

## Science Standard 5 Earth's Dynamic Systems

Earth's dynamic systems are made up of the solid earth (geosphere), the oceans, lakes, rivers, glaciers and ice sheets (hydrosphere), the atmosphere, and organisms (biosphere). Interactions among these spheres have resulted in ongoing changes to the system. Some of these changes can be measured on a human time scale, but others occur so slowly, that they must be inferred from geological evidence.

Strand	Grades K-3	Grades 4-5	Grades 6-8	Grades 9-12
<p><b><u>Components of Earth</u></b></p> <p>Enduring Understanding: Earth's systems can be broken down into individual components which have observable measurable properties.</p> <p>Essential Question: How does understanding the properties of Earth materials and the physical laws that govern their behavior lead to prediction of Earth events?</p>	<p>A. Components of Earth's system include minerals, rocks, soil, water and air. These materials can be observed, sorted and/or classified based on their physical properties. <b>Level: Essential</b></p> <p>B. Water can exist as a solid, liquid or gas and in different forms such as rain, snow and ice. <b>Level: Important</b></p> <p>C. Sand, clay and humus have distinct physical properties and are components of soils. <b>Level: Essential</b></p> <p>D. A soil's composition varies from environment to environment. <b>Level: Important</b></p> <p>E. Soil type can be identified by testing for grain size and composition. <b>Level: Essential</b></p> <p>F. Rocks are natural combinations of minerals. Minerals can be classified according to their physical properties (i.e., luster, color and hardness). <b>Level: Essential</b></p>	<p>A. Water exists in three states (solid, liquid and gas) that are dependent upon the surrounding temperature. <b>Level: Important</b></p> <p>B. Rocks and minerals are broken down over time to clay and sand sized particles. These particles combine with plant remains to form soil. <b>Level: Important</b></p> <p>C. The ability of water to pass through soil depends on the relative amounts of clay and sand in the soil. <b>Level: Important</b></p>	<p>A. Water exists on the Earth in reservoirs (on or within the Earth's surface and atmosphere). The total amount of water in these reservoirs does not change, however, the ratio of water in solid, liquid, or gaseous form varies over time and location. <b>Level: Essential</b></p> <p>B. The movement of water among the geosphere, hydrosphere and atmosphere affects such things as weather systems, ocean currents, and global climate. <b>Level: Essential</b></p> <p>C. The formation of sediment and soil requires a long period of time as rocks are weathered, eroded and deposited. <b>Level: Important</b></p> <p>D. The atmosphere is a mixture having as its principle components a fixed ratio of nitrogen and oxygen and, depending on the location, variable amounts of carbon dioxide, water vapor, and dust particles. <b>Level: Compact</b></p>	<p>A. Minerals are the building blocks of rocks. Common rock-forming minerals found in Delaware (calcite, quartz, mica, feldspar, and hornblende) can be identified by their chemical and physical properties. <b>Level: Essential</b></p> <p>B. Rocks can be classified as igneous, metamorphic and sedimentary based on the method of formation. The natural cycling of rocks includes the formation of new sediment through erosion and weathering and of new rock through heat and compaction of the sediment. <b>Level: Essential</b></p> <p>C. Earth's geosphere is composed of layers of rocks which have separated due to density and temperature differences and classified chemically into a crust (which includes continental and oceanic rock), a hot, convecting mantle, and a dense metallic core. <b>Level: Essential</b></p> <p>D. Continental and oceanic rock differ in overall composition, density and age. <b>Level: Important</b></p> <p>These differences help explain the distribution and configuration of land masses and ocean basins. <b>Level: Compact</b></p>

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<p><b><u>Interactions Throughout Earth's Systems</u></b></p> <p>Enduring Understanding: Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally.</p> <p>Essential Question: How do changes in one part of the Earth system affect other parts of the system?</p> <p>Essential Question: In what ways can Earth processes be explained as interactions among spheres?</p>	<p>A. Weather influences plants, animals and human activity. <b>Level: Essential</b></p> <p>B. People who work or play outdoors often dress and base their activities on the speed of the wind and the temperature of the air. <b>Level: Essential</b></p> <p>C. Water from rain, lakes, and underground, is needed by plants, animals and people for their everyday activities. <b>Level: Compact</b></p> <p>D. Clouds are shaped by winds and are made of small water droplets or ice crystals. Cloud shapes can be used to help forecast weather. <b>Level: Important</b></p>	<p>A. Earth is a dynamic system resulting from interactions among the geosphere, hydrosphere, atmosphere and biosphere. <b>Level: Important</b></p> <p>B. Water reshapes Earth's land surface by eroding rock and soil in some areas and depositing them in other areas. <b>Level: Essential</b></p> <p>C. The flow of water can be affected by human activities, ground cover and the slope of the land affected. <b>Level: Essential</b></p> <p>D. Water in rivers and streams transports materials. As a general rule, when a stream enters a larger body of water, less massive materials in suspension will travel farther than more massive materials before settling. <b>Level: Essential</b></p> <p>E. The surface of Earth changes constantly. Some of these changes happen slowly and are difficult to detect on a daily basis. Other changes happen quickly and result from events (i.e., major storms and volcanoes). <b>Level: Essential</b></p>	<p>A. Water cycles from one reservoir to another through the processes of evaporation, transpiration, condensation and precipitation. Energy transfers and/or transformations are associated with each of these processes. <b>Level: Essential</b></p> <p>B. Water within a watershed travels over and through the land at various speeds based on the rate of change in elevation and the permeability and porosity of the soil. Water carries with it products of human activity. <b>Level: Important</b></p> <p>C. Surface water always flows downhill. Areas of higher elevation separate watersheds. In Delaware, this water eventually reaches the Delaware River, the Delaware Bay, the Atlantic Ocean or the Chesapeake Bay. <b>Level: Important</b></p> <p>D. Constructive processes that build up the land and the destructive processes of weathering and erosion shape and reshape the land surface. The height of Earth landforms is a result of the difference between the rate of uplift and the rate of erosion at a particular location. <b>Level: Important</b></p>	<p>A. Earth's four spheres interact as part of a dynamic system in which changes over time are the result of external and internal energy sources. <b>Level: Compact</b></p> <p>B. Tectonic plates press against one another in some places (convergence), pull apart in other places (divergence), or slide past each other. These plate movements may result in the formation of mountain ranges, and can lead to earthquakes, volcanic eruptions, and tsunamis. The consequences of these events impact the surrounding atmosphere, geosphere, hydrosphere, and the life existing within them. <b>Level: Essential</b></p> <p>C. Earthquakes result when rocks rupture and slide by one another releasing stored energy which travels through the geosphere in the form of waves. Local earthquake risks can be assessed and preparations made to minimize the hazards. <b>Level: Important</b></p> <p>D. The type and eruptive style of volcanoes is determined by the viscosity and gas pressure of the magma. The effects of these eruptions can have both local and global consequences. <b>Level: Important</b></p>

