

Earth and its Spheres

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Earth is an extraordinary planet which has several parts working together making it a perfect system. It's the only planet in the solar system that supports life. Availability of liquid water and atmosphere are two most important factors that make life possible on Earth. Earth is the third planet in the solar system which is classified as an inner or terrestrial planet. Known to be roughly 4.6 billion years old, Earth revolves around the sun and rotates around itself. It takes 24 hours for it to rotate around itself and 365 days to revolve around the sun. Earths rotates around its imaginary axis that goes from north pole to south pole. The tilt of Earth's axis results in multiple seasons. Some scientists believe that the tilt was resulted by the collision of Earth with another celestial object.

The gravity of Earth is  $9.8 \text{ } 9.807 \text{ m/s}^2$ ., and it was discovered by Sir Isaac Newton. Earth was believed to be at the center of the solar system before until Nicolaus Copernicus published his theory of revolution of the heavenly bodies in 1543. Scientific community then accepted the heliocentric model as the evidence of geocentrism was not enough. It took a long time for people to accept the theory of Copernicus but increase in evidence due to advancement in technology only led to further support of the heliocentric models. Further research of Galileo, Brahe, Kepler, and Newton totally disproved the idea that Earth is in the center of the solar system. Earth also happens to be the densest planet in our solar system. Earth's interior is divided into three different layers – crust, mantle, and core.

There are four spheres of Earth that work together making it a perfect system. Earth is so complex that scientists divide it into smaller systems for easier understanding of the planet. It's the balance among all these systems that make life possible on Earth. Imbalance in the nature is the consequence of imbalance in one or more of these smaller systems in the ecosystem. Any

element on Earth falls on one of the four spheres. Land, water, air, and life are four divisions of Earth. Biosphere consists of all the living things. The part of the Earth that contains water is called hydrosphere. While layers of air that surround the earth is called atmosphere, solid part of the earth is called geosphere. All these spheres have their sub-categories. This paper discusses all the spheres in details. Environmental science, earth science, and ecology study the systems of Earth and its interactions. Biogeoscience is a new field that specifically studies the biological and environmental processes in the Earth's systems.

Our scientific community has been conducting intense research in this field in the last few decades. The understanding of these system has changed a lot in recent days. State of Florida's science standards requires it's 6<sup>th</sup> grade students to develop in-depth understanding of these systems. Many Organizations such as NASA have been doing tremendous research in this field, and the latest data has proven to be very effective for kids in our schools to develop better understanding of our planet. Contribution of NASA to study Earth system from outside the Earth has provided tremendous support to Earth Science educators of all levels. Understanding these systems helps students develop their own perspectives. 'An Introduction to Making Observations of Earth Using an Earth System's Science Approach' is one of the most effective resource for teaching Earth systems to any grade level. This is written and developed by NASA science education specialist Paige Valderrama Graff.

Hydrosphere is the part of the Earth that contains water. Majority of earth's surface is covered with water. This is the reason Earth is also referred to as the blue planet or water planet. Water is distributed on the surface, below the surface, and in the atmosphere. The frozen part of the hydrosphere is also referred to as cryosphere. According to V.N Malinin, "Cryosphere consists of glacial covers (GC), alpine glaciers (AP), sea ices (SI), seasonal snow cover (SSC),

and permafrost glaciers (PG)” (p.4). According to Merray, the hydrosphere “consists mostly of the World Ocean and lakes and rivers as well. Part of the water may be in solid and gaseous condition in the form of ice, snow, hail and water vapors of atmosphere.” Biosphere contains all the flora and fauna of the planet. Living things can be found air, water, and air. Thus, biosphere is large, and it doesn’t have a distinct boundary. It includes all the living things from microbes to largest mammals and trees. According to Erle Ellis (2009), “biosphere is defined as the biological component of earth systems, which includes the atmosphere, lithosphere, hydrosphere and other spheres” (p.1). Millions of living things in the biosphere interact with each other through food webs and food chains. Living things interact with each other at different trophic levels. These trophic levels are divided into producers, consumers, and decomposers. Consumers are further divided into primary, secondary, and tertiary. Plant supply energy to all the heterotrophs. This interaction plays a very important role maintaining balance in the ecosystem. According to Goran Wall (2018), “Energy is the “fuel” for living systems, that are sustained by converting energy and materials; e.g. a living cell, an organism, an ecosystem, the Earth’s surface with its material cycles, or a society. The green plants, which represent the production process, convert exergy from the sunlight into the exergy-rich matter of biomass, via photosynthesis. The energy as biomass then passes through different food chains in the ecosystems” (p.9).

Atmosphere serves as a blanket that covers our Earth. It’s divided into troposphere, stratosphere, mesosphere, thermosphere and ionosphere. Some scientists also consider Exosphere to be the outermost layer of the atmosphere. Ionosphere is not a distinct layer of the atmosphere. It is the region in parts of mesosphere and thermosphere where charged ions are found. Ozone layer is found in the stratosphere. It absorbs the UV radiation and protects Earth from its effects. Geosphere is the solid portion of the Earth. It includes all interior and crust. All these spheres of

Earth interact with each other in several ways. Yao et al. (2015) state that “The Tibetan Plateau’s unique land surface processes have responded sensitively to global climate change. Its processes have been accompanied by an integrated interaction between the Earth's surfaces (upper crust, atmosphere, hydrosphere, cryosphere, and biosphere) and deeper (mantle and crust) layers, more specifically between the lithosphere, hydrosphere, cryosphere, biosphere, atmosphere, and anthrosphere” (p. 1). Water cycle and volcanic eruption are the most common examples which explain the interdependence of these systems. All four systems directly interact with each other in these two examples. Goran Wall (2018) points out, “All these spheres interact with each other in a mostly constructive manor, e.g. the evolution of life, creation of free oxygen and fossil fuels from the living processes of the biosphere. Further examples are erosion to mineralize water and sedimentation to remove toxic substances from the biosphere” (p.6). Continuous interaction among hydrosphere and biosphere maintains ecological balance on the planet. This interaction takes place mostly in cycles. As Merray states, “water also percolates deeply into the stony crust of the Earth where it performs hydration of minerals and also forms a significant part of the biosphere.” “Ocean circulation, which realizes the transfer of water masses, on one hand contributes to close interaction of physical, chemical, and biological processes, and on the other, it creates variety and differences of processes, which in their turn contribute to the eternal motion of water masses” (Malinin, p.7).

Other common examples of interaction among the Earth spheres are natural disasters such as hurricane and flood, ozone layer depletion, acid rain, desertification, drought, extinction, climate change, wild-fires etc. These are the examples of destructive interactions. Goran Wall (2018) states, “However this interaction may also be destructive, e.g. volcanic eruptions, hurricanes, ozone depletion, greenhouse effect, and an increase in DDT and PCB in the

biosphere” (p.6). All these interactions also contribute toward the evolution of the planet. The interactions among all these natural processes makes Earth a dynamic planet.

It is our common responsibility to protect the planet. Creating awareness among our students is the most important contribution we can make in this cause as educators. I am determined to effectively integrate all other disciplines while teaching Earth Science, and ensure that my students really understand the need to preserve our ecosystems. As Nelson Mandela once said, “Education is the most powerful weapon which you can use to change the world.” And I feel very fortunate that I am in it.

## References

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