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Geology in Kindergarten

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by Carol Boynton

Introduction

In this unit, I would like my young students to learn some basic aspects of how our Earth works. To introduce any new topic, a book or story provides a launching point for discussion and awareness. *The Street Beneath My Feet* by Charlotte Guillian and Yoval Zommer starts this unit off. This double-sided foldout book shows a journey down through the layers of the Earth, all the way to the planet's core and out the other side. One side of the foldout shows the ground beneath the city, while the reverse side shows the ground beneath the countryside. We follow a boy walking down a noisy city street, his red sneakers pounding the pavement, and he wonders, "What's going on deep in the ground?" Level by level, he describes what can be found beneath his feet - cables and pipes, earthworms and insects, then moving on to subway systems and the artifacts of lost civilizations, the boy travels deeper and deeper, highlighting the unique characteristics of each layer of the earth's crust, mantle, and core. This overview of basic earth science provides an interesting and clear visual for us to begin our questions and conversations about what it is like to be a geologist. Throughout this curriculum unit students build a model showing the surface of the Earth and what might be in the layers beneath. The Next Generation Science Standards for Kindergarteners state that students will make observations to determine the effect of sunlight on Earth's surface and recognize temperature differences, essentially warmer or cooler. Examples of Earth's surface include sand, soil, rocks, and water. (K-PS3-1). This unit will extend this learning to have the students "go" beneath the surface to experience the time-traveling idea, using *The Street Beneath My Feet* to help them "see" what is happening or has happened over time under the ground. This text will be the basis for introducing this content to curious Kindergarten geologists.

As a Kindergarten teacher in a self-contained classroom at Edgewood Magnet School in New Haven, I find the neighborhood/ magnet setting a rewarding environment, with students coming to school each day from a variety of home circumstances and with differences in academic levels. As a result of these variables, the children arrive with differing levels of background knowledge and life experiences. The classroom is a mixture of varied ethnicities, economic strata, and social and emotional strengths and weaknesses. Edgewood is a STEAM school with curricula focused on science, technology, engineering, arts, and mathematics. This planned unit aligns with the philosophy of the school. The use of scientific inquiry allows all students at all levels to learn in an inherently differentiated environment, learning new concepts and experiencing science in the classroom and outside, not only on the school property but across the street at Edgewood Park This unit will support the place-based learning that Edgewood Magnet school encourages. Trips to Edgewood Park to visit the ponds and river for hands-on investigation and experimentation will be modeled on experiences from the seminar.

Rationale

People are spending increasingly more time indoors. As much as 96% of our day is spent inside so consequently, we are experiencing the outdoors less and less. This is an unfortunate and unhealthy trend. Nature deficit disorder, a term coined by Richard Louv in his book, *Last Child in the Woods*, identifies a result of this extreme amount of time spent indoors. Children are not being exposed to nature regularly and are not making a connection to their natural world. He points out that the children who play outside are less likely to get sick, be stressed, or become aggressive, and are more adaptable to life's unpredictable turns.[1] I want to mention this phenomenon because it pertains to many of my students. Preparing and teaching a unit about what happens outside and under the ground allows me to change this, even just a bit. Each year I have young students who are uncomfortable being outside and interacting with 'nature' and students who are the complete opposite, ready to participate in any activities or lessons.

Content Objectives

One thing Kindergarten students love to do is collect rocks! They examine all the amazing attributes - color, shape, size, "sparkle" - and tend to pack them in their pockets at the end of recess. They seem to be natural geologists.

The unit begins with some foundational content for students to build a foundation.

The geology of the Earth is a fascinating subject of study. Whether it is identifying rocks along the road or in our backyards or the threat of climate change, geology is a major part of our everyday lives. Geology includes everything from the study of rocks and minerals to Earth's history and the effects of natural disasters on society. To understand it and what geologists study, we'll look at the basic elements that make up the science of geology. Geology is the study of the Earth and everything that makes up the planet. To understand the smaller elements that geologists study, we must first look at the bigger picture, the makeup of the Earth itself. Beneath the stony crust lies the rocky mantle and, at Earth's heart, the iron core. All are areas of active research and competing theories.[2]

Among these theories is that of plate tectonics. This one attempts to explain the large-scale structure of the Earth's crust and mantle. When the tectonic plates move, mountains and volcanoes are formed, earthquakes occur, and other shifts in the planet can happen. The geologic timescale gives geologists a way to map Earth's history. Through the study of land formations and fossils, they can put together the story of the planet. New discoveries can make increasingly refined changes to the timeline. This is divided into a series of eons and eras that help us further understand what previously occurred on Earth.