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<p><b><u>Interactions Throughout Earth's Systems</u></b> <i>(Continued from previous page)</i></p>		<p>F. Weather changes daily and seasonally. Weather in Delaware may change little from day to day, but can vary greatly when storm systems move into the area. <b>Level: Compact</b></p> <p>G. Some weather events, such as snowstorms, hurricanes, thunderstorms or tornadoes are more likely to occur at different times of the year. <b>Level: Compact</b></p> <p>H. Local weather at any point in time varies at different locations around the world. <b>Level: Compact</b></p>	<p>E. Some Earth events such as El Nino, volcanism and global warming can affect the entire Earth system and are likely the result of complex interactions among Earth spheres. <b>Level: Compact</b></p> <p>F. The atmosphere has properties that can be observed, measured, and used to predict changes in weather and to identify climatic patterns. <b>Level: Essential</b></p> <p>G. The climate at a location on Earth is the result of several interacting variables such as latitude, altitude and/or proximity to water. <b>Level: Essential</b></p> <p>H. Energy from the Sun heats the Earth unevenly causing pressure differences and air movements (convection currents) resulting in changing weather patterns. <b>Level: Essential</b></p> <p>I. Ocean currents, global winds, and storm systems, redistribute heat energy on Earth's surface and therefore affect weather and long-term climatic patterns of a region. <b>Level: Essential</b></p>	<p>E. The atmosphere can be described as being in a state of dynamic equilibrium which is maintained in part by plate tectonic processes which recycle atmospheric gases trapped in the ground back into the atmosphere. <b>Level: Compact</b></p>

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<p><b><u>Interactions Throughout Earth's Systems</u></b> <i>(Continued from previous page)</i></p>			<p>J. Uneven heating and cooling of the Earth's surface produce air masses that differ in density, humidity and temperature. The interaction of these air masses results in significant weather changes. <b>Level: Essential</b></p> <p>K. Past geological events and environments can be reconstructed by interpreting fossilized remains and successive layering of sedimentary rocks. <b>Level: Important</b></p> <p>L. The fit of continental coastlines, the similarity of rock types and fossilized remains provide evidence that today's continents were once a single land mass. The continents moved to their current positions on plates driven by energy from Earth's interior. <b>Level: Important</b></p> <p>M. Heat energy stored in the oceans and transferred by currents influence climate. A disruption of the circulation and temperature of the world's oceans would foster climate change and have environmental and economic consequences. <b>Level: Important</b></p>	

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<p><b><u>Technology and Applications</u></b></p> <p>Enduring Understanding: Technology enables us to better understand Earth's systems. It also allows us to analyze the impact of human activities on Earth's systems and the impact of Earth's systems on human activity.</p> <p>Essential Question: How does technology extend human senses and understanding?</p>	<p>A. Earth materials can be observed and described using simple tools (e.g., hand lens and balances). <b>Level: Essential</b></p> <p>B. Weather can be observed, measured and described through the use of simple tools such as a thermometer, rain gauge and wind vane. <b>Level: Important</b></p>	<p>A. Some satellites allow scientists to observe, over time, large-scale changes in the geosphere as well as the development of short term weather events. <b>Level: Compact</b></p>	<p>A. Global weather data from ground measurements, satellites and radar are recorded on maps, analyzed, and used to predict local weather. <b>Level: Essential</b></p> <p>B. Water from some natural sources is unfit to drink and requires the use of specialized technology to analyze and purify it. <b>Level: Compact</b></p>	<p>A. Advances in science and technology (such as satellite imaging, Global Positioning Satellite (GPS), and Geographic Information Systems (GIS)) have improved our understanding of global and local changes that result from Earth system interactions, and our capacity to anticipate and mitigate natural hazards such as volcanoes and earthquakes. <b>Level: Compact</b></p>