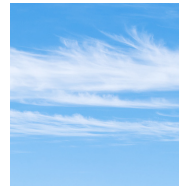


Earth's Systems Interactions



Teacher Background

Earth is the only planet in our solar system that has the perfect conditions for life. Earth has not only the right amount of sunlight but also air, water, and land that promote life. Earth has various systems working together to sustain life for the organisms that occupy it. Earth's major systems are the *geosphere* (solid and molten rock, soil, and sediments), the *hydrosphere* (water and ice), the *atmosphere* (air), and the *biosphere* (living organisms, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes that support life. There have been constant changes on Earth since the time it was formed approximately 4.6 billion years ago. These changes have occurred over both short and long periods of time. The systems on Earth are responsible for these changes.



Earth's major systems are the geosphere, hydrosphere, atmosphere, and biosphere.

The geosphere is made of the crust, the mantle, and the core. The crust layer is the cold, hard rock that makes up Earth's surface. The mantle is the hot, semihard rock layer just under the crust. The hot, liquid rock and solid iron center beneath the mantle is the core. Earth's surface includes many formations, such as continents, bodies of water, mountains, valleys, canyons, and caves.

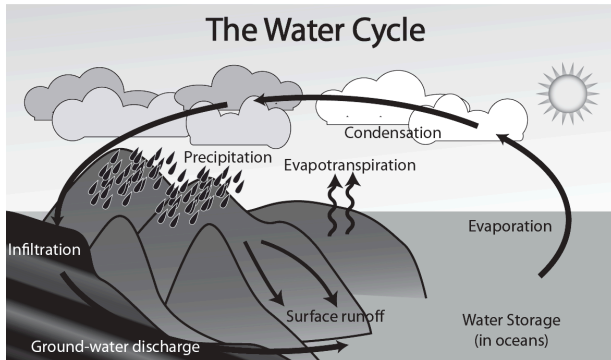
The formation of these structures is the result of both gradual events, such as precipitation, weathering, erosion, deposition, and freezing, and sudden events, such as hurricanes, tornados, earthquakes, volcanic eruptions, tsunamis, and floods. Ice, wind, and moving water weather and erode Earth's surface, breaking down rock and soil and moving it to different locations. Weathering and erosion are both responsible for creating new soil deposits (deposition or sedimentation). Erosion is also responsible for washing away fertile soil. In addition, living organisms aid in the processes of weathering and erosion.



Volcanic activity creates new land in the geosphere.

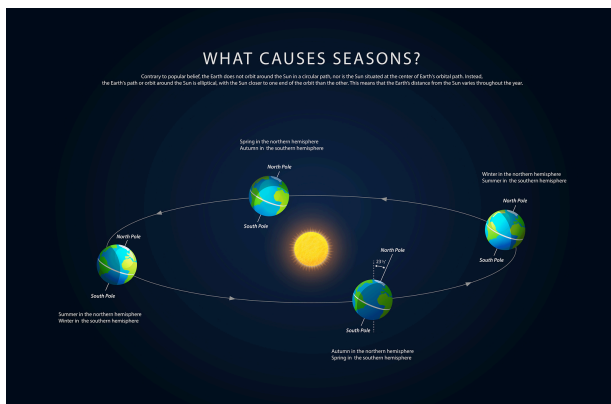
The hydrosphere contains all of Earth's water—liquid, solid, and gaseous. It includes both fresh water (rivers, lakes, and glaciers) and salt water (oceans). The majority of water on Earth (97%) is salt water found in oceans. Oceans support a variety of ecosystems and organisms. The hydrologic cycle, or water cycle, is central to connecting Earth's systems. It is powered by energy from the Sun. The cycle of evaporation, condensation, precipitation, infiltration, percolation, and surface runoff as well as freezing and melting moves water

between the clouds, land, and oceans (and other bodies of water) and back to the clouds. Energy is exchanged as water moves through the cycle, causing natural variation in global climates. Climate is the long-term pattern of temperature and weather and is impacted by the absorption and release of heat. When water evaporates, it removes heat from the surrounding environment. Condensation causes the release of heat and the warming of the environment. Oceans release and absorb heat more slowly than land. During winter, oceans are warmer than surrounding lands, and during summer, oceans are cooler than surrounding lands.



The water cycle connects Earth's systems.

