High School Science Curriculum Handbook of Expectations

BIOLOGY

High School Science
Curriculum Expectations
Course: Biology

SCHOOL MISSION

Through small class sizes, individualized instruction and an innovative social skills curriculum, we help students reach their fullest potential academically, socially and emotionally, so they may enjoy productive and successful futures. We believe it is our job to: assess all students' needs, plan both instruction and interventions to meet those needs, provide ongoing progress-monitoring, support our community with parent training, and teach all of our students. Our charter is to educate children with autism spectrum disorders (ASDs). These children learn differently than those without ASDs. With this in mind, we use research-based curriculum to blend requirements of Utah State Core Curriculum, social skills instruction, and sensory integration with identified behavior-based instructional practices, while accommodating the individual education plans (IEPs) for our student population.

OUR THEORY OF ACTION

The staff of Spectrum Academy has committed to help our students meet our learning expectations. We approach this in the following ways: assessing students' reading and math skills prior to instruction to ensure appropriate course placement, leveling in accordance with Utah State Core Curriculum, and differentiating instructional methods as needed within each class. Other factors considered include: age, grade, developmental level, social needs, class size, and appropriate student-teacher matching.

INTRODUCTION TO CURRICULUM EXPECTATIONS

The curriculum expectations for this course were developed by blending all elements of the Utah State Core Standards for Science with Next Generation Science Standards (NGSS). The National NGSS were developed by the following organizations:

- National Research Council (NRC)
- American Association for the Advancement of Science (AAAS)
- National Science Teachers Association (NSTA)

Resources…
http://www.uen.org/core/science/
http://www.nextgenscience.org/

POWER STANDARDS

By the end of the year, all biology students will be able to…

- ✓ Characterize interactions between living things and between organisms and their environment.
- ✓ Describe the structure and function of cells, emphasizing the cycling of matter and energy in cellular processes.
- ✓ Identify the relationship between structure and function of organs and organ systems in various forms of life.
- ✓ Compare and contrast sexual and asexual reproductive strategies of organisms, highlighting the role of DNA in patterns of genetic inheritance and protein synthesis.
- ✓ Understand the basis for the general theory of evolution, its role in the history of biodiversity, and its use in classification of species.

UNITS OF STUDY (KUDOS)

KUDOS is a curricular framework in which instructors clearly define what students will know, understand, and be able to do by the end of the course. The USOE core standards were developed with this framework in mind, organizing science curricula into standards, objectives, and indicators. Indicators suggest ways that students can demonstrate that they have mastered educational objectives. The following are the Utah standards around which Spectrum Academy faculty has developed the Earth Science course.

Standard 1: Students will understand that living organisms interact with one another and their environment.

Objective 1: Summarize how energy flows through an ecosystem.

Indicator A: Arrange components of a food chain according to energy flow.

Indicator B: Compare the quantity of energy in the steps of an energy pyramid.

Indicator C: Describe strategies used by organisms to balance the energy expended to obtain food to the energy gained from the food (e.g., migration to areas of seasonal abundance, switching type of prey based upon availability, hibernation or dormancy).

Indicator D: Compare the relative energy output expended by an organism in obtaining food to the energy gained from the food (e.g., hummingbird - energy expended hovering at a flower compared to the amount of energy gained from the nectar, coyote - chasing mice to the energy gained from catching one, energy expended in migration of birds to a location with seasonal abundance compared to energy gained by staying in a cold climate with limited food).

Indicator E: Research food production in various parts of the world (e.g., industrialized societies' greater use of fossil fuel in food production, human health related to food product).

Objective 2: Explain relationships between matter cycles and organisms.

Indicator A: Use diagrams to trace the movement of matter through a cycle (i.e., carbon, oxygen, nitrogen, water) in a variety of biological communities and ecosystems.

Indicator B: Explain how water is a limiting factor in various ecosystems.

Indicator C: Distinguish between inference and evidence in a newspaper, magazine, journal, or Internet article that addresses an issue related to human impact on cycles of matter in an ecosystem and determine the bias in the article.

Indicator D: Evaluate the impact of personal choices in relation to the cycling of matter within an ecosystem (e.g., impact of automobiles on the carbon cycle, impact on landfills of processed and packaged foods).

Objective 3: Describe how interactions among organisms and their environment help shape ecosystems.