Rocks form the basis for solid-Earth geology, though they are not always hard or completely solid. There are three types of rocks: igneous, sedimentary, and metamorphic. They differ from one another by how they are formed. By learning what makes each unique, you are one step closer to being able to identify rocks. What is even more interesting is that these rocks are related. Geologists use the "rock cycle" to explain how many rocks transform from one category to another.[3]

Essential questions students may consider during this unit:

What can we learn from identifying what is “under our feet”?

How will this information help us?

How did it all get there?

Can we “see” what is under the ground? How can we do that?

Why is important for us to know this?

Earth’s Spheres

Everything in Earth's system can be placed into one of four major subsystems: land, water, living things, or air. These four subsystems are called "spheres." Specifically, they are the "geosphere" (land), "hydrosphere" (water), "biosphere" (living things), and "atmosphere" (air). Each of these four spheres can be further divided into sub-spheres.[4]

The Geosphere contains all of the cold, hard solid rocks of the planet's crust (closest to the surface), the semi-solid rocks underneath the crust, and the liquid and solid iron near the center of the Earth. The surface of the geosphere is very uneven. High mountain ranges like the Rockies and Andes, huge plains or flat areas like those in Texas, Iowa, and Brazil and deep valleys along the ocean floor. The solid, semi-solid, and liquid parts of the geosphere form layers that are physically and chemically different. If someone were to cut through Earth to its center, these layers would be revealed like the layers of an onion. The outermost layer of the geosphere consists of loose soil rich in nutrients, oxygen, and silicon. Beneath that layer lies a thin, solid crust of oxygen and silicon. Next is a thick, semi-solid mantle of oxygen, silicon, iron, and magnesium. Below that is a liquid outer core of nickel and iron. At the center of Earth is a solid inner core of nickel and iron.

The Hydrosphere contains all the solid, liquid, and gaseous water of the planet (some scientists distinguish the solid ice portion of the hydrosphere as its own “cryosphere”). It ranges from 10 to 20 kilometers in thickness. The hydrosphere extends from Earth's surface downward several kilometers into the geosphere, and upward about 12 kilometers into the atmosphere. A small portion of the water in the hydrosphere is fresh (non-salty). This water flows as precipitation from the atmosphere down to Earth's surface, as rivers and streams along Earth's surface, and as groundwater beneath Earth's surface. The majority of Earth's fresh water, however, is actually frozen, locked within vast ice caps covering Antarctica and Greenland as well as mountain glaciers.

Ninety-seven percent of Earth's water is salty. The salty water collects in the oceans. Seawater near the poles is very cold while surface water near the equator is very warm. The differences in temperature cause water to change physical states. Extremely low temperatures like those found at the poles cause water to freeze into a solid such as a polar icecap, a glacier, or an iceberg. High temperatures like those found at the equator cause water to evaporate readily into a gas.

The Biosphere contains all the planet's living things. This sphere includes all of the microorganisms, plants, and animals of Earth. Within the biosphere (which also contains a non-negligible reservoir of water, thus overlapping the hydrosphere), living things form ecological communities based on the physical surroundings of an area. These communities are referred to as biomes. Deserts, grasslands, and tropical rainforests are three of the many types of biomes that exist within the biosphere.

The Atmosphere contains all the air in Earth's system. It extends from less than 1m below the planet's surface to more than 10 km above the planet's surface. The upper portion of the atmosphere protects the organisms of the biosphere from the sun's ultraviolet radiation. It also absorbs and emits heat. When air temperature in the lower portion of this sphere changes, weather occurs. As the air in the lower atmosphere is heated or cooled, it moves around the planet. The result can be as simple as a breeze or as complex as a tornado.[5]

