SCIENCE
RHINEBECK PRIORITIZED CURRICULUM
Earth Science
The Physical Setting

Standard 4:	**Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.**
Key Idea 1:	**The Earth and celestial phenomena can be described by principles of relative motion and perspective.**

Background:

People have observed the stars for thousands of years, using them to find direction, to note the passage of time, and to express their values and traditions. As our technology has progressed, so has understanding of celestial objects and events.

Theories of the universe have developed over many centuries. Although to a casual observer celestial bodies appeared to orbit a stationary Earth, scientific discoveries, led us to the understanding that Earth is one planet that orbits the Sun, a typical star in a vast and ancient universe. We now infer an origin and an age and evolution of the universe, as we speculate about its future.

As we look at Earth, we find clues to its origin and how it has changed through nearly five billion years, as well as the evolution of life on Earth.

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Standard 4: Key Idea 1: Performance Indicator 1.1: Explain complex phenomena, such as tides, variations in day lengths, solar insulation, apparent motion of the planets, and annual traverse of the constellations.					
Essential Knowledge/Skills (Major Understandings)	***Priority Code***	***Essential Questions***	***Classroom Ideas***	***Assessment Ideas***	***Time/Notes***
UNIT ONE 1.1c Earth's coordinate system of latitude and longitude, with the equator and prime meridian as reference lines, is based upon Earth's rotation and our observation of the Sun and stars 1.1d Earth rotates on an imaginary axis at a rate of 15 degrees per hour. To people on Earth, this turning of the planet makes it seem as though the Sun, the moon, and the stars are moving around Earth once a day. Rotation provides a basis for our system of local time; meridians of longitude are the basis for time zones. 2.1q Topographic maps represent landforms through the use of contour lines that are isolines connecting points of equal elevation. Gradients and profiles can be determined from changes in elevation over a given distance. Earth's "spheres": - Atmosphere - Lithosphere - Hydrosphere Earth's shape: - Oblate - Spheroid	 E E E E	▪ Besides a road map, what other types of maps are there? ▪ What is the purpose of these maps? ▪ How do we locate specific points of interest on a map? ▪ When viewed from space, which sphere is most visible? ▪ What is the relationship between the Earth's rotation and time zones?	▪ Use maps from simple to topographic to practice identifying locations using latitude and longitide ▪ Use a markable globe to pose the question, "How can we describe a position?" then continue with a discussion of various student suggestions on ways to describe the position. Give a brief history of the development of the latitude and longitude development. ▪ Give the students a list of major cities in New York State. Using the *Earth Science Reference Tables*, have them identify the latitude and longitude. ▪ Measure the altitude of Polaris at home with a homemade astrolobe ▪ Students need to know how to read and interpret the isolines on a field map. They should understand the rules for drawing isolines, how to interpret spacing, and how to calculate gradient or rate of change from a field map. Find examples of field maps to be used to make transparencies and handouts. ▪ Have students search the Internet for examples of various field maps and construct questions for the field maps they found. These will be shared with other students to gain experience reading various field maps.	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student- developed rubrics for performance tasks or projects ▪ Lab rubric ▪ Quick quiz ▪ Start question ▪ Homework checks ▪ Lab reports	

Standard 4: Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.
Key Idea 3: Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.
Background: **Observation and classification have helped us understand the great variety and complexity of Earth materials. Minerals are the naturally occurring inorganic solid elements, compounds, and mixtures from which rocks are made. We classify minerals on the basis of their chemical composition and observable properties. Rocks are generally classified by their origin (igneous, metamorphic, and sedimentary), texture, and mineral content.** **Rocks and minerals help us understand Earth's historical development and its dynamics. They are important to us because of their availability and properties. The use and distributi8on of mineral resources and fossil fuels have important economic and environmental impacts. As limited resources, they must be used wisely.**

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Standard 4: Key Idea 3: Performance Indicator 3.1: Explain the properties of materials in terms of the arrangement and properties of the atoms that compose them.

Essential Knowledge/Skills (Major Understandings)	*Priority Code*	*Essential Questions*	*Classroom Ideas*	*Assessment Ideas*	*Time/ Notes*
UNIT TWO 3.1a Minerals have physical properties determined by their chemical composition and crystal structure. - minerals can be identified by well-defined physical and chemical properties, such as cleavage, fracture, color, density, hardness, streak, luster, crystal shape, and reaction with acid. - chemical composition and physical properties determine how some minerals are used by humans. 3.1b Minerals are formed inorganically by the process of crystallization as a result of specific environmental conditions. These include: - cooling and solidification of magma. - precipitation from water caused by such processes as evaporation, chemical reactions, and temperature changes - rearrangement of atoms in existing minerals subjected to conditions of high temperature and pressure 3.1c Rocks are usually composed of one or more minerals. - rocks are classified by their, origin, mineral content and texture. - conditions that existed when a rock formed can be inferred from the rocks mineral composition and texture. - the properties of rocks determine how they are used and also influence land usage by humans. 7.1 Conservation of resources fossil fuels and non-renewable resources. Reduce, reuse, recycle, reclaim	E E E I	▪ How are minerals used? ▪ Under what conditions will minerals form? ▪ How can you distinguish between rocks and minerals? ▪ What can be done to assure we have enough energy?	▪ **Describe the relationship between atomic structure and mineral properties.** ▪ **Use posters, diagrams and mineral sample kits to show the diversity of minerals.** ▪ **Provide mineral samples, reference tables, streak plate, hardness kit, etc., and have students identify minerals based on their observed characteristics.** ▪ **Provide minerals and racks, reference tables, microscopes or hand lens and have students observe minerals previously studied in the rocks.** ▪ **Have students identify the rock by utilizing reference tables.** ▪ **Have students utilize various media sources to prepare a report on Earth's resources.**	▪ Teacher observations ▪ Student responses/demonstrations ▪ Journal entries ▪ Teacher-developed and student-developed rubrics for performance tasks or projects ▪ Lab rubric	