The atmosphere is all the air on Earth. The air on our planet is 78% nitrogen and just under 21% oxygen. The small component remaining is composed of carbon dioxide and other gases. Weather and climate are both determined by the energy provided by the Sun. On any given day, different parts of Earth's surfaces are heated differently because the Sun rises at different times, climbs to different heights in the sky, and shines for different amounts of time at different latitudes. The amount of heating at any given place varies seasonally because Earth's axis is tilted 23.5 degrees compared to a line perpendicular to the plane of its orbit around the Sun. A common misconception is that seasons result from Earth's distance from the Sun during its orbit around the Sun. However, seasons are a direct result of the tilt of Earth on its axis. If Earth's axis were not tilted, there would be no seasons.



Seasons are caused by the tilt of Earth on its axis, not by Earth's distance from the Sun.

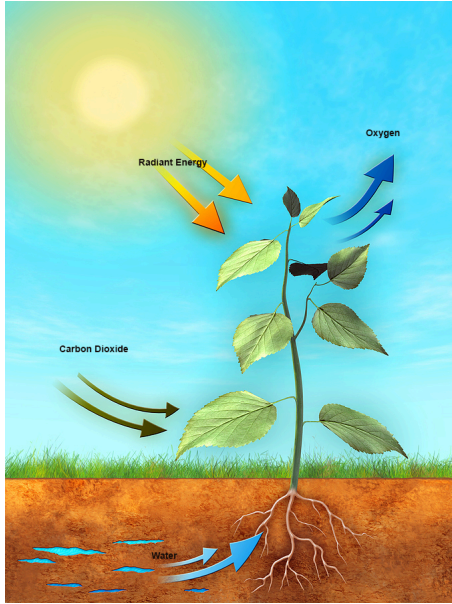
The intensity of energy from the Sun on Earth's surface is also impacted by cloud cover and proximity to mountains and oceans. Because the Sun heats Earth unevenly, areas of high and low pressure occur. Wind is caused by the movement of air from areas of high pressure to areas of low pressure.

Climate also results from the interaction between the atmosphere, landforms, and bodies of water. Weather is different from climate and is the short-term condition that occurs in specific regions when energy and water are moved into and out of the atmosphere. Winds and clouds in the atmosphere interact with landforms and bodies of water to create weather patterns.

The atmosphere includes wind, weather, and climate.



The biosphere is a system containing all of the planet's living things. The biosphere is made up of smaller parts called biomes that contain different living organisms. Biomes may be terrestrial (land) or aquatic (water). Terrestrial biomes include rain forests, temperate forests, deserts, grasslands, taiga, and tundra. Aquatic biomes include marine, estuarine, and freshwater. Organisms in the biosphere include plants, animals, fungi, and microscopic organisms. Plants depend on each system to perform photosynthesis: soil (geosphere) for nutrients, air (atmosphere) for carbon dioxide, and water (hydrosphere). Every biome depends upon landforms (geosphere), available water (hydrosphere), and climate (atmosphere) to determine what type of life-forms will flourish there. In addition, living organisms affect other systems. For example, plants take in carbon dioxide and give off oxygen during photosynthesis.



Photosynthesis demonstrates how the biosphere, atmosphere, hydrosphere, and geosphere all interact.

Soil contains living and nonliving components. It contains all four systems: broken-down rock, water, air, and living organisms. Soil supports life on Earth. It provides the resources for food, building materials, and energy that living things need for survival. Soil also plays a role in the planet's climate through the exchange of water and energy between the biosphere and the atmosphere. Soil supports the breakdown and synthesis of organic materials by supplying organic and inorganic building blocks, such as carbon, nitrogen, and other trace minerals. Soil is formed by actions of the atmosphere, hydrosphere, and biosphere on the geosphere, such as weathering, erosion, and deposition. All four systems are necessary to create soil, which supports life on Earth.



A system is a group of interdependent parts within a set boundary. The geosphere, hydrosphere, atmosphere, and biosphere all work together to support life on Earth. Earth is a set of complex systems in which chemical elements and the building blocks of life are recycled on Earth's surface among the oceans and landforms and the atmosphere. These systems are interconnected. A change to one system will most likely result in a change to at least one of the other systems. The change within a system may be the result of nature or

human activities—an earthquake versus an oil spill. The change may be local, national, or worldwide. Flooding, El Niño, and ozone depletion are examples of these types of changes.



The geosphere, the hydrosphere, the atmosphere, and the biosphere all interact in various ways, helping shape the planet we have today.