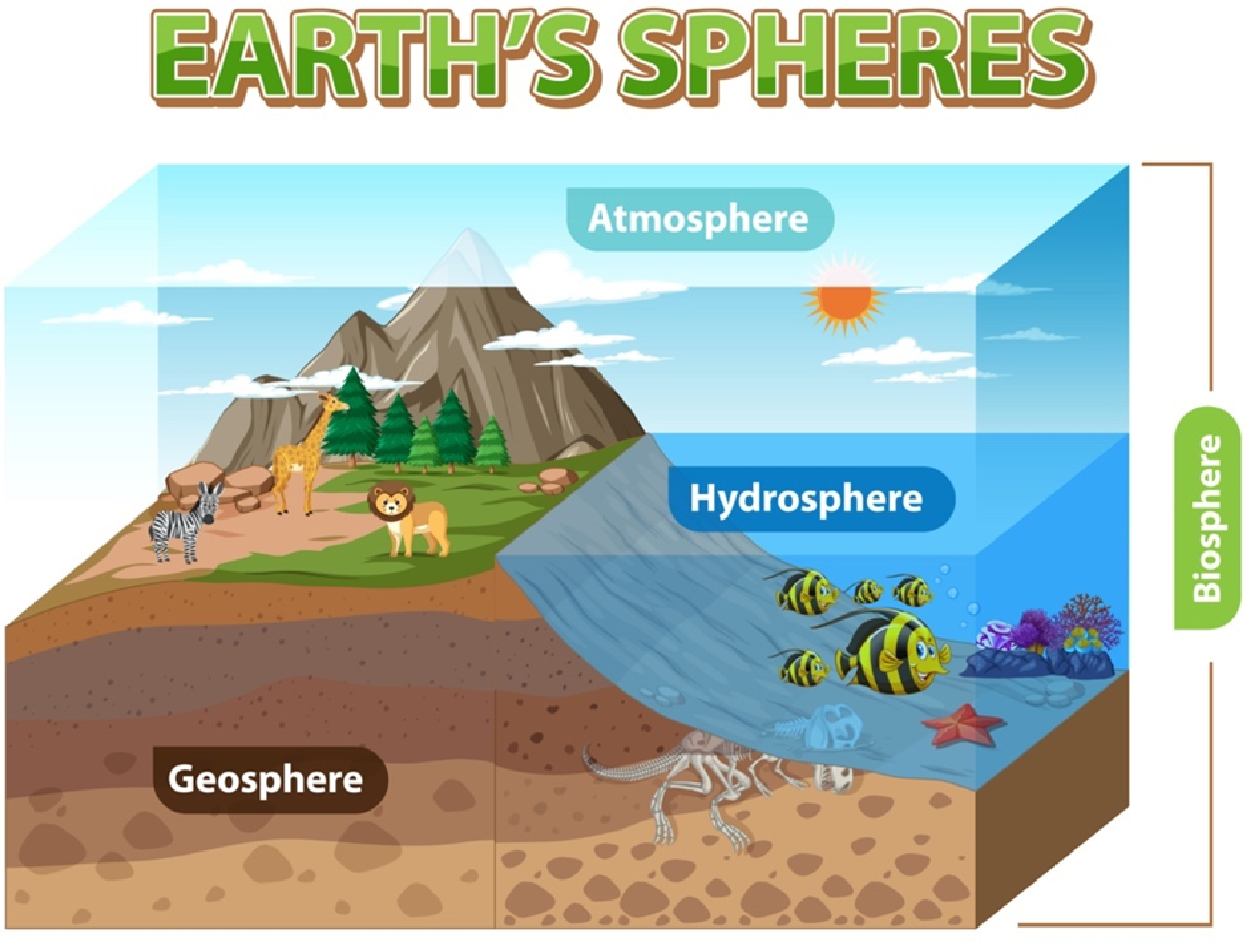

Figure 1: The Earth's Four Spheres [6]

Interactions Between the Four Spheres

Although the four systems have individual identities, important interactions occur between them. Environmental scientists study the effects of events in one sphere on the other spheres. Ten possible types of interactions could occur within the Earth system. Some of these interactions involve all four of Earth's spheres.[7] For example, a volcanic eruption in the geosphere may cause profound direct and indirect effects on the hydrosphere, atmosphere, and biosphere as follows. On May 18, 1980, Mount Saint Helens, in the state of Washington, erupted. This event altered the surrounding environment and provided scientists an opportunity to study the effects of volcanic eruptions on the lithosphere, hydrosphere, atmosphere, and biosphere. Such studies are important because volcanic eruptions will continue to occur, and will have an increasing impact on humans as people continue to settle lands closer to dormant volcanoes.

The ten types of interactions that can occur within Earth spheres often do so as a series of chain reactions. This means one interaction leads to another interaction, which leads to yet another interaction--it is a ripple effect through the earth's spheres. Volcanoes (an event in the geosphere) release a large amount of particulate matter into the atmosphere. These particles serve as nuclei for the formation of water droplets (hydrosphere). Rainfall (hydrosphere) often increases following an eruption, stimulating plant growth (biosphere). Particulate matter in the air (atmosphere) falls out, initially smothering plants (biosphere), but ultimately enriching the soil (geosphere) and thereby stimulating plant growth (biosphere). Volcanoes (events in the lithosphere) may release a substantial amount of hot lava (geosphere), which causes mountain glaciers (hydrosphere) to melt. Mudflows (geosphere) and flooding may occur downstream from volcanoes and may inundate streamside communities (biosphere).