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Standard 4: **Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.**

Key Idea 2: Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

Background:

Earth may be considered a huge machine driven by two engines, one internal and one external. These heat engines convert heat energy into mechanical energy.

Earth's external heat engine is powered primarily by solar energy and influenced gravity. Nearly all the energy for circulating the atmosphere and oceans is supplied by the Sun. As insolation strikes the atmosphere, a small percentage is directly absorbed, especially by gases such as ozone, carbon dioxide, and water vapor. Clouds and Earth's surface reflect some energy back to space, and Earth's surface absorbs some energy. Energy is transferred between Earth's surface and the atmosphere by radiation, conduction, evaporation, and convection. Temperature variations within the atmosphere cause differences in density that cause atmospheric Circulation, which is affected by Earth's rotation. The interaction of these processes results in the complex atmospheric occurrence known as weather.

Average temperatures on Earth are the result of the total amount of insolation absorbed by Earth's surface and its atmosphere and the amount of long-wave energy radiated back into space. However, throughout geologic time, ice ages occurred in the middle latitudes. In addition, average temperatures may have been significantly warmer at times in the geologic past. This suggests that Earth had climate changes that were most likely associated with long periods of imbalances of its heat budget.

Earth's internal heat engine is powered by heat from the decay of radioactive materials and residual heat from Earth's formation. Differences in density resulting from heat flow within Earth's interior caused the changes explained by the theory of plate tectonics: movement of the lithospheric plates; earthquakes; volcanoes; and the deformation and metamorphism of rocks during the formation of young mountains.

Precipitation resulting from the external heat engine's weather systems supplies moisture to Earth's surface that contributes to the weathering of rocks. Running water erodes mountains that were originally uplifted by Earth's internal heat engine and transports sediments to other locations where they are deposited and may undergo the processes that transform them into sedimentary rocks.

Global climate is determined by the interaction of solar energy with Earth's surface and atmosphere. This energy transfer is influenced by dynamic processes such as cloud cover and Earth rotation, and the positions of mountain ranges and oceans.

Guiding Questions:

What are the various forces that energize Earth processes?
How does technology help us to monitor Earth's processes?
How is the Sun responsible for weather conditions on Earth?
How does the transfer of energy cause weather changes on Earth?
How are weathering and erosion related to the hydrologic cycle?
How is the climate of a location on Earth determined?
What are the various destructive forces that can alter the Earth's surface?

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Standard 4: Key Idea 2: Performance Indicator 2.1: Use the concepts of density and heat energy to explain observations of weather patterns, seasonal changes, and the movements of Earth's plates.

Essential Knowledge/Skills (Major Understandings)	*Priority Code*	*Essential Questions*	*Classroom Ideas*	*Assessment Ideas*	*Time/ Notes*
UNIT THREE 2.1j Properties of Earth's internal structure (crust, mantle, inner core, and outer core) can be inferred from the analysis of the behavior of seismic waves (including velocity and refraction). Analysis of seismic waves allows the determination of the location of earthquake epicenters, and the measurement of earthquake intensity; this analysis leads to the inference that Earth's interior is composed of layers that differ in composition and states of matter. 2.1k The outward transfer of Earth's internal heat drives convective circulation in the mantle that moves the lithospheric plates comprising Earth's surface. 2.1l The lithosphere consists separate plates that ride on the more fluid asthenosphere and move slowly in relationship to one another, creating convergent, divergent, and transform plate boundaries. These motions indicate Earth is a dynamic geologic system. These plate boundaries are the sites of most earthquakes, volcanoes, and young mountain ranges. Compared to continental crust, ocean crust is thinner and denser. New ocean crust continues to form at mid-ocean ridges. Earthquakes and volcanoes present geologic hazards to humans. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness	 E E E	▪ What have we learned about the Earth from studying earthquakes? ▪ What is the driving force supporting the concept of plate tectonics? ▪ What can humans do to reduce damage inflicted by earthquakes and volcanoes?	▪ Use posters, charts, diagrams or video programming to show the inferred structure of the Earth's. ▪ Use the inferred properties of the Earth located in the *Earth Science Reference Tables* as a teaching aid. ▪ Have students find the density of a small lump of clay using a balance and the water displacement method for finding volume. Cut the sample into 2 pieces and calculate the density of each piece. Graph the class results on an overhead transparency. Students summarize the results. ▪ Develop the concept of deductive reasoning to form a hypothesis or make inferences. ▪ Describe convection in terms of the mantle and the effect these convection currents have on moving lithospheric plates. ▪ Teach the students about the structure of the lithosphere, the composition of the crust and the relationship of young mountains, earthquakes and volcanic activity to the location of active plate margins. ▪ Using a local topographical map, superimpose a "new" volcano using an overhead transparency. Students have to develop an evacuaton plan in the event of and impending eruption and predict ash fall and lava floods based on the prevailing winds and local terrain.	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student- developed rubrics for performance tasks or projects	

