- compare and contrast dehydration synthesis (condensation) and hydrolysis reaction.
- explain the relationship between the structure and function of enzymes.

**Sample Assessment**
What's the Juice on Enzymes?

**Pacing**
3.5 weeks **(end quarter #1)**

## 4. CELL STRUCTURE AND FUNCTION

**Science Standards**

***Cell Chemistry and Biotechnology – Structure and Function***

**Fundamental life processes depend on the physical structure and the chemical activities of the cell.**

Students will explain the role of the cell membrane in supporting cell functions.

**Essential Question**

- How are organisms structured to ensure efficiency and survival?

**Focus Questions**

- What is the relationship between structure and function?
- How does the cell function as a basic building block of life?
- How do living things maintain homeostasis?
- What is the difference between prokaryotic and eukaryotic cells?
- How do materials go in and out of cells?

**Core Topics**

- Fluid mosaic model
- Differences between cells with and without nuclei
- Mechanisms for materials to move in and out of cells
- Organelles and their functions

**Unit Objectives**

Students will be able to:

- compare and contrast prokaryotic and eukaryotic cells.
- use digital microscopes to compare plant and animal cell structures.
- explain the structure of the nucleus and cytoplasmic structures and their functions.
- differentiate among the various structures that comprise the fluid mosaic model of the cell.
- summarize the flow of materials through the endo-membrane system.
- predict the outcome of the mechanisms of passive and active transport.

**Sample Assessments**

Digital Microscopy

**Pacing**

3.5 weeks

# 5. CELL ENERGETICS

**Science Standards**

***Cell Chemistry and Biotechnology – Structure and Function***

**Fundamental life processes depend on the physical structure and the chemical activities of the cell.**

Students will describe significant similarities and differences in the basic structure of plant and animal cells.

**Essential Questions**

- What is the role of energy in our world?
- How are organisms structured to ensure efficiency and survival?

**Focus Questions**

- What are the similarities and differences between autotrophs and heterotrophs?
- How do organisms obtain, use and transfer energy to maintain homeostasis?
- What are the similarities and differences between photosynthesis and cell respiration?
- How are aerobic and anaerobic respiration different?

**Core Topics**

- Energy producing organelles in plant and animal cells
- Phases of photosynthesis
- Aerobic vs. anaerobic respiration
- Relationship of absorption to color

**Unit Objectives**

Students will be able to:

- explain and diagram the energy transformations of life (for example photosynthesis and respiration).
- identify the ATP cycle
- compare the structure and function of mitochondria and chloroplasts.
- distinguish between aerobic and anaerobic respiration at the molecular level.
- define light absorption and light reflection and relate them to pigments.
- interpret the relationship between the light-dependent and light-independent reactions of photosynthesis.

**Sample Assessment**

Most or least yeast?

**Pacing**

2.5 weeks

# 6. CELL CYCLE AND MEIOSIS

## Science Standards

***Genetics, Evolution and Biodiversity – Heredity and Evolution***

**In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.**

Students will explain how meiosis contributes to the genetic variability of organisms.

## Essential Question

- What are the processes responsible for life's unity and diversity?

## Focus Questions

- How is life perpetuated from generation to generation?
- What types of cells are produced by mitosis and meiosis?
- What are the differences in chromosomes in prokaryotic and eukaryotic cells?
- What problems can occur in meiosis to cause mutations?

## Core Topics

- Differentiate between steps and end products in mitosis and meiosis
- Differentiate mitosis in plant and animal cells
- Effects of mutations (including crossing over) on genetic variation
- Differentiate between oogenesis and spermatogenesis
- Karyotypes

## Unit Objectives

Students will be able to:

- compare and contrast the structure of a chromosome in both a prokaryotic and eukaryotic organisms.
- Identify each phase of the cell cycle including the steps of mitosis and meiosis.
- compare and contrast the phases of mitosis in plant and animal cells.
- explain crossing over in meiosis and how it contributes to genetic variation.
- summarize the processes of oogenesis and spermatogenesis and predict the products.
- describe chromosome mutations.

## Sample Assessment

Cell cycles

## Pacing

2 weeks

***ALL PRECEEDING TOPICS WILL APPEAR ON THE MID-YEAR EXAM. EACH INDIVIDUAL TEACHER WILL ADD UNIT 7 OR UNIT 8.***

## 7. CLASSICAL AND APPLIED GENETICS

**Science Standards**

***Genetics, Evolution and Biodiversity – Heredity and Evolution***

**In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.**

Students will use the Punnett Square technique to predict the distribution of traits in mono- and di-hybrid crossings.