Volcanoes (events of the geosphere) release a large amount of carbon dioxide (atmosphere), the raw material for sugar production in plants (biosphere). This may increase photosynthetic production and eventually increase the amount of biomass, which, after a very long time, forms coal and oil deposits (geosphere).

Volcanoes (geosphere) may also emit large quantities of sulfur dioxide (atmosphere). When atmospheric sulfur dioxide combines with water (hydrosphere), sulfuric and sulfurous acid form. Rain (hydrosphere) may bring these acids to the Earth, acidifying soils (geosphere), lakes and rivers (hydrosphere). Acidic water leaches nutrients from the soil (geosphere) into the water table (hydrosphere), making the soil less fertile for plants (biosphere), and the subterranean water supply (hydrosphere) less potable for humans (biosphere). Acid rain falling on lakes and streams reduces the pH of the water (hydrosphere), which may result in a decrease in phytoplankton and zooplankton growth (biosphere). If photosynthesis is reduced, atmospheric concentrations of carbon dioxide can build up and stimulate global warming (atmosphere) which may contribute to increased melting of glaciers (hydrosphere).[8]

The Layers of the Earth

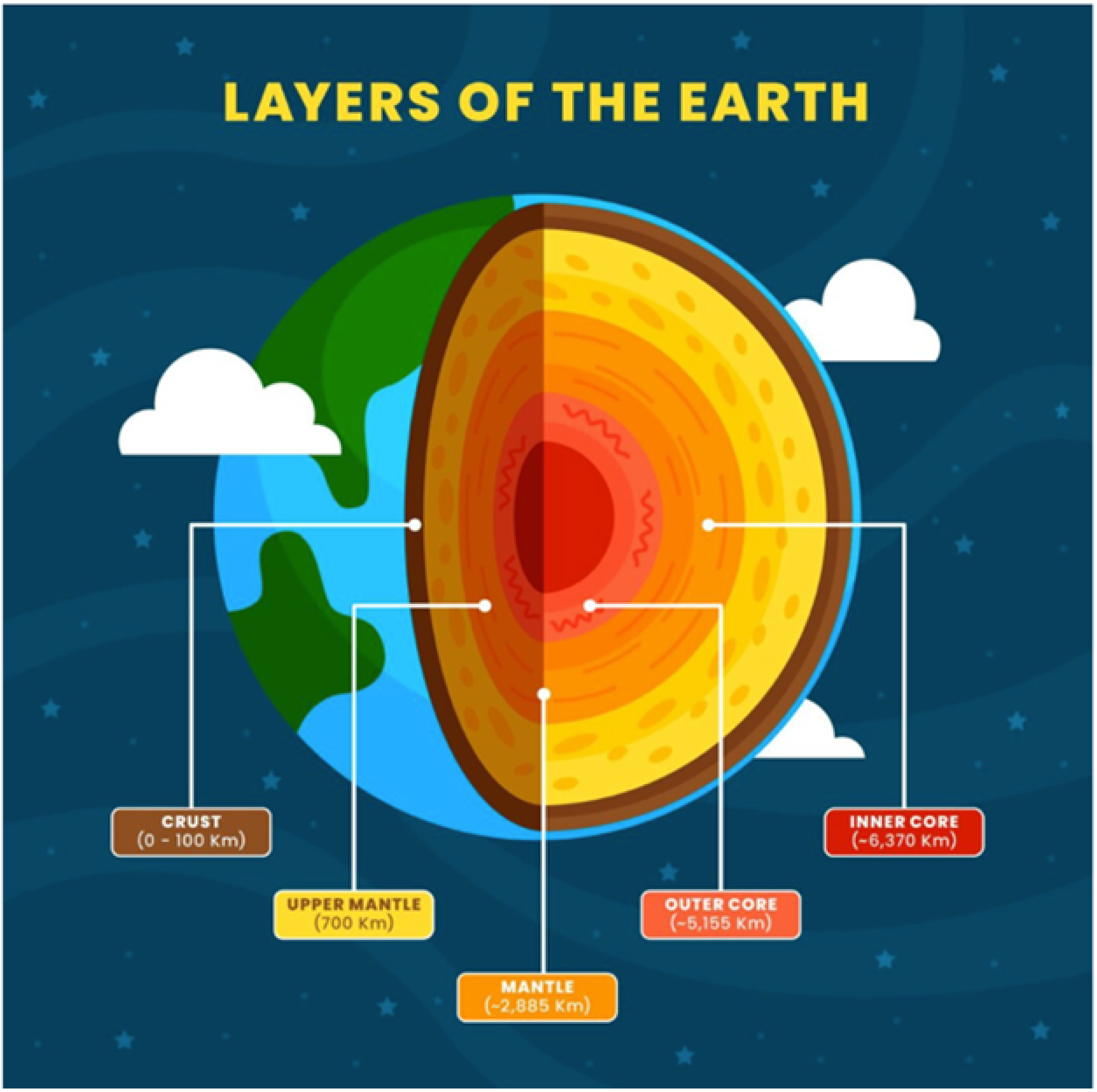

Figure 2: The Layers of the Earth [9]