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Standard 4: Key Idea 2: Performance Indicator 2.1: Use the concepts of density and heat energy to explain observations of weather patterns, seasonal changes, and the movements of Earth's plates.

Essential Knowledge/Skills (Major Understandings)	*Priority Code*	*Essential Questions*	*Classroom Ideas*	*Assessment Ideas*	*Time/Notes*
UNIT THREE 2.1m Many processes of the rock cycle are consequence of plate dynamics. These include the production of magma (and subsequent igneous rock formation and contact metamorphism) at both subduction and rifting regions, regional metamorphism within subduction zones and the creation of major depositional basins through down-warping of the crust. 2.1n Many of Earth's surface features such as mid-ocean ridges/ rifts, trenches/ subduction zones/ island arcs, mountain ranges (folded, faulted, and volcanic), hot spots, and the magnetic and age patterns in surface bedrock are a consequence of forces associated with plate motion and interaction. 2.1o Plate motions have resulted in global changes in geography, climate, and the patterns of organic Deformed rock strata- Sedimentary rocks appear to form in horizontal layers. However observations indicate that rocks have changed from their original formation.	 E E E I	▪ What role(e) does plate tectonics play in the rock cycles? ▪ How have the motions of lithosphere plates affected life on earth?	▪ Show models or charts including the *Earth Science Reference Tables* of the different types of plate boundaries. Make connections between convergent and divergent boundaries with the various surface features associated with them. ▪ Students diagram and label the various types of plate margins. ▪ Use the "Planet Earth Series" produced by the Annenburg Project and PBS. ▪ Present students with a series of diagrams with the final diagram left out. Based on the sequence of diagrams given, the students will make a prediction regarding the final frame of the sequence. ▪ Demonstrate: Tilting, folding, faulting, displacement, uplift and subsidence with layers of multicolored clay, multicolored foam.	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student-developed rubrics for performance tasks or projects ▪ Lab rubric	

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Essential Knowledge/Skills (Major Understandings)	*Priority Code*	*Essential Questions*	*Classroom Ideas*	*Assessment Ideas*	*Time/ Notes*
UNIT FOUR 2.1p Landforms are the result of the interaction of tectonic forces and the processes of weathering, erosion, and deposition. 2.1r Climate variations, structure, and characteristics of bedrock influence the development of landscape features including mountains, plateaus, plains, valleys, ridges, escarpments, and stream drainage patterns. 2.1s Weathering is the physical and chemical breakdown of rocks at or near Earth's surface. Soils are the result of weathering and biological activity over long periods of time. 2.1t Natural agents of erosion, generally driven by gravity, remove, transport and deposit weathered rock particles. Each agent of erosion produces distinctive changes in the material that it transports and creates characteristic surface features and landscapes. In certain erosional situations, loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.	 E E E E	▪ How have humans affected the landscape? ▪ What forces are at work which shape earth's landforms?	▪ Show examples of rocks that have been subjected to various agents of erosion. ▪ Set out a dozen samples of different rocks outside in the elements where they will not be disturbed for several months. Have students record observations of the rocks at one week or one month intervals. ▪ Provide students with soil sample bags to do a representative study of the different soils found in the school district. ▪ Have students sketch and label a series of diagrams showing how a soil profile matures. ▪ Use laser disc images of various landforms created by the action of weathering and erosion. ▪ Show a series of diagrams that illustrate the stages of stream development. ▪ Using local stream and flood stage data have students prepare an evacuation route and procedures in the event of the 5-year, 50-year and 100-year flood stage. ▪ Obtain and display photos of real streams from your school districts locale. Research their history. ▪ Prepare samples of topsoil and water for the microscope to observe soil microorganisms. ▪ Demonstrate glacial flow using a mixture of snow and gravel. Place the mixture at the top of a cleaned stream table. As the snow melts a region of outwash will develop at the lower end of the table and a region of till will be located at the upper end. ▪ Have students identify specific glacial features from photos, charts and diagrams. ▪ Students create a concept map for glaciers contrasting and comparing the features associated with continental vs. valley glaciers.	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student- developed rubrics for performance tasks or projects ▪ Lab rubric	

