The Mission of the Chardon Local Schools is High Achievement for All Students, Where Learning is Our Most Important Work.

Science Course of Study:

ENVIRONMENTAL SCIENCE

(Grade 9)

Revised 2021-22

Committee Members: Heather Spreitzerand Jodie Tagliaferri

Strand: Nature of Science

Learning Standards: Ohio Learning Standards
Scientific Inquiry, Practice and Application

- Identify questions and concepts that guide scientific investigations.
- Design and conduct scientific investigations using a variety of methods and tools to collect empirical evidence, observing appropriate safety techniques.
- Use technology and mathematics to improve investigations and communications.
- Formulate and revise explanations and models using logic and scientific evidence (critical thinking).
- Recognize and analyze explanations and models.
- Communicate and support scientific arguments.

Science is a Way of Knowing

- Various science disciplines use diverse methods to obtain evidence and do not always use the same set of procedures to obtain and analyze data (i.e., there is no one scientific method).
    - Make observations and look for patterns.
    - Determine relevant independent variables affecting observed patterns.
    - Manipulate an independent variable to affect a dependent variable.
    - Conduct an experiment with controlled variables based on a question or hypothesis.
    - Analyze data graphically and mathematically.
- Science disciplines share common rules of evidence used to evaluate explanations about natural phenomenon by using empirical standards, logical arguments and peer reviews.
    - Empirical standards include objectivity, reproducibility, and honest and ethical reporting of findings.
    - Logical arguments should be evaluated with open-mindedness, objectivity and skepticism.
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation.
- The various scientific disciplines have practices, methods, and modes of thinking that are used in the process of developing new science knowledge and critiquing existing knowledge.

Science is a Human Endeavor

- Science depends on curiosity, imagination, creativity and persistence.
- Individuals from different social, cultural, and ethnic backgrounds work as scientists and engineers.
- Science and engineering are influenced by technological advances and society; technological advances and society are influenced by science and engineering.
- Science and technology might raise ethical, social and cultural issues for which science, by itself, does not

How Taught?
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provide answers and solutions.

Scientific Knowledge is Open to Revision in Light of New Evidence

- Science can advance through critical thinking about existing evidence.
- Science includes the process of comparing patterns of evidence with current theory.
- Some science knowledge pertains to probabilities or tendencies.
- Science should carefully consider and evaluate anomalies (persistent outliers) in data and evidence.
- Improvements in technology allow us to gather new scientific evidence.

Materials:

- Textbook
- Workbook
- Online resources (supplemental resources)
- Interactive academic games (Kahoot, Gimkit, Quizlet)
- Study Stack flashcards
- Explore Learning (Gizmos)

How Assessed?
Assessments may include, but are not limited to:

- Pre-Assessments (pre-tests, observation, questioning, diagnostics)
- Formative Assessments (entry/exit slips, mini analysis assignments, group work, discussions, homework/classwork, self and peer evaluations, checklists, guided notes, observations,quizzes, conferences, rubrics, lesson review questions, lab reports)
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How Re-Taught?
Re-teaching activities may include, but are not limited to:

- descriptive feedback on original task/assessment
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- review sessions
- graphic organizers
- small-group instruction
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Strand: Diversity

Learning Standards: Ohio Learning Standards

B.DI.1: Biodiversity

- The great diversity of organisms and ecological niches they occupy result from more than 3.8 billion years of evolution.
- Populations of individual species and groups of species comprise a vast reserve of genetic diversity.
- Loss of diversity alters energy flow, cycles of matter and persistence within biological communities.
- Loss of genetic diversity in a population increases its probability of extinction.

B.DI.2: Ecosystems

- Ecosystems change as geological and biological conditions vary due to natural and anthropogenic factors. Like many complex systems, ecosystems have cyclical fluctuations around a state of equilibrium. The rate of these fluctuations in ecosystems can increase due to human induced pollutants.
- Changes in ecosystems may lead to disequilibrium, which can be seen in variations in carrying capacities.
- Authentic data are used to study the rate of change in matter and energy relationships, population dynamics, carbon and nitrogen cycling, population changes and growth within an ecosystem.
- Graphs, charts, histograms and algebraic thinking could be used to explain concepts of carrying capacity of populations and homeostasis within ecosystems by investigating changes in populations that occur locally or regionally.
- Carrying capacity is defined as the population equilibrium size when births and deaths are equal; hence Population Growth Rate = zero.

