BIOLOGY 22

Description

This course will provide students with a broad knowledge and appreciation of the concepts of biology. The course uses an ecological approach to biological concepts. Topics will be illustrated through the following themes that will recur throughout the course: evolution; structure and function; energy relationships; reproduction and inheritance; unity and diversity; and stability and patterns of change. The course is designed for students who have well-developed study skills and note-taking ability.

Course Overview

Course Goals

Students will understand that:

- due to its unique chemical structure, carbon forms many organic and inorganic compounds.
- fundamental life processes depend on the physical structure and the chemical activities of the cell.
- similarities in the chemical and structural properties of DNA in all living organisms allow the transfer of genes from one organism to another.
- in sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.
- evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.
- microorganisms have an essential role in life processes and cycles on Earth.
- 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.
- the use of resources by human populations may affect the quality of the environment.

Essential Questions

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

Assessments

Common Assessments

- Apple Juice/Enzymes Performance Task
- Bioengineered Food STS
- Eggmosis Lab Investigation
- Yeast population Dynamic Performance Task
- Human population Dynamics STS
- Antibiotic Resistance lab investigation

Content Outline	Standards	Grade Level Skills

I. Unit 1 – Introduction: Biological Processes II. Unit 2a – Energy Flow III. Unit 2b – Population Ecology IV. Unit 3 – Organic Compounds V. Unit 4 - Cytology(with Micro intro) VI. Unit 5 - Energetics VII. Unit 6 - DNA VIII. Unit 7 - Cell Division & Meiosis IX. Unit 8 - Genetics Patterns of Evolution & Speciation X. Unit 9 - Natural Selection XI. Unit 10 - Taxonomy XII. Unit 11 - Microbiology XIII. Unit 12a - Plant and Animal Evolution XIV. Unit 12b - Plant and Animal Evolution	State of Connecticut Science Curriculum Frameworks Connecticut State Standards in Core Science are met in the following areas: • ***Scientific Inquiry*** • ***Scientific Literacy*** • ***Scientific Numeracy*** • ***Global Interdependence - Science and Technology in Society*** • ***Chemical Structures and Properties – Properties of Matter*** • ***Cell Chemistry and Biotechnology – Structure and Function*** • ***Cell Chemistry and Biotechnology – Science and Technology in Society*** • ***Genetics, Evolution and Biodiversity – Heredity and Evolution*** • ***Genetics, Evolution and Biodiversity - Science and Technology in Society***	Students will: • make predictions based on observations. • present relationships between variables in appropriate formats (table, graph, chart). • evaluate the credibility and validity of various sources of scientific information. • formulate a testable hypothesis. • demonstrate logical connections between scientific concepts guiding a hypothesis and experimental design. • assess the validity of experimental results based on the design of an experiment. • use scientific information responsibly.

Pacing Guide							
1st Marking Period				2nd Marking Period			
September		October		November	December		January
Unit 1 **Introduction : Biological Processes** 1 week	Unit 2a & 2b **Energy Flow** 1.5 weeks	Unit 2b **Population Ecology** 2 weeks	Unit 3 **Organic Compounds** 2.5 weeks	Unit 4 **Cytology** 2.5 weeks	Unit 5 **Energetics** 2.5 weeks	Unit 6 **DNA** 2.5 weeks	Unit 7 **Cell Division & Meiosis** 1.5 weeks
3rd Marking Period				4th Marking Period			
February		March		April	May		June
Unit 8 **Genetics** 3 weeks	Unit 9 **Natural Selection** 3 weeks	Unit 10 **Taxonomy** 1.5 weeks	Unit 11 **Microbiology** 3 weeks	Unit 12a & 12b **Plant and Animal Evolution** 4 weeks			

NOTES:

- 1 week of genetics PRIOR to the mid-year review/exam
- 1 week allotted for mid-year review at the end of quarter #2
- Unit #7 – Natural Selection to be completed BEFORE CAPT testing in March
- 1 week for final review at the end of quarter #4

Unit 1 - Introduction: Biological Processes, 1 week top

Standards

Scientific Inquiry

Scientific inquiry:

- is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- progresses through a continuous process of questioning, data collection, analysis and interpretation.
- 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.
- 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:

- read, interpret and examine the credibility and validity of scientific claims in different sources of information.
- formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
- design and conduct appropriate types of scientific investigations to answer different questions.
- assess the reliability of the data that was generated in the investigation.

Unit Objectives

Students will be able to:

- identify characteristics of life.
- identify the themes of biology.
- identify the organization of Earth's system.
  - biosphere to atoms

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?
- How do biologists use scientific inquiry in a search for biological knowledge?