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Essential Knowledge/Skills (Major Understandings)	*Priority Code*	*Essential Questions*	*Classroom Ideas*	*Assessment Ideas*	*Time/ Notes*
UNIT FOUR 2.1u The natural agents of erosion include: - *Streams (running water):* Gradient, discharge, and channel shape influence a stream's velocity and the erosion and deposition of sediments. Sediments transported by streams tend to become rounded as a result of abrasion. Stream features include v-shaped valleys, deltas, flood plains, and meanders. A watershed is the area drained by a stream and its tributaries. - *Glaciers (moving ice):* Glacial erosional processes include the formation of u-shaped valleys, parallel scratches, and grooves in bedrock. Glacial features include moraines, drumlins, kettle lakes, finger-lakes, and outwash plains. - *Wave Action:* Erosion and deposition cause changes in shoreline features, including beaches, sandbars, and barrier islands. Wave action rounds sediments as a shore within the zone of breaking waves. - *Wind:* erosion of sediments by wind is most common in arid climates and along shorelines. Wind-generated features include dunes and sandblasted bedrock. - *Mass Movement:* Earth materials move down slope under the influence of gravity. 2.1v Patterns of deposition result from a loss of energy within the transporting system and are influenced by the size, shape, and density of the transported particles. Sediment deposits may be sorted or unsorted. 2.1w Sediments of inorganic and organic origin often accumulate in depositional environments. Sedimentary rocks form when sediments are compacted and/or cemented after burial or as the result of chemical precipitation from seawater.	E E E	▪ What role does climate play in determining the type of erosion present? ▪ Why do erosion agents deposit sediment?	▪ See "Classroom Ideas" for 2.1p through 2.1t ▪ Landsmankill Lab Activity- walk to mini-park. Point out to students and have them observe first hand stream erosion and deposition features. .	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student-developed rubrics for performance tasks or projects ▪ Lab rubric	

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UNIT FOUR Landscape regions of New York State. Due to a large number of bedrock variations NYS has many distinctive landscape regions Glacial history in New York State Landscape Development - time's affect - human's affect - positive and negative Consider: - Technology - Agriculture - High population	I	▪ What factors have influenced New York State's varied landscape regions? ▪ What effect have glaciers had on New York State economy and geography?	▪ Describe the geologic history of New York State and how it influences New York State's various landscape regions. ▪ Have students draw boundaries and label landscape regions of New York State on a map. ▪ Have students create a model of New York State landscape features. ▪ Describe the various factors which play a role in landscape development. ▪ Have students infer how a landscape may change given a list of various conditions such as climate type, technology, tectonic activity, etc.	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student-developed rubrics for performance tasks or projects ▪ Lab rubric	

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Background:

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Theories of the universe have developed over many centuries. Although to a casual observer celestial bodies appeared to orbit a stationary Earth, scientific discoveries Led us to the understanding that Earth is one planet that orbits the Sun, a typical star in a vast and ancient universe. We now infer an origin and an age and evolution of the universe, as we speculate about its future.

As we look at Earth, we find clues to its origin and how it has changed through nearly five billion years, as well as the evolution of life on Earth.

Guiding Questions:

How can we explain the real motions of celestial objects?
How can we describe the position of the Earth in the Cosmos?
What are the similarities and differences between objects found in the Cosmos?
How can we prove the Earth rotates and revolves?
How is the Earth influenced directly of indirectly by other members of the Cosmos?
How was our universe formed?
How did our planet form?
How can the future of Earth be affected by events occurring in the Cosmos?
How can fossil evidence and geologic structures help us to understand changes that have occurred in Earth's history?

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Standard 4: Key Idea 1: Performance Indicator 1.2: Describe current theories about the origin of the universe and solar system.					
Essential Knowledge/Skills (Major Understandings)	***Priority Code***	***Essential Questions***	***Classroom Ideas***	***Assessment Ideas***	***Time/ Notes***
UNIT FIVE 1.2j Geologic history can be reconstructed by observing sequences of rock types and fossils to correlate bedrock at various locations. - The characteristics of rocks indicate the processes by which they formed and the environments in which these processes took place. - Fossils preserved in rocks provide information about past environmental conditions. - Geologists have divided Earth history into time units based upon the fossil record. - Age relationships among bodies of rocks can be determined using principles of original horizontally, superposition, inclusion, cross-cutting relationships, contact metamorphism, and unconformity. The presence of volcanic ash layers, index fossils, and meteoritic debris can provide additional information. - The regular rate of nuclear decay (half-life time period) of radioactive isotopes allows geologists to determine the absolute age of minerals found in some rocks.	E	▪ How does geology support the theory of evolution? ▪ What can rocks and geologic structures explain about Earth's history? ▪ How have fossils been used to interpret geologic history? ▪ Of what use are radioactive elements in understanding Earth's history?	▪ Show students how rock formations are symbolized in diagrams. Demonstrate with a "think aloud" how the diagrams can be interpreted to give the history of an area. Have students work with partners to do the same. ▪ Make or show 3-dimensional models of rock formations. These can be used to further practice the rules of interpretation. ▪ Radioactive isotopes are also used to determine the absolute age of rock formations or organic artifacts. Develop a model to demonstrate the concept of half-life and radioactive decay. *Example:* bring in 100 pennies. Shake the pennies on to the table and remove the heads. Continue to shake and remove until all the pennies have "decayed". Students can graph the results. Use the graph to continue ▪ Lead a discussion of other isotopes with half-lives of different lengths. ▪ Investigation 48	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student-developed rubrics for performance tasks or projects ▪ Lab rubric	

