VALWOOD

GO BEYOND

Earth Systems Curriculum

Earth Systems Course Overview

Course Description	Topics at a Glance
This course provides the opportunity to develop knowledge and understanding about the relationships between the structure, processes, and resources on Earth and other solar bodies. Emphasis is placed on laboratory and field experiences. Units of study include Cosmology and Earth History, energy and forces in the Solar System, plate tectonics, climate processes, resources and the environment, physical and chemical changes in the geosphere, and natural hazards. This course is inquiry based and involves both independent and cooperative learning.	• Cosmology and Earth history • Energy and forces in the Solar System • Atmospheric processes • Changes in the geosphere • Natural hazards • Plate tectonics • Resources and the environment • Rocks and Minerals • History of Earth • Hydrology

Assessments

- Teacher-created assessments
- Assessments Adopted from Course Materials

Standard	Big Ideas In Earth Systems
3. Earth Systems Science	1. The history of the universe, Solar system and Earth can be inferred from evidence left from past events. 2. As part of the Solar System, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways. 3. The theory of plate tectonics helps explain geological, physical, and geographical features of Earth. 4. Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere. 5. There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources. 6. The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes. 7. Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms.

3. Earth Systems Science

Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.

Valwood Graduates:
The preschool through twelfth-grade concepts and skills that all students must master to ensure their success in a postsecondary and workforce setting.

Valwood Graduate Competencies in the Earth Systems Science standard:

- Describe and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet
- Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system
- Describe how humans are dependent on the diversity of resources provided by Earth and Sun

Content Area: Science - High School Earth, Space, Geophysical Science

Standard: 3. Earth Systems Science

Valwood Graduates:

Describe and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet

GRADE LEVEL EXPECTATION:

Concepts and skills students master:

1. The history of the universe, solar system and Earth can be inferred from evidence left from past events

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Create an evidence-based scientific explanation addressing questions about Earth's history b. Analyze and interpret data regarding Earth's history using direct and indirect evidence such as ice core and deep ocean core data c. Analyze and interpret data regarding the history of the universe using direct and indirect evidence such as spectrographic data and the Doppler shift in the electromagnetic spectrum d. Seek, evaluate, and use a variety of specialized resources available from libraries, the Internet, and the community to find scientific information on Earth's history e. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate the history of the universe, solar system and Earth	**Inquiry Questions:** 1. How do we know the age of Earth, Sun and universe? 2. How did the formation of Earth help shape its features today? 3. How can we interpret the geologic history of an area? **Relevance and Application:** 1. Geologic principles such as original horizontality, superposition, cross-cutting relationships, unconformities, and index fossils allow us to accurately interpret geologic history. 2. Employ data-collection technology such as geographic mapping systems and visualization tools to gather and analyze data and scientific information about Earth's history. **Nature of Discipline:** 1. Understand that all scientific knowledge is subject to new evidence and that the presence of reproducible results yields a scientific theory. 2. Critically evaluate scientific claims in popular media and by peers regarding Earth's history, and determine if evidence presented is appropriate and sufficient to support the claims.

Content Area: Science - High School Earth, Space, Geophysical Science

Standard: 3. Earth Systems Science

Valwood Graduates:

Describe and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet

GRADE LEVEL EXPECTATION:

Concepts and skills students master:

2. As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation addressing questions around the extraterrestrial forces and energies that influence Earth b. Analyze and interpret data regarding extraterrestrial forces and energies c. Clearly identify assumptions behind conclusions regarding extraterrestrial forces and energies and provide feedback on the validity of alternative explanations d. Use specific equipment, technology, and resources such as video libraries, image libraries, and computers to explore the universe, as well as GPS, GIS, and telescopes if available	**Inquiry Questions:** 1. What influences Earth's position in the universe? 2. How does Earth get its energy? 3. How does the electromagnetic spectrum positively and negatively impact Earth's systems? **Relevance and Application:** 1. Fusion is the most common source of energy in the universe, and it provides the basis of Earth's energy through fusion reactions in the Sun. 2. Different types of telescopes have given us data about the universe, galaxy, and Solar System. **Nature of Discipline:** 1. Understand the physical laws that govern Earth are the same physical laws that govern the rest of the universe. 2. Critically evaluate strengths and weaknesses of a model which represents complex natural phenomena.