Indicator A: Categorize relationships among living things according to predator-prey, competition, and symbiosis.

Indicator B: Formulate and test a hypothesis specific to the effect of changing one variable upon another in a small ecosystem.

Indicator C: Use data to interpret interactions among biotic and abiotic factors (e.g., pH, temperature, precipitation, populations, diversity) within an ecosystem.

Indicator D: Investigate an ecosystem using methods of science to gather quantitative and qualitative data that describe the ecosystem in detail.

Indicator E: Research and evaluate local and global practices that affect ecosystems.

Standard 2: Students will understand that all organisms are composed of one or more cells that are made of molecules, come from preexisting cells, and perform life functions.

Objective 1: Describe the fundamental chemistry of living cells.

Indicator A: List the major chemical elements in cells (i.e., carbon, hydrogen, nitrogen, oxygen, phosphorous, sulfur, trace elements).

Indicator B: Identify the function of the four major macromolecules (i.e., carbohydrates, proteins, lipids, nucleic acids).

Indicator C: Explain how the properties of water (e.g., cohesion, adhesion, heat capacity, solvent properties) contribute to maintenance of cells and living organisms.

Indicator D: Explain the role of enzymes in cell chemistry.

Objective 2: Describe the flow of energy and matter in cellular function.

Indicator A: Distinguish between autotrophic and heterotrophic cells.

Indicator B: Illustrate the cycling of matter and the flow of energy through photosynthesis (e.g., by using light energy to combine CO2 and H2O to produce oxygen and sugars) and respiration (e.g., by releasing energy from sugar and O2 to produce CO2 and H2O).

Indicator C: Measure the production of one or more of the products of either photosynthesis or respiration.

Objective 3: Investigate the structure and function of cells and cell parts.

Indicator A: Explain how cells divide from existing cells.

Indicator B: Describe cell theory and relate the nature of science to the development of cell theory (e.g., built upon previous knowledge, use of increasingly more sophisticated technology).

Indicator C: Describe how the transport of materials in and out of cells enables cells to maintain homeostasis (i.e., osmosis, diffusion, active transport).

Indicator D: Describe the relationship between the organelles in a cell and the functions of that cell.

Indicator E: Experiment with microorganisms and/or plants to investigate growth and reproduction.

Standard 3: Students will understand the relationship between structure and function of organs and organ systems.

Objective 1: Describe the structure and function of organs.

Indicator A: Diagram and label the structure of the primary components of representative organs in plants and animals (e.g., heart - muscle tissue, valves and chambers; lung - trachea, bronchial, alveoli; leaf - veins, stomata; stem - xylem, phloem, cambium; root - tip, elongation, hairs; skin - layers, sweat glands, oil glands, hair follicles; ovaries - ova, follicles, corpus luteum).

Indicator B: Describe the function of various organs (e.g. heart, lungs, skin, leaf, stem, root, ovary).

Indicator C: Relate the structure of organs to the function of organs.

Indicator D: Compare the structure and function of organs in one organism to the structure and function of organs in another organism.

Indicator E: Research and report on technological developments related to organs.

Objective 2: Describe the relationship between structure and function of organ systems in plants and animals.

Indicator A: Relate the function of an organ to the function of an organ system.

Indicator B: Describe the structure and function of various organ systems (i.e., digestion, respiration, circulation, protection and support, nervous) and how these systems contribute to homeostasis of the organism.

Indicator C: Examine the relationships of organ systems within an organism (e.g., respiration to circulation, leaves to roots) and describe the relationship of structure to function in the relationship.

Indicator D: Relate the tissues that make up organs to the structure and function of the organ.

Indicator E: Compare the structure and function of organ systems in one organism to the structure and function in another organism (e.g., chicken to sheep digestive system; fern to peach reproductive system).

Standard 4: Students will understand that genetic information coded in DNA is passed from parents to offspring by sexual and asexual reproduction. The basic structure of DNA is the same in all living things. Changes in DNA may alter genetic expression.

Objective 1: Compare sexual and asexual reproduction.

Indicator A: Explainthesignificanceofmeiosisandfertilizationingeneticvariation.

Indicator A: Compare the advantages/disadvantages of sexual and asexual reproduction to survival of species.

Indicator C: Formulate, defend, and support a perspective of a bioethical issue related to intentional or unintentional chromosomal mutations.