The Earth can be divided into four layers - crust, mantle, outer core, and inner core. Many geologists believe that after the Earth initially cooled, over four billion years ago, the heavier, denser materials sank to the center and the lighter materials rose to the top. Because of this, the crust is made of the lightest materials (rock- basalts and granites) and the core consists of heavy metals (nickel and iron). The crust is what humans live on, and it consists of only one percent of the Earth's mass. The center of the Earth, a solid ball of nickel and iron, is roughly 70% the size of the moon.[10]

The Crust is the most widely studied and understood. The Mantle is much hotter and has the ability to flow. The Outer and Inner Cores are hotter still with tremendous pressures.

Geologists have come a long way in terms of the collective knowledge of the Earth and our solar system. Though it is impossible to see directly more than about 10 km deep into the planet's center, various scientific tests and predictions such as geological samples and seismic analysis have helped create a picture of what the Earth (and other planets) look like below the surface. In this way, the Earth has been separated into its distinct layers.[11]

Why the Earth Has Different Layers

The Earth's layers are caused by what it is made of and how it formed. The core is made of metal (mostly iron), while the rest of the Earth is made of rock. Metal and rock don't easily mix (kind of like oil and water). The metal and rock separated when the Earth first formed. Metal sank to the middle because it was heavier. The crust is made of different kinds of rocks than the mantle. The crust is formed by volcanism, and it's made of lighter rocks than the mantle, so those rocks tend to stay at the surface and form a separate layer after they erupt. The subdivisions within the crust, mantle, and core are often due to phase transitions; for example, the outer core is a liquid while the inner core is a solid, and the layers within the mantle are made of different combinations of minerals that have their atoms arranged in different ways, giving them different properties.[12]

Earth's layers can be assigned according to chemical composition (what they're made of) or mechanical properties (rock strength and elasticity). Layers based on chemical composition are the core, mantle, and crust. According to mechanical properties, Earth's layers are the lithosphere, asthenosphere, lower mantle (also known as mesospheric mantle), outer core and inner core.

Scientists know the layers are there. Seismic waves can tell them about Earth's interior, including where the lithosphere and asthenosphere are located. During an earthquake, primary (P) and secondary (S) waves spread out through the Earth's interior. Special stations situated around the world detect these waves and record their velocities, as well as the direction of wave travel and whether they have been refracted (bent). Seismic waves travel faster through dense material like solid rocks and will slow down in liquids.

Relative differences in arrival times of waves at several recording stations reveal their velocities and subsequently the density of the material they have traveled through. S waves, for example, cannot travel through liquids and do not travel through Earth's outer core, implying that this layer is liquid.[13]

The Crust

The crust of the Earth is the area that is arguably best known by scientists, and certainly, the one the general public is the most familiar with, as it is where we live. Human life all exists on the crust of the Earth, as does the rest of known organic life. The crust is the thinnest of the four layers on Earth and is only 1 percent of the whole Earth. The crust’s thickness ranges in measurement from only 5 to 70 km thick, depending on location.

The crust can be further divided into two categories - the continental crust, and the oceanic crust. The continental crust is generally much thicker, less dense, and is composed mainly of rock, and this is the ‘dry land’ crust which includes all earth above sea level. The other type of crust is known as the oceanic crust, is considerably thinner, denser, and made up of rock basalt. This is anything below sea level, and the thinner layers hold the oceans, seas, and gulfs. [14]

The Earth’s crust is also broken up into various pieces, known as tectonic plates, which fit together in a puzzle-like manner to form what is collectively called the crust or lithosphere. These plates, which contain large chunks of the crust, are free-floating in/on the deformable solid lower level known as the mantle. Tectonic plates exist in both oceanic and continental areas, and traverse political and continental borders. There are seven major plates: the Pacific, North American, Eurasian, African, Antarctic, Indo-Australian, and South American plates, and at least 10 minor plates: Somali, Nazca, Philippine Sea, Arabian, Caribbean, Cocos, Caroline, Scotia, Burma, and the New Hebrides plates.[15]