Students will deduce the probable mode of inheritance of traits (e.g., recessive/dominant, sex-linked) from pedigree diagrams showing phenotypes.

**Essential Question**

- What are the processes responsible for life's unity and diversity?

**Focus Questions**

- How does genetic inheritance explain both the diversity and similarity of organisms?
- How do Punnett squares predict probability?
- What is a pedigree and how is it used?
- How is sex determined?

**Core Topics**

- Punnett squares
- Dominant vs. recessive traits
- Genotype vs. phenotype
- Mono- and di-hybrid crosses

**Unit Objectives**

Students will be able to:

- predict the outcome of various genetic crosses using Punnett squares.
- analyze inheritance patterns using pedigrees.
- apply rules of probability is used to predict the results of genetic crosses.
- apply chromosome theory to genetic traits.
- explain the effect of crossing over on the inheritance of genes in linkage groups.
- explain the role of sex chromosomes in sex determination.

**Sample Assessment**

What type are you? (ABO)

**Pacing**

3.5 weeks

## 8. NUCLEIC ACIDS AND MOLECULAR GENETICS

**Science Standards**

***Cell Chemistry and Biotechnology – Structure and Function***

**Fundamental life processes depend on the physical structure and the chemical activities of the cell.**

Students will describe the general role of DNA and RNA in protein synthesis.

***Cell Chemistry and Biotechnology – Science and Technology in Society***

**Similarities in the chemical and structural properties of DNA in all living organisms allow the transfer of genes from one organism to another.**

Students will describe, in general terms, how the genetic information of organisms can be altered to make them produce new materials.

Students will explain the risks and benefits of altering the genetic composition and cell products of existing organisms.

**Essential Questions**

- How do science and technology affect the quality of our lives?
- How are organisms structured to ensure efficiency and survival?

**Focus Questions**

- How are prokaryotes and eukaryotes regulated on a molecular level?
- How is DNA replicated?
- What is the "genetic code"?
- How do we use biotechnology to enhance our lives?
- How do genes explain both the diversity and similarity of organisms?

**Core Topics**

- Genetic engineering including cloning
- Bioethics
- Recombinant DNA

**Unit Objectives**

Students will be able to:

- describe DNA structure and replication including leading and lagging strands.
- analyze the structure and function of rRNA, mRNA, and tRNA.
- describe the near universal nature of the genetic code.
- interpret the relationship between transcription and translation in eukaryotes.
- categorize mutations at the molecular level in DNA.
- model how scientists use restriction enzymes in genetic engineering.
- explain how DNA technology can be used in medicine, pharmacology, criminology, agriculture, classification.

**Sample Assessment**
DNA Fingerprinting

**Pacing**
4 weeks (end marking period 3)

## 9. EVOLUTION AND POPULATION GENETICS

**Science Standards**

***Genetics, Evolution and Biodiversity – Heredity and Evolution***

**Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.**

Students will explain how the current theory of evolution provides a scientific explanation for fossil records of ancient life forms.

**Essential Question**

- What are the processes that are responsible for life's unity and diversity?

**Focus Questions**

- What causes organisms to change over time?
- What is evolution and what is the scientific evidence to support it?
- Are there different types of evolution?
- How long does evolution take to change organisms?
- What impacts the survival of organisms?

**Core Topics**

- Darwin, Lamarck, Wallace, Malthus, Lyell
- Genetic drift
- Punctuated equilibrium, gradualism
- Hardy-Weinberg theory
- Rates of evolution
- Evidence for evolution

**Unit Objectives**

Students will be able to:

- Describe the evidence to support the theory of evolution.
- investigate the development of evolutionary theory.
- compare and contrast rates of evolution.
- compare and contrast patterns of convergent, divergent, and co-evolution.
- explain the Hardy-Weinberg theory and relate it to changes in gene frequencies within populations.

**Sample Assessment**

Amino Acid Sequences

**Pacing**

1.5 weeks

## 10. TAXONOMY AND SYSTEMATICS

*(this unit can be done as a discreet unit or incorporated into other units throughout the course)*

**Science Standards**

***Genetics, Evolution and Biodiversity – Heredity and Evolution***

**Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.**

Students will explain how the processes of genetic mutation and natural selection are related to the evolution of species.

**Essential Question**

- What are the processes that are responsible for life's unity and diversity?