Objective 2: Predict and interpret patterns of inheritance in sexually reproducing organisms.

Indicator A: Explain Mendel's laws of segregation and independent assortment and their role in genetic inheritance.

Indicator B: Demonstrate possible results of recombination in sexually reproducing organisms using one or two pairs of contrasting traits in the following crosses: dominance/recessive, incomplete dominance, co-dominance, and sex-linked traits.

Indicator C: Relate Mendelian principles to modern-day practice of plant and animal breeding.

Indicator D: Analyze bioethical issues and consider the role of science in determining public policy.

Objective 3: Explain how the structure and replication of DNA are essential to heredity and protein synthesis.

Indicator A: Use a model to describe the structure of DNA.

Indicator B: Explain the importance of DNA replication in cell reproduction.

Indicator C: Summarize how genetic information encoded in DNA provides instructions for assembling protein molecules.

Indicator D: Describe how mutations may affect genetic expression and cite examples of mutagens.

Indicator E: Relate the historical events that lead to our present understanding of DNA to the cumulative nature of science knowledge and technology.

Indicator F: Research, report, and debate genetic technologies that may improve the quality of life (e.g., genetic engineering, cloning, gene splicing).

Standard 5: Students will understand that biological diversity is a result of evolutionary processes.

Objective 1: Relate principles of evolution to biological diversity.

Indicator A: Describe the effects of environmental factors on natural selection.

Indicator B: Relate genetic variability to a species' potential for adaptation to a changing environment.

Indicator C: Relate reproductive isolation to speciation.

Indicator D: Compare selective breeding to natural selection and relate the differences to agricultural practices.

Objective 2: Cite evidence for changes in populations over time and use concepts of evolution to explain these changes.

Indicator A: Cite evidence that supports biological evolution over time (e.g., geologic and fossil records, chemical mechanisms, DNA structural similarities, homologous and vestigial structures).

Indicator B: Identify the role of mutation and recombination in evolution.

Indicator C: Relate the nature of science to the historical development of the theory of evolution.

Indicator D: Distinguish between observations and inferences in making interpretations related to evolution (e.g., observed similarities and differences in the beaks of Galapagos finches leads to the inference that they evolved from a common ancestor; observed similarities and differences in the structures of birds and reptiles leads to the inference that birds evolved from reptiles).

Indicator E: Review a scientific article and identify the research methods used to gather evidence that documents the evolution of a species.

Objective 3: Classify organisms into a hierarchy of groups based on similarities that reflect their evolutionary relationships.

Indicator A: Classifyorganismsusingaclassificationtoolsuchasakeyorfieldguide.

Indicator B: Generalize criteria used for classification of organisms (e.g., dichotomy, structure, broad to specific).

Indicator C: Explainhowevolutionaryrelationshipsarerelatedtoclassificationsystems.

Indicator D: Justify the ongoing changes to classification schemes used in biology.

SCIENCE REPORT CARDS

Traditional high school report cards communicate very little about the specific academic achievements of students, commonly listing only the name of the course, a percent or letter grade, and sometimes a citizenship grade. It is the goal of Spectrum Academy faculty to report to parents/guardians the degree to which students have mastered educational objectives of each course. To this end, we plan to send home standards-based report cards.

SOURCES FOR GRADES

There will be several assignments/assessments each week. Students should not expect to be able to finish all assignments during class. Types of assignments/assessments will include: reading, vocabulary, reports and essays, hands-on labs, individual and group projects, presentations, quizzes, tests, etc.

CURRICULAR APPROACHES

The following are common approaches to education used at Spectrum Academy:

Inquiry-Based Learning: students investigate questions, scenarios, or problems in a hands-on style

Socratic Method: a form of inquiry and debate between participants based on asking and answering questions to stimulate critical thinking and to illuminate ideas

Outcome-Based Education: methods that focus on empirically measuring student performance

Autonomous Learning Opportunities: the student is given responsibility for learning, choosing which interests to pursue and what projects to complete

Coyote Teaching: avoidance of giving direct answers; instead, answer questions with questions with the goal in mind to inspire students to dig deeper into the lessons and search for embedded or concrete lessons

Lecture: oral presentation, accompanied by audio and visual aids to convey critical information, history, background, theories and questions