Content Area: Science - High School Earth, Space, Geophysical Science

Standard: 3. Earth Systems Science

Valwood Graduates:

Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system

GRADE LEVEL EXPECTATION:

Concepts and skills students master:

3. The theory of plate tectonics helps explain geological, physical, and geographical features of Earth

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation about the theory of plate tectonics and how it can be used to understand geological, physical, and geographical features of Earth b. Analyze and interpret data on plate tectonics and the geological, physical, and geographical features of Earth c. Understand the role plate tectonics has had with respect to long-term global changes in Earth's systems such as continental buildup, glaciations, sea-level fluctuations, and climate change d. Investigate and explain how new conceptual interpretations of data and innovative geophysical technologies, such as paleomagnetic reversals, led to the current theory of plate tectonics	**Inquiry Questions:** 1. How do the different types of plate boundaries create different landforms on Earth? 2. How have scientists "discovered" the layers of Earth? 3. What drives plate motion? 4. What might happen to Earth's landforms in the future? **Relevance and Application:** 1. New conceptual interpretations of data and innovative geophysical technologies led to the current theory of plate tectonics. **Nature of Discipline:** 1. Understand that all scientific knowledge is subject to new findings and that the presence of reproducible results yields a scientific theory. 2. Ask testable questions and make a falsifiable hypothesis about plate tectonics and design a method to find an answer. 3. Share experimental data, and respectfully discuss conflicting results. 4. Recognize that the current understanding of plate tectonics has developed over time and become more sophisticated as new technologies have led to new evidence.

Content Area: Science - High School Earth, Space, Geophysical Science

Standard: 3. Earth Systems Science

Valwood Graduates:

Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system

GRADE LEVEL EXPECTATION:

Concepts and skills students master:

4. Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation that shows climate is a result of energy transfer among the atmosphere, hydrosphere, geosphere and biosphere b. Analyze and interpret data on Earth's climate c. Explain how a combination of factors such as Earth's tilt, seasons, geophysical location, proximity to oceans, landmass location, latitude, and elevation determine a location's climate d. Identify mechanisms in the past and present that have changed Earth's climate e. Analyze the evidence and assumptions regarding climate change f. Interpret evidence from weather stations, buoys, satellites, radars, ice and ocean sediment cores, tree rings, cave deposits, indigenous knowledge, and other sources in relation to climate change	**Inquiry Questions:** 1. How can changes in the ocean create climate change? 2. How is climate influenced by changes in Earth's energy balance? 3. How have climates changed over Earth's history? 4. How does climate change impact all of Earth's systems? 5. How have climate changes impacted human society? **Relevance and Application:** 1. Much of the data we receive about the ocean and the atmosphere are from satellites. 2. Human actions such as burning fossil fuels might impact Earth's climate. 3. Technological solutions and personal choices such as driving higher mileage cars and using less electricity could reduce the human impact on climate. **Nature of Discipline:** 1. Understand how observations, experiments, and theory are used to construct and refine computer models. 2. Examine how computer models are used in predicting the impacts of climate change. 3. Critically evaluate scientific claims in popular media and by peers regarding climate and climate change, and determine if the evidence presented is appropriate and sufficient to support the claims.