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Standard 4: Key Idea 1: Performance Indicator 1.2: Describe current theories about the origin of the universe and solar system.

Essential Knowledge/Skills (Major Understandings)	*Priority Code*	*Essential Questions*	*Classroom Ideas*	*Assessment Ideas*	*Time/ Notes*
UNIT FIVE 1.2e Earth's early atmosphere formed as a result of the out-gassing of water vapor, carbon dioxide, nitrogen, and lesser amounts of other gases from its interior.	E	▪ What relationship do volcanoes have to the first life on Earth? ▪ How does geology support the theory of evolution?	▪ Use a sponge filled with water to represent a rock. Squeeze the sponge to describe de-watering. ▪ Students can gently heat copper II sulfate crystals in a test tube to observe the formation of water droplets on the walls of the test tube. ▪ Describe in general terms the process of photosynthesis. Emphasize the production of oxygen and consumption of carbon dioxide. Also include the form and function of guard cells as related to transpiration. ▪ Students search the Internet for articles regarding the atmosphere and write abstracts. ▪ Pass around fossil samples representative of the different geologic periods. ▪ Put up a scale of geologic time. Have students identify what they think are the more significant events and defend their decisions. ▪ Introduce the concept of an index fossil showing examples of fossils that represent specific geologic time periods. ▪ Students use the *Earth Science Reference Tables* to answer questions about the geologic history of New York State	▪ Teacher observations ▪ Student responses/demonstrations ▪ Journal entries ▪ Teacher-developed and student- developed rubrics for performance tasks or projects ▪ Lab rubric	
1.2f Earth's oceans formed as a result of precipitation over millions of years. The presence of an early ocean is indicated by sedimentary rocks of marine origin, dating back about four billion years.	E				
1.2h The evolution of life caused dramatic changes in the composition of Earth's atmosphere. Free oxygen did not form in the atmosphere until oxygen-producing organisms evolved	E				
1.2i The pattern of evolution of life forms on Earth is at least partially preserved in the rock record. - Fossil evidence indicates that a wide variety of life forms have existed in the past and that most of these forms have become extinct - Human existence has been very brief compared to the expanse of geologic time	E				
Plate motions have resulted in global changes in the patterns of organic evolution	I				

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Guiding Questions:

What are the various forces that energize Earth processes?
How does technology help us to monitor Earth's processes?
How is the Sun responsible for weather conditions on Earth?
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UNIT SIX 2.1a Earth systems have internal and external sources of energy, both of which create heat. 2.1b The transfer of heat energy within the atmosphere, the hydrosphere, and Earth's interior results in the formation of regions of different densities. These density differences result in motion. 2.2b The transfer of heat energy within the atmosphere, the hydrosphere, and Earth's surface occurs as the result of radiation, convection, and conduction. Heating of Earth's surface and atmosphere by the Sun drives convection within the atmosphere and oceans, producing winds and ocean currents. 2.1c Weather patterns become evident when weather variables are observed, measured, and recorded. These variables include air temperature, air pressure, moisture (relative humidity and dew point), precipitation (rain, snow, hail, sleet, etc.), wind speed and direction, and cloud cover. 2.1d Weather variables are measured using instruments such as thermometers, barometers, psychrometers, precipitation gauges, anemometers, and wind vanes.	 E E E E E	▪ How is energy moved in the lithosphere, hydrosphere and atmosphere? ▪ What are the energy sources for the Earth? ▪ What is the distinction between climate and weather? ▪ How are weather variables interrelated?	▪ Describe the structure and process of the sun to generate electromagnetic energy. ▪ Set up a solar collector in lab and have students use the collector to measure temperature change vs. time. ▪ Have students use the magnifiers to concentrate the sun's energy. ▪ Demonstrate convection. ▪ Set up a chimney box to show convection in air. ▪ Show the basic weather instruments. Describe how they are used and the type of data we obtain using them. ▪ Show students how to get weather off the Internet. ▪ Guide students in how to watch and interpret weather forecasters on television. ▪ Form teams of 2–4 to make long term weather observations. Have students prepare a short weather report for the school announcements or school newspaper. ▪ Do an Internet search on S'Cool. Basically this is a cloud research project out of Langley. Satellites are orbiting Earth that record cloud cover. Students make ground observations of clouds coordinated with the over flight of a satellite. Student's observations are sent to Langley to help the researchers make better interpretations of the satellite images.	▪ Teacher observations ▪ Student responses/demonstrations ▪ Journal entries ▪ Teacher-developed and student-developed rubrics for performance tasks or projects ▪ Lab rubric	

