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TEACHER GUIDE

INTERACTION OF EARTH'S SPHERES GRADES 3-5

COMMON MISCONCEPTIONS

- **The spheres are separate and do not interact.**

The main reason we talk about spheres is to better understand their interactions, which shape the surface of the Earth and are responsible for most of Earth's processes. For example, the hydrosphere shapes the geosphere when waves crash into rocks creating sand and ocean currents, which affect the atmosphere and have a major impact on weather.

- **People are not part of the spheres.**

Humans are part of the biosphere since we are living things, but we also have major effects on all the other spheres. Negative effects include piling up trash in the geosphere and positive include recycling, which helps all 4 spheres.

EARTH'S SPHERES

All materials, from Earth's core to the edge of the atmosphere, fall into one of these four categories: the geosphere, hydrosphere, biosphere, or atmosphere. It is the interaction between these four spheres that make up most processes on Earth.

GEOSPHERE

Geo means Earth. The geosphere is made up of Earth's rocks, minerals, sediments, volcanoes, magma, mountains, and canyons. These materials and features were formed through the rock cycle, which involves all spheres. For example, fossils (biosphere), erosion by water (hydrosphere), and erosion by wind (atmosphere). Soil contains rock and mineral components which are part of the geosphere, but on a higher educational level, soil also contains organic matter (biosphere), air pockets (atmosphere), and water molecules (hydrosphere) too small to be seen.

HYDROSPHERE

The hydrosphere contains all of Earth's water. The majority of liquid water is found in the ocean as saltwater. Liquid freshwater is found as lakes, rivers, streams, and ponds, but also as groundwater under the Earth's surface. Water vapor is found throughout the atmosphere and forms clouds. Water cycles around the planet but as it does so it flows over and through the geosphere, evaporates into the atmosphere, and is even incorporated into the biosphere (we drink water).

BIOSPHERE

The biosphere includes humans as well as all other life forms, both plant and animal. Microorganisms and elephants are both part of the biosphere. Plant roots can break rocks or anchor soil to a hillside. Earth's largest animals (whales) rely on the hydrosphere to support their bodies. Almost all life forms require water to live.

ATMOSPHERE

The atmosphere might be the most difficult to conceptualize because the gases that comprise it are not visible. We can see clouds, which are made from water vapor (hydrosphere), and smoke in the air (ash is part of the geosphere). Earth's atmosphere is critical to the biosphere. Animals and plants utilize different gases in the atmosphere to support life processes. The air we need to breathe is found relatively close to the Earth's surface. Our atmosphere is mainly made of nitrogen, oxygen, argon, carbon dioxide, and some other trace gases. The troposphere is closest to the Earth's surface, followed by the stratosphere, mesosphere, thermosphere and exosphere. Each layer has a different composition and temperature.

INTERACTION OF EARTH'S SPHERES

Although we can clearly define each sphere, it is difficult to think of a process that does not involve more than one of the spheres in some way. Each of Earth's processes can be looked at as interactions between these four spheres—some much more complex than others. What the students learn about these spheres and their interactions at this level will help them better understand more complex processes and interactions in the future.

EARTH'S SPHERES AND THE NGSS—AVOIDING FUTURE MISCONCEPTIONS

In looking closely at the DCI ESS2.A (below) suggested by the Next Generation Science Standards for this level regarding Earth's spheres, soil is categorized as part of the geosphere. It should also be noted that the assessment boundary for Performance Expectation 5-ESS2-1 (below) related to interactions between spheres at this level is limited to the interaction of two systems or spheres at a time. As students' understanding of Earth's spheres progresses over time, they will come to understand that soil, in fact, represents an interaction of all four spheres—too complex an interaction to be assessed at this level but something that could come up in discussion. Additionally, in the DCI the hydrosphere is defined as including water and ice, but does not mention water vapor. Wind and clouds in the atmosphere are mentioned. Water cycles through the atmosphere and it is debatable whether clouds should be considered part of the atmosphere or the hydrosphere. This is better described as an interaction between the two spheres but student

understanding of the particle nature of gases is limited at this level, and thus some simplification to this content has been made. However, discussion and questions in class may lead to the necessity of explanation beyond the definitions and assessment boundaries at this level to eliminate future misconceptions.

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

ESS2.A: Earth Materials and Systems. 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 things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