The Mantle

The mantle makes up 84 percent of the Earth's volume and is entirely solid except for very small places beneath volcanoes where the rock has melted into magma. When the Earth was young, the majority of the mantle would have been viscous melted rock (the so-called "magma ocean"), but this has cooled and solidified over millions of years to form the mantle we know today. The mantle is much thicker than the crust, measures some 2,900 km in depth, and is mainly composed of silicate minerals such as olivine, garnet, pyroxene, or magnesium oxide. Several other elements are common in the mantle layer, including iron, minor calcium, and traces of aluminum, sodium, and potassium.[16]

As you go deeper into the Earth, temperature and pressure increase. Within the mantle, there is a range of temperature, which rises depending on depth. Nearest the crust, the mantle registers temperatures around 1000° Celsius (~1800° Fahrenheit). At its deepest, temperatures can read as high as 3700° Celsius (~6700° Fahrenheit) or more.

As mentioned, the tectonic plates which form the mantle, are often described as 'floating' on the mantle asthenosphere. The mantle is least viscous at these plate borders and faults, allowing for mobility of the plates over large expanses of time. The mantle itself can be divided into several sub-layers which include the upper mantle, the transition zone, the lower mantle, and D or D double-prime layer. [17]

The Core

Below the mantle lies the layer known as the Outer Core. This is a thick layer - some 2,200 km (~1400 miles) thick - that consists of liquid iron and nickel. In order for the nickel and iron to be in liquid form, the core must sustain intensely high heat. The Outer Core is thought to be as hot as 6,100 degrees Celsius (11,000 Fahrenheit) It has been determined that this layer is liquid, based on the extensive study of seismic waves, and the way in which they bounce off the center of the Earth. The waves move differently through solids or liquids, thus distinguishing the outer core from its solid inner counterpart. This layer is also not static. As the Earth rotates on its axis, the liquid metal of the outer core also spins, turning approximately 0.3 to 0.5 degrees per year relative to the rotation of the surface. The outer core is also thought to be the cause of the magnetic field on Earth.[18]

At the very center of the Earth is what is known as the Inner Core. Protected by the liquid outer core, mantle, and crust, the inner core is a hot solid ball of highly pressurized nickel and iron, with a temperature of approximately 5,400 °C (~9,800 °F), which is roughly the same as that of the surface of the sun. The core is an extremely dense and highly pressurized environment. The inner core is actually expanding very slowly as the outer core layer solidifies. This solidification can be attributed to the high density and pressure found in the Earth's center, and the very slow loss of Earth's heat to outer space. In theory, this means the whole core will eventually fully cool and become a purely solid mass over billions of years. [19]

Teaching Strategies

Experiential Learning: The major strategy for this unit is to engage the students in hands-on learning. I want them to be actively participating as inquisitive scientists and engineers. The layers of the Earth design and boiled egg/avocado activities are designed to be exploratory for the students so that they are engaged in the enjoyment of the inquiry and design as well as the process.

Differentiated Instruction: The students will use a variety of approaches, working sometimes individually and sometimes in small groups, determined by the complexity of the activity. Because these are young children with variance in levels and background, the unit's guidance and pacing are adjusted to ensure that all students are engaged and active throughout the learning experiences. Students will have opportunities to work with a variety of peers as they explore design ideas using various materials.

Cooperative Learning: The students will be given opportunities to work in cooperative groups to complete assignments and activities. This strategy will allow students to work collaboratively taking on various roles necessary to complete the experiments and journal work, with a focus on success for all.

Classroom Activities

Activity One: Introduction to Earth's Layers

Objective: Make observations (firsthand or from media) to collect data that can be used to make comparisons.

Materials: read-aloud book - *The Street Beneath My Feet,* copies of earth labeling activity, pencils scissors, glue.

Begin the unit by reading *The Street Beneath My Feet* by Charlotte Guillain and Yuval Zommer.. This will introduce the unit with a fundamental foundation of geology, recognizing that earth is made up of many layers of different materials. The book contains an extensive fold-out section that provides a visual of what is happening from where we are standing all the way to the center of the planet.

Introduce the by showing the video, *Layers of the Earth for Kids* | *Learn facts about the different layers of Earth* or one similar. This eight-minute video shows students each of the layers beneath our feet and teaches the correct terms and vocabulary.