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Standard 4: Key Idea 2: Performance Indicator 2.1: Use the concepts of density and heat energy to explain observations of weather patterns, seasonal changes, and the movements of Earth's plates.					
Essential Knowledge/Skills (Major Understandings)	***Priority Code***	***Essential Questions***	***Classroom Ideas***	***Assessment Ideas***	***Time/ Notes***
UNIT SIX 2.1e Weather variables are interrelated. For example: - Temperature and humidity affect air pressure and probability of precipitation. - Air pressure gradient controls wind velocity 2.1f Air Temperature, dew point, cloud formation, and precipitation, are affected by the expansion and contraction of air due to vertical atmospheric movement. 2.1g Weather variables can be represented in a variety of formats including radar and satellite images, weather maps (including station models, isobars, and fronts), atmospheric cross-sections, and computer models. 2.1h Atmospheric moisture, temperature and pressure distributions; jet streams, wind; air masses and frontal boundaries; and the movement of cyclonic systems and associated tornadoes, thunderstorms, and hurricanes occur in observable patterns. Loss of property, personal injury, and loss of life can be reduced by effective emergency procedures. 2.1i Seasonal changes can be explained using concepts of density and heat energy. These changes include the shifting of global temperature zones, the shifting of planetary wind and ocean current patterns, the occurrence of monsoons, hurricanes, and flooding, severe weather.	 E E E E E	▪ What are the various ways that weather data are depicted? ▪ How do humans prepare themselves for destructive weather? ▪ How do seasonal changes impact weather?	▪ Students locate a weather site on the Internet and evaluate the site as to what it contains and general usefulness. Bookmark the best sites. ▪ Students need to know how to read and interpret the isolines on a field map. They should understand the rules for drawing isolines, how to interpret spacing, and how to calculate gradient or rate of change from a field map. Find examples of field maps to be used to make transparencies and handouts. ▪ Have students search the Internet for examples of various field maps and construct questions for the field maps they found. These will be shared with other students to gain experience reading various field maps. ▪ Students select one example of violent or extraordinary weather to research and prepare a report for classmates. Students complete graphic organizers on the information shared by others about types of extraordinary weather.	▪ Teacher observations ▪ Student responses/demonstrations ▪ Journal entries ▪ Teacher-developed and student-developed rubrics for performance tasks or projects	

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Standard 4: Key Idea 2: Performance Indicator 2.2: Explain how incoming solar radiation, ocean currents, and land masses affect weather and climate.					
Essential Knowledge/Skills (Major Understandings)	***Priority Code***	***Essential Questions***	***Classroom Ideas***	***Assessment Ideas***	***Time/ Notes***
UNIT SEVEN 2.2a Insolation (incoming solar radiation) heats Earth's surface and atmosphere unequally due to variations in: - The intensity caused by differences in atmospheric transparency and angel of incidence, which vary with time of day, latitude and season. - Characteristics of the materials absorbing the energy such as color, texture, transparency, state of matter, and specific heat. - Duration, which varies with seasons and latitude 2.2c A location's climate is influenced by latitude, proximity to large bodies of water, ocean currents, prevailing winds, vegetative cover, elevation, and mountain ranges. 2.2d Temperature and precipitation patterns are altered by natural events such as El Nino and volcanic eruptions and human influences including deforestation, urbanization, and the production of greenhouse gases such as carbon dioxide and methane. 1.1f Earth's changing position with regard to the Sun and the Moon has noticeable effects: - Earth revolves around the Sun with its rotational axis tilted at 23.5 degrees to a line perpendicular to the plane of its orbit, with the North Pole aligned with Polaris. - During Earth's one-year period of revolution, the tilt of its axis results in changes in the angle of incidence to the Sun's rays at given latitude; these changes cause variation in the heating of the surface. This produces seasonal variation in weather.	 E E I/E E	▪ What factors determine the temperature at a given location? ▪ What differences in insolation can be observed as the seasons change? ▪ What does the Earth do to cause the change of seasons? ▪ Why is determining a location's climate sometimes quite difficult?	▪ Heat equal masses of water and sand, have students note temperature of each. ▪ Heat paper, ½ colored white, ½ colored black, note temperature of each. ▪ Use a large inflated beach ball to model the Earth. Attach a "pole" at the top and bottom of the ball. Orient the "North Pole" in a particular direction in the room. Simulate the revolution of the Earth around the room describing parallelism. ▪ Using the above model, have students demonstrate how the vertical rays of the sun strike the Earth directly in different locations when the Earth is in different positions in its orbit. ▪ Conduct a long-term (3-4 month) study of the Sun's motion. ▪ Have students do investigation 21, angle of insolation and temperature. ▪ Model Earth's revolution, axis tilt, and changes in duration and intensity of insolation with large lamp and a globe.	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student- developed rubrics for performance tasks or projects ▪ Lab rubric	