Assessments

- Bean germination
- Inquiry cube lab

Skill Objectives

Students will:

- apply scientific methods to perform inquiry based laboratories.
  - design a controlled experiment (Independent variable, Dependent variable, Control, Variables held Constant).
  - create and use graphs to analyze data.
  - draw conclusions from analyzed data.
  - assess the validity of the experimental design and data collected.
- demonstrate safe lab techniques.

Unit 2a - Energy Flow, 1.5 weeks top

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

Chemical Structures and Properties – Properties of Matter

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

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

Global Interdependence - Science and Technology in Society

The use of resources by human populations may affect the quality of the environment.

Students will explain how the accumulation of mercury, phosphates and nitrates affects the quality of water and the organisms that live in rivers, lakes and oceans.

Unit Objectives

Students will be able to:

- describe the flow of energy and nutrition through an ecosystem.
  - food chain – nutrients
  - trophic levels - Producers, 1°, 2°, 3° consumers, decomposers, predator/prey relationship
- food web
  - energy pyramid/10% Rule
  - recognize the biosphere is a closed system, nutrients must be recycled.
    - overview of carbon(make connection to combustion), water, and nitrogen cycles
    - algal blooms due to fertilizer runoff
- explain how community interactions can powerfully affect an ecosystem.

Essential Question

- What is the role of energy in our world?

Focus Questions

- Why are all of parts of an ecosystem dependent on each other?
- What is a food web?
- What is a trophic level?
- What are the effects of humans on the environment?

Assessment

- Owl pellets

Skill Objectives

Students will:

- create/interpret food webs and food chains.
- analyze the impact of changes in a food web.

Unit 2b – Population Ecology, 2 weeks top

Standards

Cell Chemistry and Biotechnology – Science and Technology in Society
Microorganisms have an essential role in life processes and cycles on Earth.
Students will explain how bacteria and yeasts are used to produce foods for human consumption.

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

Unit Objectives
Students will be able to:

- distinguish between biotic/abiotic factors in ecosystems.
- explain how carrying capacity is regulated by abiotic and biotic factors.
- explain how technological advances affected the size and growth rate of human populations through history.
- identify factors that affect population density.
  - emigration, immigration, birth/death rate and relationship to human population growth.
- analyze and discuss human affect on the environment.
  - population growth, technology, loss of biological resources, competition.

Essential Questions

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

Focus Questions

- How do organisms interact with the biotic and abiotic components in the biosphere?
- What factors affect human populations?

Assessment

- STS Human Population Dynamics*

Skill Objectives
Students will:

- compare age structure diagrams for a developed, developing and underdeveloped country and identify the factors that affect a population's age structure.

Unit 3 – Organic Compounds, 2.5 weeks top

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

Chemical Structures and Properties – Properties of Matter
Due to its unique chemical structure, carbon forms many organic and inorganic compounds.
Students will explain the general formation and structure of carbon-based polymers, including synthetic polymers, such as polyethylene, and biopolymers, such as carbohydrate.

Unit Objectives
Students will be able to:
- explain the general functions of organic compounds/macromolecules in living things.
  - carbohydrates, Lipids, Proteins, monomers, polymers
  - examine the function of enzymes.
  - identify the factors affecting enzyme function (temperature, pH)

Essential Question
- What is the role of energy in our world?

Focus Questions
- What are organic compounds and how do they form the basis of life?
- Why are enzymes important?
- What factors affect how enzymes work?

Assessments
- Apple Juice Released Task
- Organic compounds lab

Skill Objectives
Students will:
- formulate a testable hypothesis.
- demonstrate logical connections between scientific concepts guiding a hypothesis and experimental design.
- assess the validity of experimental results based on the design of an experiment.

Unit 4 – Cytology, 2.5 weeks top

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

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.

Unit Objectives

Students will be able to:

- compare and contrast structural components and their functions in prokaryotes, eukaryotes (plant and animal) and viruses.
- use microscopes to differentiate between cell types.
- explain how organelles interact to carry out cell processes.
- differentiate between passive and active transport with regards to concentration gradient.
  - Passive Transport: osmosis, diffusion (O_2 and CO_2) Facilitated Diffusion(glucose)
  - Active Transport:
  - Differentiate between bulk transport (exocytosis and endocytosis).

Essential Question

- How are organisms structured to ensure efficiency and survival?

Focus Questions

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

Assessments

- Microscope lab
- Eggmosis lab

Skill Objective

Students will:

- use digital microscopes to observe and record information about various plant and animal cells.

