High School Science Curriculum Handbook of Expectations

EARTH SCIENCE

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 and 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.schools.utah.gov/CURR/science/Home/Earth-Science-Core-Standards-October-2012.aspx
http://www.nextgenscience.org/

POWER STANDARDS

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

- ✓ Evaluate evidence supporting theories about the origin of the universe and our solar system.
- ✓ Characterize planetary features that permit the existence of life.
- ✓ Identify, analyze, and explain major phenomena within Earth's evolving environments; including the cycling of matter and energy through the atmosphere, hydrosphere, geosphere, and biosphere.
- ✓ Describe the theorized relationship between planetary evolution and biological developments, citing relevant examples and evidences.
- ✓ Understand how Earth Science interacts with society.

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 the scientific evidence that supports theories that explain how the universe and the solar system developed. They will compare Earth to other objects in the solar system.

- **Objective 1:** Describe both the big bang theory of universe formation and the nebular theory of solar system formation and evidence supporting them.
  - **Indicator A:** Identify the scientific evidence for the age of the solar system (4.6 billion years), including Earth (e.g., radioactive decay).
  - **Indicator B:** Describe the big bang theory and the evidence that supports this theory (e.g., cosmic background radiation, abundance of elements, distance/redshift relation for galaxies).
  - **Indicator C:** Describe the nebular theory of solar system formation and the evidence supporting it (e.g., solar system structure due to gravity, motion and temperature; composition and age of meteorites; observations of newly forming stars).
  - **Indicator D:** Explain that heavy elements found on Earth are formed in stars.
  - **Indicator E:** Investigate and report how science has changed the accepted ideas regarding the nature of the universe throughout history.
  - **Indicator F:** Provide an example of how technology has helped scientists investigate the universe.
- **Objective 2:** Analyze Earth as part of the solar system, which is part of the Milky Way galaxy.
  - **Indicator A:** Relate the composition of objects in the solar system to their distance from the Sun.
  - **Indicator B:** Compare the size of the solar system to the Milky Way galaxy.
  - **Indicator C:** Compare the size and scale of objects within the solar system.
  - **Indicator D:** Evaluate the conditions that currently support life on Earth (biosphere) and compare them to the conditions that exist on other planets and moons in the solar system (e.g., atmosphere, hydrosphere, geosphere, amounts of incoming solar energy, habitable zone).

Standard 2: Students will understand Earth's internal structure and the dynamic nature of the tectonic plates that form its surface.

- **Objective 1:** Evaluate the source of Earth's internal heat and the evidence of Earth's internal structure.
  - **Indicator A:** Identify that radioactive decay and heat of formation are the sources of Earth's internal heat.

Indicator B: Trace the lines of scientific evidence (e.g., seismic studies, composition of meteorites, and samples of the crust and mantle) that led to the inference that Earth's core, mantle, and crust are separated based on composition.

Indicator C: Trace the lines of scientific evidence that led to the inference that Earth's lithosphere, asthenosphere, mesosphere, outer core, and inner core are separated based on physical properties.

Indicator D: Model how convection currents help distribute heat within the mantle.

Objective 2: Describe the development of the current theory of plate tectonics and the evidence that supports this theory.

Indicator A: Explain Alfred Wegener's continental drift hypothesis, his evidence (e.g., fossil record, ancient climates, geometric fit of continents), and why it was not accepted in his time.

Indicator B: Cite examples of how the geologic record preserves evidence of past change.

Indicator C: Establish the importance of the discovery of mid-ocean ridges, oceanic trenches, and magnetic striping of the sea floor to the development of the modern theory of plate tectonics.

Indicator D: Explain how mantle plumes (hot spots) provide evidence for the rate and direction of tectonic plate motion.

Indicator E: Organize and evaluate the evidence for the current theory of plate tectonics: sea floor spreading, age of sea floor, distribution of earthquakes and volcanoes.