B.DI.3: Loss of diversity

- An ecosystem will maintain equilibrium with small fluctuations in its abiotic and biotic components, but significant fluctuations can result in long-term alterations of the ecosystem and ultimately a loss of biodiversity.
    - Caused by both natural and anthropogenic events
        - Humans are a biotic factor in ecosystems and can impact critical variables within these systems.
- Climate is dependent on a number of feedback loops between sunlight, the ocean, the atmosphere and the biosphere. Increasing mean global temperatures cause increased variance in weather that impacts both biotic and abiotic factors.
- Multiple changes happening simultaneously can stress ecosystems. Extreme events can result in long-term alterations to ecosystems and their functions.
    - prolonged drought
    - floods
    - introduction or removal of species

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- Students should examine the factors that contribute to the accelerated extinction rates observed today and the implications of declining biodiversity carrying capacity.
- The observed rates of biodiversity loss are indicative of a severe and pervasive disequilibrium in ecosystems.
- Misconceptions about population growth capacity, interspecies and intraspecies competition for resources, and what occurs when members of a species immigrate to or emigrate from ecosystems are included in this topic.
- Technology can be used to access real-time/authentic data to study population changes and growth in specific locations.

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Strand: Evolution : Changes in Organisms Over Time due Environmental Factors

Learning Standard: Ohio Learning Standards

B.E.1: Mechanisms

- Natural selection is used to describe the process by which traits become more or less common in a population due to consistent environmental pressures upon the survival and reproduction of individuals with the trait.
- Populations evolve over time.
- Evolution through natural selection is the consequence of the interactions of:
    - The potential for a population to increase its numbers;
    - The genetic variability of offspring due to mutation and recombination of genes;
    - A finite supply of the resources required for life; and
    - The differential survival and reproduction of individuals based on phenotype(s).
- Mutations are described in the content elaboration for Heredity. Apply the knowledge of mutation and genetic drift to real-world examples.
- Biological evolution explains the natural origins for the diversity of life. Emphasis shifts from thinking in terms of selection of individuals with a particular trait to changing proportions of a trait in populations as a result of the mechanisms of natural selection, genetic drift, movement of genes into and out of populations and sexual selection.

B.E.2: Speciation

- Biological classification expands to molecular evidence. Classification systems are frameworks, developed by scientists, for describing the diversity of organisms; indicating the degree of relatedness among organisms.
- Recent molecular sequence data generally support earlier hypotheses regarding lineages of organisms based upon morphological comparisons.
- Both morphological and molecular comparisons can be used to describe patterns of biodiversity (cladograms present hypotheses to explain descent from a common ancestor with modification).
- The concept of descent from a common ancestor with modification provides a natural explanation for the diversity of life on Earth as partially represented in the fossil record and in the similarities of existing species.

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Strand: Heredity : Influences on Population Genetics

Learning Standard: Ohio Learning Standards

B.H.1: Cellular genetics

- Life is specified by genomes. Each organism has a genome that contains all the biological information needed to develop and maintain that organism.
- The biological information contained in a genome is encoded in its deoxyribonucleic acid (DNA) and is divided into discrete units called genes. Genes code for proteins.
- Different parts of the genetic instructions are used in different types of cells, influenced by the cell's environment and history. The many body cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions. (AAAS)
    - Cell differentiation

B.H.2: Structure and function of DNA in cells

- Mendel's laws of inheritance are interwoven with knowledge of DNA and chromosome structure and function to build toward basic knowledge of modern genetics.
- Genes are segments of DNA molecules.
- The sequence of DNA bases in a chromosome determines the sequence of amino acids in a protein.
- Inserting, deleting or substituting segments of DNA molecules can alter genes.
- Sorting and recombination of genes in sexual reproduction and meiosis specifically result in a variance in traits of the offspring of any two parents. This content can be explicitly connected to evolution.