**Focus Question**

- How do scientists classify organisms using "relatedness"?

**Core Topics**

- Linnaeus
- Binomial nomenclature
- Domains and kingdom systems
- Cladistics vs. systematics

**Unit Objectives**

Students will be able to:

- interpret taxonomic hierarchies.
- defend developments in higher classification systems.

**Sample Assessment**

You hold the key

**Pacing**

1 week

# 11. MICROBIOLOGY

**Science Standards**
***Cell Chemistry and Biotechnology – Science and Technology in Society***
**Microorganisms have an essential role in life processes and cycles on Earth.**

Students will describe the similarities and differences between bacteria and viruses.

Students will describe how bacterial and viral infectious diseases are transmitted, and explain the roles of sanitation, vaccination and antibiotic medications in the prevention and treatment of infectious diseases.

Students will explain how bacteria and yeasts are used to produce foods for human consumption.

Students will describe the difference between genetic disorders and infectious diseases.

**Essential Questions**
- How are organisms structured to ensure efficiency and survival?
- How do science and technology affect the quality of our lives?

**Focus Questions**
- Why are microbes important?
- How does the structure and function of microbes influence their role in nature?
- What impacts, both positive and negative, do microorganisms have on human society?)
- How are viruses, bacteria, protista and yeast different?
- How do bacteria mutate?

**Core Topics**
- Environmental roles of bacteria (helpful vs. harmful)
- Transmission, treatment and prevention of diseases caused by bacteria and viruses

**Unit Objectives**
Students will be able to:
- explain the structure and function of subcellular parasites to include viruses, prions, and viroids.
- relate lysogenic and lytic cycles in viruses.
- recognize variations in bacterial morphology, modes of respiration and modes of nutrition.
- distinguish among transformation, transduction, and conjugation in genetic recombination in bacteria.
- identify the role of microorganisms in our environment.
- compare and contrast the structure of viruses, bacteria, protista, and yeast.
- defend the use of microorganisms in medicine, pharmacology and agriculture.

**Sample Assessment**
Bacterial Sensitivity

**Pacing**
3 weeks

# 12. ECOLOGY

## Science Standards

***Genetics, Evolution and Biodiversity - Science and Technology in Society***

**Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.**

Students will describe the factors that affect the carrying capacity of the environment.

Students will explain how change in population density is affected by emigration, immigration, birth rate and death rate, and relate these factors to the exponential growth of human populations.

Students will explain how technological advances have affected the size and growth rate of human populations throughout history.

## Essential Questions

- What is the role of energy in our world?
- How do science and technology affect the quality of our lives?
- How do materials cycle through Earth's systems?

## Focus Questions

- Why are all of parts of an ecosystem dependent on each other?
- How do organisms interact with the biotic and abiotic components in the biosphere?
- How do the water cycle and carbon-oxygen cycle affect the Earth?
- What is a food web?
- What is a trophic level?
- Why do populations change size?

## Core Topics

- Advances in: agriculture, medicine, construction, use of energy, population growth, consumption of resources
- Biotic vs. abiotic factors/components
- Food webs, trophic levels
- Effect of humans & technology on the environment

## Unit Objectives

Students will be able to:

- distinguish between the abiotic and biotic components in an ecosystem.
- trace the interactions among populations of different species within a community (food webs, trophic levels).
- summarize the steps in the major biogeochemical cycles (water and carbon-oxygen).

- identify the factors that effect population density and demographics.
- assess how technological advances have affected both human populations and the environment.

**Sample Assessment**
"Who" swallowed the mouse?

**Pacing**
2 weeks

## 13. ANIMAL AND PLANT EVOLUTION

**Science Standards**

***Genetics, Evolution and Biodiversity – Heredity and Evolution***

**Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.**

Students will describe how structural and behavioral adaptations increase the chances for organisms to survive in their environments.

**Essential Question**

- What processes are responsible for life's unity and diversity?

**Focus Questions**

- What are the effects of water on the evolution of plants and animals?
- How does natural selection contribute to the success or demise of a new species?
- How did organisms meet the challenges of moving to land?

**Core Topics**

- Animal adaptations to a changing environment
- Plant adaptations to a changing environment

**Unit Objectives**

Students will be able to:

- explain the adaptations that made it possible for animals to move from water to land
- explain the adaptations that made it possible for plants to move from water to land

**Sample Assessment**

Adaptations of plants and animals

**Pacing**

3 weeks