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Standard 4: Key Idea 2: Performance Indicator 2.2: Explain how incoming solar radiation, ocean currents, and land masses affect weather and climate.					
Essential Knowledge/Skills (Major Understandings)	***Priority Code***	***Essential Questions***	***Classroom Ideas***	***Assessment Ideas***	***Time/ Notes***
UNIT SEVEN 1.1g Seasonal changes in the apparent positions of constellations provide evidence of Earth's revolution. 1.1h The Sun's apparent path through the sky varies with latitude and season. 1.2g Earth has continuously been recycling water since the out gassing of water early in its history. This constant recirculation of water at and near Earth's surface is described by the hydrologic (water) cycle. - Water is returned from the atmosphere to Earth's surface by precipitation. A portion of the precipitation becomes runoff over the land or infiltrates into the ground to become stored in the soil or ground water below the weather table. Soil capillarity influences this process. - The amount of precipitation that seeps into the ground or runs off is influenced by climate, slope of the land, soil, rock type, vegetation, land use, and degree of saturation. - Porosity and permeability affect runoff and infiltration.	 E E E	▪ How do the stars prove that the Earth revolves around the Sun? ▪ What are the various steps of the hydrologic cycle?	▪ Give students a diagram or three-dimensional model of the earth as it moves around the Sun. Students identify the time of year based on the orientation of the North Pole relative to the Sun. ▪ Have students practice calculating the Noon altitude of the Sun based on latitude and time of year. ▪ Pose the question, " How old is the water you used to take your shower this morning?" Have a distillation apparatus set up with a supply of "fouled water". Let the still run for a day or until the fouled water has evaporated and condensed as "clean" water. Come back to the question above. Lead a discussion on where the water might have been in its long history. ▪ Students prepare a short report on an imaginary trip as a raindrop. They are to include evaporation, precipitation and transpiration in creating the path they choose as a drop of water. ▪ Set up and demonstrate capillarity. ▪ Cover a small green plant with a plastic baggie to observe transpiration. ▪ Have students construct models of the ground water system. ▪ Hand out a diagram of the hydrologic cycle. Discuss condensation, precipitation, evaporation, and transpiration. Have students label diagrams.	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student- developed rubrics for performance tasks or projects ▪ Lab rubric	

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Standard 4:	**Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.**
Key Idea 1:	**The Earth and celestial phenomena can be described by principles of relative motion and perspective.**

Background:

People have observed the stars for thousands of years, using them to find direction, to note the passage of time, and to express their values and traditions. As our technology has progressed, so has understanding of celestial objects and events.

Theories of the universe have developed over many centuries. Although to a casual observer celestial bodies appeared to orbit a stationary Earth, scientific discoveries Led us to the understanding that Earth is one planet that orbits the Sun, a typical star in a vast and ancient universe. We now infer an origin and an age and evolution of the universe, as we speculate about its future.

As we look at Earth, we find clues to its origin and how it has changed through nearly five billion years, as well as the evolution of life on Earth.

Guiding Questions:

How can we explain the real motions of celestial objects?
How can we describe the position of the Earth in the Cosmos?
What are the similarities and differences between objects found in the Cosmos?
How can we prove the Earth rotates and revolves?
How is the Earth influenced directly of indirectly by other members of the Cosmos?
How was our universe formed?
How did our planet form?
How can the future of Earth be affected by events occurring in the Cosmos?
How can fossil evidence and geologic structures help us to understand changes that have occurred in Earth's history?

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Standard 4: Key Idea 1: Performance Indicator 1.1: Explain complex phenomena, such as tides, variations in day lengths, solar insulation, apparent motion of the planets, and annual traverse of the constellations.