B.H.3: Genetic mechanisms and inheritance

- Genetic variation in traits among offspring is a result of the movement of chromosomes crossing over, independent assortment, and recombination during gamete formation.
- Genetic mechanisms, both classical and modern, including incomplete dominance, sex-linked traits, and dihybrid crosses, are investigated through real-world examples.
- Statistics and probability allow us to compare observations made in the real world with predicted outcomes.
- Dihybrid crosses can be used to explore linkage groups, gene interactions and phenotypic variations.
- Chromosome maps reveal linkage groups.

B.H.4: Mutations

- Genes can be altered by insertion, deletion, or substitution of a segment of DNA molecules.
- An altered gene is a mutation and will be passed on to every cell that develops from it. The resulting features may help, harm or have little or no effect on the offspring's success in its environments.
- Gene mutations in gametes are passed onto offspring.

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B.H.5: Modern genetics ● Technological developments that lead to the current knowledge of heredity are introduced for study. ● The development of the model for DNA structure was the result of experimentation, hypothesis, testing, statistical analysis and technology as well as the studies and ideas of many scientists and their models. ○ James Watson and Francis Crick developed the current model based on the work of ○ Rosalind Franklin and others. ● Scientists continue to use these models to devise technologies in order to further our understanding and application of genetics. ● The emphasis is the interpretation and application of the results.	
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Strand: Cells : Environmental Impacts on Cellular Structures

Learning Standard: Ohio Learning Standards **B.C.1: Cell structure and function** ● Every cell produces a membrane through which substances pass differentially, maintaining homeostasis. ● Molecular properties and concentration of the substances determine which molecules pass freely and which molecules require energy. ● In most cells, a complex network of proteins provides organization and shape. ● Within the cell are specialized parts that transport materials, transform energy, build proteins, dispose of waste and provide information feedback and movement. ● Many chemical reactions that occur in some cells of multicellular organisms do not occur in most of the other cells of the organism. ● Prokaryotes, simple single-celled organisms, are first found in the fossil record about 3.8 billion years ago. ● Cells with nuclei, eukaryotes, developed one billion years ago and from these increasingly complex multicellular organisms descended. **B.C.2: Cellular processes** ● Living cells interact with, and can have an impact on, their environment. ● Carbon is a necessary element that cells acquire from their environment. ● Cells use carbon, along with hydrogen, oxygen, nitrogen, phosphorus and sulfur, during essential processes like respiration, photosynthesis, chemosynthesis and biosynthesis of macromolecules (e.g., proteins, lipids, carbohydrates). ● Chemical reactions that occur within a cell can cause the storage or release of energy by forming or breaking chemical bonds. ● Specialized proteins called enzymes lower the activation energy required for chemical reactions, increasing the reaction rate. ● Positive and negative feedback mechanisms regulate internal cell functions as external conditions vary. ● Most cells function within a narrow range of temperature and pH. ● Variations in external conditions that exceed the optimal range for a cell can affect the rate at which essential chemical reactions occur in that cell. ● At very low temperatures, reaction rates are slow. High temperatures can change the structure of most protein molecules. ● Changes in pH can alter the structure of most protein molecules and change how molecules within the cell	**How Taught?** ●Students closely read select passages from documents to analyze text structure, development, and consequent meanings ●Teacher provides direct instruction, give feedback, and model critical thinking ●Small group and class discussions ●Cooperative learning groups ●Students to define, use, and connect to content area and based vocabulary ●Students analyze video content related to standards that provide a broader global perspective of content. ●Design and conduct lab-based investigations that connect content to real-life experiences. ●Provide opportunities for out of building excursions (field trips) to provide additional real world application of standards. ●Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction

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● The sequence of DNA bases on a chromosome determines the sequence of amino acids in a protein.
● Enzymes catalyze most chemical reactions in cells.
● Protein molecules are long, folded chains made from combinations of 20 common amino-acids.
● The activity of each protein molecule results from its sequence of amino acids and the shape the chain takes as a result of that sequence.</td><td></td></tr>
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