Unit 5 – Energetics, 2.5 weeks top

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

Unit Objectives

Students will be able to:

- examine the role of cellular respiration and photosynthesis in a cycle.
  - Examine the complementary roles of photosynthesis and cellular respiration in both producers and consumers.
  - Distinguish between aerobic and anaerobic cell respiration.
  - Identify the role of microorganisms in food production.
- identify the evolutionary sequence of anaerobic → photosynthesis → aerobic respiration.

Essential Question

- How do materials cycle through the Earth's systems?

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?
- What is the evolutionary sequence of events in the development of autotrophs, anaerobic and aerobic heterotrophs?

Assessment

- Yeast Lab

Skill Objectives

Students will:

- make predictions based on observations.
- present relationships between variables in appropriate formats (table, graph, chart).

Unit 6 – DNA, 2.5 weeks top

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.
- describe the general role of enzymes in metabolic cell processes.

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:

- explain the risks and benefits of altering the genetic composition and cell products of existing organisms.
- explain, in general terms, how the genetic information of organisms can be altered to make them produce new materials.

Unit Objectives

Students will be able to:

- explain how the structures of nucleic acids are related to their functions of storing information and synthesizing proteins.
- compare and contrast the basic structure and function of DNA and RNA.
- describe the basic mechanism of DNA replication.
- transcribe and translate a simple DNA sequence into a polymer.
- identify the possible effects of gene mutations on altering the genetic code.
- discuss, in general terms, how genetic information can be altered to produce organic materials and new organisms.
- analyze the risks and benefits of altering the genetic composition of organisms to create genetically modified foods.

Essential Question

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

Focus Questions

- What is DNA's function?
- How is DNA replicated?
- What is the "genetic code" and how is it used to create proteins?
- How do we use biotechnology to enhance our lives?
- How do genes explain both the diversity and similarity of organisms

Assessments

- DNA models
- STS genetically modified foods

Skill Objectives

Students will:

- use a codon chart to determine the amino acid sequence from DNA.
- research and present information (brochure, PowerPoint, oral presentation, etc.) about the risks and benefits of genetically modified foods.
- evaluate the credibility and validity of various sources of scientific information.
- use scientific information responsibly.

Unit 7 – Cell Division & Meiosis, 1.5 weeks top

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.

Unit Objectives

Students will be able to:

- describe how genetic information is organized in the chromosome.
- identify the basic function of the cell cycle phases.
- differentiate between mitosis in plant and animal cells.
- compare the genetic material between parent and daughter cells in mitosis and meiosis.
- explain crossing over in meiosis and how it contributes to genetic variation.
- identify the role of independent assortment and segregation in meiosis to produce unique daughter cells.
- describe non-disjunction.

MID-YEAR EXAM

Essential Question

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

Focus Questions

- What types of cells are produced by mitosis and meiosis?
- How is life perpetuated from generation to generation?

Assessments

- Microviewers plant vs. animal
- Karyotypes

Skill Objectives

Students will:

- use microscopes and microviewers to identify the stages of mitosis in both plant and animal cells.
- interpret human karyotypes for gender and non-disjunction.

Unit 8 – Genetics, 3 weeks top

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 dihybrid crossings.
- deduce the probable mode of inheritance of traits (e.g. recessive/dominant, sex-linked) from pedigree diagrams showing phenotypes
- describe the difference between genetic disorders and infectious diseases.

Cell Chemistry and Biotechnology – Science and Technology in Society

Microorganisms have an essential role in life processes and cycles on Earth.

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..

Unit Objectives

Students will be able to:

- utilize the terms genotype, phenotype, homozygous, heterozygous, and allele.
- analyze codominant and incomplete dominant inheritance patterns.
- identify gender using sex chromosomes.
- compare prevention, transmission and treatment of genetic vs. infectious diseases.

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 does genetic inheritance explain both the diversity and similarity of organisms?
- What are the ways that diseases are transmitted?
- How can diseases be treated or prevented?

Assessments

- Punnett squares
- Pedigrees
- Genetic diseases

Skill Objectives

Students will:

- set up and use Punnett Squares to predict the outcome of monohybrid (one factor) crosses.
- interpret dihybrid crosses
- distinguish dominant, recessive and sex-linked inheritance patterns using pedigrees

Unit 9 – Natural Selection, 3 weeks top

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.