In our Layers of the Earth for Kids video, the students will discover some facts about the four main layers that make up our Earth. The Earth is not simply a giant ball of dirt, rocks, and minerals. On the contrary, our planet is much more than meets the eye. The crust is the outer layer of the earth and is mostly between 5 and 40 km thick depending on where you are. Under the oceans, it is only about 5 to 8 km thick, and we refer to these areas as oceanic crust. The crust beneath tall mountain ranges reaches up to 80 km thick. We refer to these parts as continental crust. The temperatures of the earth's crust can range anywhere between air temperature and 900°C, which is hot enough to melt rocks! This thin layer consists of broken pieces called plates, which float on top of the soft mantle layer below. (The movement of these plates is what often causes earthquakes.)

The mantle layer is the largest at about 2900 km thick. It comprises extremely hot, dense rock that flows like asphalt. The temperature at the top is about 900°C, but it's about 4000°C at the bottom! This layer is entirely solid except for very small zones that have melted due to excess heat, reduced pressure, or unusual chemistry. In those places, the melted rock escapes to the earth's surface, creating volcanoes. Then comes the outer core of the earth. The outer core consists mostly of melted nickel and iron. This layer lies around 2900 km below the earth's surface and is around 2200 km thick. The temperature ranges from 4000°C to 5000°C! The inner core is about 1200 km thick with about 5000°C temperature. There is so much pressure in the core that the metals squeeze very tightly, forcing them to vibrate as solids do. This pressure comes from the weight of the other layers that press down on it.

Activity Two: Hard-Boiled Egg Dissection

Objective: The students will practice how scientists use models to visualize what may be difficult to see or understand and learn how models have limitations

Materials: hard-boiled eggs, trays, plastic knives

Overarching questions to continue to consider are: ‘What is under our feet?’ and ‘How do rocks and the earth change?’ In this particular lesson, students grapple with the question, ‘Could I dig through the earth?’ The dissection gives the Kindergarteners a hands-on way to experience the layers of the earth. They practice how scientists use models to visualize what may be difficult to see or understand and learn how models have limitations.

In this dissection, students will use a hard-boiled egg to model the layers of the earth. They work with a partner to crack the shell and peel a thin layer representing the earth's crust. Students should notice that the shell was solid, like the earth's crust, and relatively thin compared to the rest of the egg. It also broke into pieces, just like tectonic plates. They will then work to separate the white from the egg's yolk, representing the earth's mantle and core.

Be sure to discuss the limitations of this model and point out that while the white of the egg can easily be squeezed by human hands, the real mantle of the earth only deforms very slowly (rates that fingernails grow) and from tremendous forces. Following this science experiment, ask the students, "What other objects or food could represent the layers of the earth?" This part of the activity is where Kindergarteners can transfer the idea of models and the layers of the earth to a different example, such as a peach, an avocado, or even a dragon fruit to represent the Earth.

An additional example of scientists relying on models would be to use a raw egg held up to a student’s ear. This activity is best done with the teacher holding the egg. Once the egg is placed, tap on the outer end and have the students notice if they hear anything from inside the egg. The sound waves that move through the egg give scientists some idea of what is inside. Tell the students the tapping is moving things inside just as an earthquake moves things inside our Earth.

Activity Three: Model of the Layers of the Earth – Example One

Objective: The students will use playdough to design and build a structure of the Earth’s layers.

Materials: ingredients for homemade playdough, wooden spoon, hot plate, potholders, plastic or latex gloves for students, plastic knife, toothpicks, small post-it notes, (purchased playdough or clay)

For this activity, cook up a batch of homemade playdough and divide the dough to make six different colors: blue, green, red, orange, yellow, and brown.

Students: To make the dough, add the following ingredients to a pot:

- 3 cups of flour
- 1/2 cup of salt
- 6 tablespoons cream of tartar
- 3 tablespoons of vegetable oil
- 3 cups of water

Students: Mix until all the lumps are gone.

Teacher: Move the pot to the hot plate, and cook over low heat, stirring often. The dough started to thicken in a few minutes. Once the batch starts pulling away from the sides (but is still a little sticky), turn off the heat and allow it to cool in the pot. Once cool, the stickiness will disappear, and the dough can be kneaded and dyed.

Divide the cooked playdough into six parts: two small (golf ball-sized), two medium, and two large balls. Drop several drops of food coloring into each ball. The two small balls become red and green, the medium balls are dyed orange and brown, and the large ones are dyed yellow and blue.

This batch will make enough dough for two groups to complete the project. Depending on the number of groups, cook up a few more batches. Be sure to do this step with the students.

Alternatively, purchased playdough or molding clay can be used for this project.

Building the Layers of Earth

Now it was time to create the layers of the earth. Start by rolling the small red dough into a ball. This serves as the Earth's solid inner core, which is almost as hot as the sun.

For the next layer, flatten the medium-sized orange dough and place it around the red ball. Pinch the sides closed, removing any extra dough in the process. This layer is the liquid outer core that spins creating Earth's magnetic field.