Objective 3: Demonstrate how the motion of tectonic plates affects Earth and living things.

Indicator A: Describe a lithospheric plate and identify the major plates of the Earth.

Indicator B: Describe how earthquakes and volcanoes transfer energy from Earth's interior to the surface (e.g., seismic waves transfer mechanical energy, flowing magma transfers heat and mechanical energy).

Indicator C: Model the factors that cause tectonic plates to move (e.g., gravity, density, convection).

Indicator D: Model tectonic plate movement and compare the results of plate movement along convergent, divergent, and transform boundaries (e.g., mountain building, volcanoes, earthquakes, mid-ocean ridges, oceanic trenches).

Indicator E: Design, build, and test a model that investigates local geologic processes (e.g., mudslides, earthquakes, flooding, erosion) and the possible effects on human-engineered structures (e.g., dams, homes, bridges, roads).

Standard 3: Students will understand the atmospheric processes that support life and cause weather and climate.

Objective 1: Relate how energy from the Sun drives atmospheric processes and how atmospheric currents transport matter and transfer energy.

Indicator A: Compare and contrast the amount of energy coming from the Sun that is reflected, absorbed or scattered by the atmosphere, oceans, and land masses.

Indicator B: Construct a model that demonstrates how the greenhouse effect contributes to atmospheric energy.

Indicator C: Conduct an investigation on how the tilt of Earth's axis causes variations in the intensity and duration of sunlight striking Earth.

Indicator D: Explain how uneven heating of Earth's atmosphere at the equator and polar regions combined with the Coriolis effect create an atmospheric circulation system including, Hadley cells, trade winds, and prevailing westerlies, that moves heat energy around Earth.

Indicator E: Explain how the presence of ozone in the stratosphere is beneficial to life, while ozone in the troposphere is considered an air pollutant.

Objective 2: Describe elements of weather and the factors that cause them to vary from day to day.

Indicator A: Identify the elements of weather and the instruments used to measure them (e.g., temperature—thermometer; precipitation—rain gauge or Doppler radar; humidity—hygrometer; air pressure—barometer; wind—anemometer; cloud coverage—satellite imaging).

Indicator B: Describe conditions that give rise to severe weather phenomena (e.g., thunderstorms, tornados, hurricanes, El Niño/La Niña).

Indicator C: Explain a difference between a low pressure system and a high pressure system, including the weather associated with them.

Indicator D: Diagram and describe cold, warm, occluded, and stationary boundaries (weather fronts) between air masses.

Indicator E: Design and conduct a weather investigation, use an appropriate display of the data, and interpret the observations and data.

Objective 3: Examine the natural and human-caused processes that cause Earth's climate to change over intervals of time ranging from decades to millennia.

Indicator A: Explain differences between weather and climate and the methods used to investigate evidence for changes in climate (e.g., ice core sampling, tree rings, historical temperature measurements, changes in the extent of alpine glaciers, changes in the extent of Arctic sea ice).

Indicator B: Explain how Earth's climate has changed over time and describe the natural causes for these changes (e.g., Milankovitch cycles, solar fluctuations, plate tectonics).

Indicator C: Describe how human activity influences the carbon cycle and may contribute to climate change.

Indicator D: Explain the differences between air pollution and climate change and how these are related to society's use of fossil fuels.

Indicator E: Investigate the current and potential consequences of climate change (e.g., ocean acidification, sea level rise, desertification, habitat loss) on ecosystems, including human communities.

Standard 4: Students will understand the dynamics of the hydrosphere.

Objective 1: Characterize the water cycle in terms of its reservoirs, water movement among reservoirs and how water has been recycled throughout time.

Indicator A: Identify oceans, lakes, running water, frozen water, ground water, and atmospheric moisture as the reservoirs of Earth's water cycle, and graph or chart the relative amounts of water in each.