Unit Objectives

Students will be able to:

- use the fossil record to support the theory of evolution.
- explain how mutations and recombination provides the variation on which natural selection acts.
- apply real-life examples to Natural Selection
  - for example; Kaibab & Albert squirrel (Grand Canyon), giraffe neck length
- describe how genetic mutations create antibiotic resistance in bacteria.
  - explain the roles of sanitation, vaccination and antibiotic medications in prevention and treatment of infectious diseases.
- describe how structural and behavioral adaptations increase the chances for organisms to survive in their environments.
- identify and explain evidence of Evolution - embryological, analogous, homologous, vestigial structures, biochemical evidence
- describe speciation - convergent, divergent and co-evolution.
- contrast Artificial selection vs. Natural Selection

CAPT

Essential Question

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

Focus Questions

- What causes organisms to change over time?
- What impacts the survival of organisms?
- 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?

Assessments

- Natural Selection lab
- Bird beak lab

Skill Objectives

Students will:

- use amino acid sequences to determine evolutionary relationships among organisms.

Unit 10 – Taxonomy, 1.5 weeks top

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.

Unit Objectives

Students will be able to:

- apply general rules to differentiate between scientific and common names.
- list correct Taxonomic Levels from domain to species.
- compare and contrast basic characteristics that distinguish between the three domains.
- compare and contrast basic characteristics that distinguish between the four eukaryotic kingdoms.

Essential Questions

- How do science and technology affect the quality of our lives?
- What processes are responsible for life's unity and diversity?

Focus Question

- How do scientists classify organisms using "relatedness"?

Assessments

- Phylogenetic trees
- Cladograms
- Dichotomous Keys

Skill Objectives

Students will:

- complete and interpret evolutionary relationships, including common ancestors, using phylogenetic trees and cladograms
- interpret a Dichotomous Key.

Unit 11 – Microbiology, 3 weeks top

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.
- 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.
- explain how bacteria and yeasts are used to produce foods for human consumption.
- describe the difference between genetic disorders and infectious diseases.

Unit Objectives

Students will be able to:

- describe how bacteria and viruses are beneficial as well as harmful to humans and the environment.
- compare and contrast bacterial and viral modes of infection.
- illustrate the human body's general immune response to pathogens.
  - first Line of Defense
  - second Line of Defense
- explain the roles of sanitation, vaccination and antibiotic medications in prevention and treatment of infectious diseases.

Essential Question

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

Focus Questions

- 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?
- Why are microbes important?
- How has the study of Biology impacted human society?

Assessment

- Bacteria Sensitivity

Skill Objectives

Students will:

- formulate a testable hypothesis.
- demonstrate logical connections between scientific concepts guiding a hypothesis and experimental design.
- assess the validity of experimental results based on the design of an experiment.
- make predictions based on observations.

Unit 12a – Plant and Animal Evolution, 2 weeks top

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.

Unit Objectives

Students will be able to:

- trace the evolutionary trends toward increasing complexity.
  - body symmetry: radial vs. bilateral
  - cephalization: concentration of nervous tissue at the anterior end
  - organ system development: respiratory, circulatory, nervous, digestive, reproductive.
  - mode of fertilization: external vs. internal
- trace the evolutionary trends toward the movement to land.
  - gas exchange/breathing: simple diffusion, gills, lungs
  - movement: fins to limbs
  - desiccation: mucus, scales, skin
  - overwintering: migration, hibernation, metamorphosis
  - reproduction: internal fertilization, amniotic egg, internal development

Essential Question

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

Focus Questions

- How does evolution shape the unity and diversity of life?
- What are the effects of water on the evolution of plants and animals?
- How did organisms meet the challenges of moving to land?

Assessments

- Preserved samples
- Dissections

Skill Objectives

Students will:

- read and interpret animal phylogenetic trees.

Unit 12b – Plant and Animal Evolution, 2 weeks top

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.

Unit Objectives

Students will be able to:

- trace the evolutionary trends toward increasing complexity.
  - vascular tissue
  - modes of Fertilization: flagellated sperm → spore → pollen
  - methods of Dispersal: water, wind, animal vectors (fruit/seed)
- trace the evolutionary trends toward the movement to land.
  - desiccation: root structure, stems, leaves, and development of bark
  - reproduction: flower, pollen, fruit, fruit dispersal, mechanisms of pollination
- various forms of symbiotic relationships

Essential Question

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

Focus Questions

- How does evolution shape the unity and diversity of life?
- 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?

Assessments

- Bean Germination Lab
- Flower dissection
- Plant Portfolio
- Flower to Fruit Lab

Skill Objectives

Students will:

- read and interpret plant phylogenetic trees.