Content Area: Science - High School Earth, Space, Geophysical Science

Standard: 3. Earth Systems Science

Valwood Graduates:

Describe how humans are dependent on the diversity of resources provided by Earth and Sun

GRADE LEVEL EXPECTATION:

Concepts and skills students master:

5. There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation regarding the costs and benefits of exploration, development, and consumption of renewable and nonrenewable resources b. Evaluate positive and negative impacts on the geosphere, atmosphere, hydrosphere, and biosphere in regards to resource use c. Create a plan to reduce environmental impacts due to resource consumption d. Analyze and interpret data about the effect of resource consumption and development on resource reserves to draw conclusions about sustainable use e. Evaluate the relative merit of alternative energy options as a means of finding sustainable non-polluting energy	**Inquiry Questions:** 1. How do humans use resources? 2. How can humans reduce the impact of resource use? 3. How are resources used in our community? 4. What are the advantages and disadvantages of using different types of energy? **Relevance and Application:** 1. Technologies have had a variety of impacts on how resources are located, extracted, and consumed. 2. Technology development has reduced the pollution, waste, and ecosystem degradation caused by extraction and use. **Nature of Discipline:** 1. Infer assumptions behind emotional, political, and data-driven conclusions about renewable and nonrenewable resource use. 2. Critically evaluate scientific claims in popular media and by peers, and determine if evidence presented is appropriate and sufficient to support the claims.

Content Area: Science - High School Earth, Space, Geophysical Science

Standard: 3. Earth Systems Science

Valwood Graduates:

Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system

GRADE LEVEL EXPECTATION:

Concepts and skills students master:

6. The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation addressing questions regarding the interaction of Earth's surface with water, air, gravity, and biological activity b. Analyze and interpret data, maps, and models concerning the direct and indirect evidence produced by physical and chemical changes that water, air, gravity, and biological activity create c. Evaluate negative and positive consequences of physical and chemical changes on the geosphere d. Use remote sensing and geographic information systems (GIS) data to interpret landforms and landform impact on human activity	**Inquiry Questions:** 1. How do Earth's systems interact to create new landforms? 2. How do the biogeochemical cycles which make up the nitrogen, oxygen, water vapor and tectonic cycles affect life on Earth? 3. How does the existence of chemosynthetic life around hydrothermal vents on the ocean floor affect our understanding of the interaction between Earth's geosphere and biosphere? 4. What are positive changes on Earth's geosphere due to water, air, gravity, and biological activity? *5.* What are negative changes on Earth's geosphere due to water, air, gravity, and biological activity?
	Relevance and Application: 1. Geologic, physical, and topographic maps can be used to interpret surface features. 2. Recognize that landform models help us understand the interaction among Earth's systems. 3. Human activities such as agricultural practices have impacts.
	Nature of Discipline: 1. Ask testable questions and make a falsifiable hypothesis about physical and chemical changes on the geosphere and use an inquiry based approach to find an answer. 2. Share experimental data, and respectfully discuss conflicting results. 3. Use appropriate technology to help gather and analyze data, find background information, and communicate scientific information on physical and chemical changes.

Content Area: Science - High School Earth, Space, Geophysical Science

Standard: 3. Earth Systems Science

Valwood Graduates:

Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system

GRADE LEVEL EXPECTATION

Concepts and skills students master:

7. Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Develop, communicate, and justify an evidence-based scientific explanation regarding natural hazards, and explain their potential local and global impacts b. Analyze and interpret data about natural hazards using direct and indirect evidence such as seismic energy travel times to triangulate the relative positions of earthquake epicenters c. Make predictions and draw conclusions about the impact of natural hazards on human activity – locally and globally	**Inquiry Questions:** 1. Why are some natural hazards difficult to predict, while others are easier to predict? 2. How are humans impacted by natural hazards? 3. How can we prepare for natural hazards? 4. How is climate change expected to change the incidence of natural hazards?
	Relevance and Application: 1. Engineers must know the hazards of a local area and design for it in ways such as building safe structures in zones prone to earthquakes, hurricanes, tsunamis, or tornadoes. 2. Differing technologies are used to study different types of natural hazards. 3. Natural hazard zones affect construction or explain why monitoring natural hazards through air traffic safety, evacuations, and protecting property is important. 4. Science is used by disaster planners who work with the scientific community to develop diverse ways to mitigate the impacts of natural hazards on the human population and on a given ecosystem.
	Nature of Discipline: 1. Scientists collaborate with local, national, and global organizations to report and review natural disaster data, and compare their conclusions to alternate explanations.