Essential Knowledge/Skills (Major Understandings)	*Priority Code*	*Essential Questions*	*Classroom Ideas*	*Assessment Ideas*	*Time/ Notes*
UNIT EIGHT 1.1a Most objects in the solar system are in regular and predictable motion. - These motions explain such phenomena as the day, the year, seasons, and phases of the moon, eclipses, and tides. - Gravity influences the motions of celestial objects. The force of gravity between two objects in the universe depends on their masses and the distance between them. 1.1b Nine planets move around the Sun in nearly circular orbits. - The orbit of each planet is an ellipse with the Sun locate at one of the foci. - Earth is orbited by one Moon and many artificial satellites. 1.1e The Foucault Pendulum and the Coriolis Effect provide evidence of Earth's rotation. 1.2a The universe is vast and estimated to be over ten billion years old. The current theory is that the universe was created from an explosion called the Big Bang. Evidence for this theory includes: - cosmic background radiation - a red-shift (the Doppler effect) in the light from very distant galaxies.	 E E E E	▪ What is the relationship between the universe, galaxies, stars and our solar system? ▪ How do the Moon and Sun influence the Earth? ▪ How can we prove the Earth rotates? ▪ What evidence is there supporting the current theory of the universe creation?	▪ Compare and contrast magnetism and gravity ▪ Graphically or pictorially represent Newton's Laws of Motion ▪ Discuss the Universal Law of Gravitation ▪ Take a "Universal field trip" to introduce the wide variety of objects found in outer space. Attempt to give students a sense of place for planet Earth. ▪ Make use of an analogy between modern special effects used in motion pictures and the ancient belief that the Earth is fixed in space. ▪ Pre-Copernican beliefs have the Earth fixed in space. Have students explore in small groups or with learning partners how we might prove the Earth actually does move. ▪ Construct diagrams or scale models of the solar system with each planet branching from the sun. ▪ Describe the various motion observed in the celestial sphere and have students identify what real motion is responsible for the observed motion. ▪ Have students use the gravitation formula in the *Earth Science Reference Tables* to perform basic calculations involving changes in mass and distance. ▪ Set up a model of a Foucault Pendulum ▪ Set up a model that can be used to demonstrate the Coriolis effect ▪ Have students diagram and create written explanations for the above models. ▪ Take a deflated weather balloon and apply stickers to represent objects in the universe. Connect the balloon to the exhaust end of a vacuum cleaner to inflate the balloon. This model can be used to represent the expanding universe theory.	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student- developed rubrics for performance tasks or projects ▪ Lab rubric	

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Standard 4: Key Idea 1: Performance Indicator 1.2: Describe current theories about the origin of the universe and solar system.					
Essential Knowledge/Skills (Major Understandings)	***Priority Code***	***Essential Questions***	***Classroom Ideas***	***Assessment Ideas***	***Time/ Notes***
UNIT EIGHT 1.2b Stars form when gravity causes clouds of molecules to contract until nuclear fusion of light elements into heavier ones occurs. Fusion releases great amounts of energy over millions of years. - The stars differ from each other in size, temperature, and age. - Our Sun is a medium-sized star within a spiral galaxy of stars known as the Milky Way. Our galaxy contains billions of stars, and the universe contains billions of such galaxies. 1.2c Our solar system formed about five billion years ago from a giant cloud of gas and debris. Gravity caused earth and the other planets to become layered according to density differences in their materials. - The characteristics of the planets of the solar system are affected by each planet's location in relationship to the Sun. - The terrestrial planets are small, rocky, and dense. The Jovian planets are large, gaseous, and of low density. - Impact craters can be identified in Earth's crust. 1.2d Asteroids, comets, and meteors are components of our solar system. - Impact events have been correlated with mass extinction and global climatic change. - Impact craters can be identified in Earth's crust. 1.1i Approximately 70% of Earth's surface covered by a relatively thin layer of water, which responds to the gravitational attraction of the Moon and the Sun with a daily cycle of high and low tides.	 E E I I E	▪ How is the Sun distinguished from other stars? ▪ How did our planet form? ▪ How do the inner and outer planets compare? ▪ What influence does the moon have on Earth's water?	▪ Carefully measure the mass of 100 grains of coarse sand. Extrapolate that measurement out to one million grains of sand. Add one grain of black sand to the million to represent earth. Use this model to develop the idea of one billion. ▪ Use the BOCES catalog of instructional materials to locate a film regarding star formation, development, classification and "death". ▪ Develop the concept of density layering by constructing a density column using water, glycerin, isopropyl alcohol and mineral oil. The water and isopropyl alcohol can be dyed with food coloring. ▪ Laser discs contain thousands of images of stars. Students could make a presentation of the various classifications of stars according to the H-R diagram. ▪ Students can calculate the density of the four fluids used in the demonstration given the mass and volume of each fluid. ▪ Take 5 or 6 rubber balls loosely covered with cotton balls. Place them in a line. Place a hairdryer or vacuum cleaner on exhaust at one end of the line to simulate the ignition of the Sun and how the lighter gasses were blown away leaving rocky planets near the sun, gaseous ones farther away. ▪ Using the 3' x 3' box from the magnetic marble model, fill the bottom of the box with about 2 cm of white sifted flour. Cover the flour with a thin (2mm) layer of fine sand or cocoa mix. Drop large (1 CM to 2 CM) ball bearings from a height of 2 meters into the box. The impacts will simulate impact craters. The white flour will represent ejecta and ray formation. Students will be responsible for measuring, massing, and sketching the results. Tracing paper can be placed over the craters so a permanent record of the pattern can be kept. Ball bearings can also be launched at an angle. ▪ On the overhead projector, use a magnetic marble, iron filings and another bar magnet to show how the pull of gravity affects the filings. Have students explain to their learning partner how this is similar to the way the moon's gravity pulls on the oceans. Have them come to consensus and write an explanation to turn in or to share with another pair of students.	▪ Teacher observations ▪ Student responses/ demonstrations ▪ Journal entries ▪ Teacher-developed and student-developed rubrics for performance tasks or projects ▪ Lab rubric	