Indicator B: Describe how the processes of evaporation, condensation, precipitation, surface runoff, ground infiltration and transpiration contribute to the cycling of water through Earth's reservoirs.

Indicator C: Model the natural purification of water as it moves through the water cycle and compare natural purification to processes used in local sewage treatment plants.

Objective 2: Analyze the characteristics and importance of freshwater found on Earth's surface and its effect on living systems.

Indicator A: Investigate the properties of water: exists in all three states, dissolves many substances, exhibits adhesion and cohesion, density of solid vs. liquid water.

Indicator B: Plan and conduct an experiment to investigate biotic and abiotic factors that affect freshwater ecosystems.

Indicator C: Using data collected from local water systems, evaluate water quality and conclude how pollution can make water unavailable or unsuitable for life.

Indicator D: Research and report how communities manage water resources (e.g., distribution, shortages, quality, flood control) to address social, economic, and environmental concerns.

Objective 3: Analyze the physical, chemical, and biological dynamics of the oceans and the flow of energy through the oceans.

Indicator A: Research how the oceans formed from outgassing by volcanoes and ice from comets.

Indicator B: Investigate how salinity, temperature, and pressure at different depths and locations in oceans and lakes affect saltwater ecosystems.

Indicator C: Design and conduct an experiment comparing chemical properties (e.g., chemical composition, percent salinity) and physical properties (e.g., density, freezing point depression) of freshwater samples to saltwater samples from different sources.

Indicator D: Model energy flow in the physical dynamics of oceans (e.g., wave action, deep ocean tides circulation, surface currents, land and sea breezes, El Niño, upwellings).

Indicator D: Evaluate the impact of human activities (e.g., sediment, pollution, overfishing) on ocean systems.

Standard 5: Students will understand how Earth science interacts with society.

Objective 1: Characterize Earth as a changing and complex system of interacting spheres.

Indicator A: Illustrate how energy flows and matter cycles within Earth's biosphere, geosphere, atmosphere, and hydrosphere give rise to processes that shape Earth.

Indicator B: Explain how Earth's systems are dynamic and continually react to natural and human-caused changes.

Indicator C: Explain how technological advances lead to increased human knowledge (e.g., satellite imaging, deep sea ocean probes, seismic sensors, weather radar systems) and ability to predict how changes affect Earth's systems.

Indicator D: Design and conduct an experiment that investigates how Earth's biosphere, geosphere, atmosphere, or hydrosphere reacts to human-caused change.

Indicator E: Research and report on how scientists study feedback loops to inform the public about Earth's interacting systems.

Objective 2: Describe how humans depend on Earth's resources.

Indicator A: Investigate how Earth's resources (e.g., mineral resources, petroleum resources, alternative energy resources, water resources, soil and agricultural resources) are distributed across the state, the country, and the world.

Indicator B: Research and report on how human populations depend on Earth resources for sustenance and how changing conditions over time have affected these resources (e.g., water pollution, air pollution, increases in population).
Indicator C: Predict how resource development and use alters Earth systems (e.g., water reservoirs, alternative energy sources, wildlife preserves).
Indicator D: Describe the role of scientists in providing data that informs the discussion of Earth resource use.
Indicator E: Justify the claim that Earth science literacy can help the public make informed choices related to the extraction and use of natural resources.

Objective 3: Indicate how natural hazards pose risks to humans.
Indicator A: Identify and describe natural hazards that occur locally (e.g., wildfires, landslides, earthquakes, floods, drought) and globally (e.g., volcanoes, tsunamis, hurricanes).
Indicator B: Evaluate and give examples of human activities that can contribute to the frequency and intensity of some natural hazards (e.g., construction that may increase erosion, human causes of wildfires, climate change).
Indicator C: Document how scientists use technology to continually improve estimates of when and where natural hazards occur.
Indicator D: Investigate and report how social, economic, and environmental issues affect decisions about human-engineered structures (e.g., dams, homes, bridges, roads).

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