Next, flatten the large yellow ball to create the mantle. This is the thickest layer and is made of very, very hot rocks.

Flatten the medium brown ball and place it over the yellow ball. The thin brown layer represents Earth's crust and is made up of cold, brittle rocks.

Finally, flatten the blue ball and cover the earth in the ocean. Form the continents, (the land we walk on) using the small green ball of dough and place them on the blue layer to create the globe.

The final step – cutting the planet in two. The easiest way to do this is to use dental floss. This will expose the layers from the crust to the core. Using toothpicks and small post-it notes, label the layers.

Activity Four: Model of the Layers of the Earth – Example Two

Objective: The students will use a variety of materials to design and build a structure of the Earth's layers.

Materials: plastic champagne-style cone-shaped glasses– one for each student, orange and yellow colored sand, stones of various sizes, red playdough, soil, blue clay, green leaves, dried leaves, twigs, trays and/or bowls for sorting materials, scoops and spoons, masking tape or painter's tape, image of layers of the Earth

Sequence of layering, bottom to top:

Red playdough

Orange sand

Yellow sand

Brown material

Blue clay

Green material

Create a model for students to use as an example. Prepare materials and divide them across tables for groups to share. As this is a step-by-step project, have students follow the directions as they are given.

1. First, place a ball of red playdough in the bottle of the jar and flatten it out. This represents the inner core.
2. Next, pour a layer of orange sand to about an inch deep. This represents the outer core.
3. Now, pour a layer of yellow sand to about two inches thick. This is the mantle of hot solid rock.
4. Brown soil mixed with twigs represents the crust.
5. Flatten a piece of blue clay to represent oceans.
6. Finally green material to represent to land.

Substitutions for the representative materials are certainly possible. Consider colored rice, a mixture of slime (cornstarch and water) of various colors, and a variety of craft materials. Depending on the shape and size of the jars, gather enough supplies to ensure all students can create each layer.

Using the masking tape or painter's tape, help students mark each layer on the outside of the jar. The labels can be prewritten or printed on address-type labels.

Resources

Dobrijevic, Daisy. "Earth's Layers: Exploring Our Planet Inside and Out." Space.com, April 8, 2022. https://www.space.com/17777-what-is-earth-made-of.html.

This website contains clear explanations of the layers of the Earth, with snapshot charts of data. Helpful

section on frequently asked questions.

Dodd, Carly. “What Are the Layers of the Earth?” WorldAtlas, December 16, 2020. https://www.worldatlas.com/articles/the-layers-of-the-earth.html.

Clearly stated facts about each layer with interesting images showing the composition from the crust to the core. Map of the major and minor tectonic plates.

“The Earth’s Layers Lesson #1.” Volcano World, December 10, 2018. https://volcano.oregonstate.edu/earths-layers-lesson-1.

Explains the fundamentals of how volcanoes work. Includes a section for teachers, lesson plans, and a virtual tour of the volcano system, volcano folklore, and volcano parks.

Education, UCAR Center for Science. “Center for Science Education.” Layers of Earth’s Atmosphere | Center for Science Education. Accessed July 7, 2024. https://scied.ucar.edu/learning-zone/atmosphere/layers-earths-atmosphere.

The University Corporation for Atmospheric Research website provides comprehensive and current news and research in Earth system science.

Everything in Earth’s system can be placed into one of four. Accessed June 3, 2024. https://gml.noaa.gov/education/info_activities/pdfs/TBI_earth_spheres.pdf.

Google Earth. Accessed March 26, 2024. https://www.google.com/earth/.

Google Earth is a computer program that renders a 3D representation of Earth based primarily on satellite imagery.

Guillain, Charlotte, and Yuval Zommer. The street beneath my feet. London: QED Publishing, 2017.

This double-sided foldout book takes the readers on a journey down through the layers of the Earth, all the way to the planet’s core and out the other side.

“Layers of the Earth for Kids | Learn Facts about the Different Layers of Earth.” YouTube, September 29, 2022. https://www.youtube.com/watch?v=N1DIn_xwvdo.

This eight-minute video takes students through a series of real and graphic images to provide a practical view of the layers of the Earth. It is set up to show in sections so not necessary to view all at once.

Louv, Richard. Last Child in the Woods: Saving our children from nature-deficit disorder. London: Atlantic Books, 2013.

The book intends to illustrate the impacts of too little time spent in nature and what to do to get more nature in kids' lives and make inner cities more accommodating to natural activities.

Marshak, Stephen. Earth: Portrait of a Planet. New York, N.Y: W. W. Norton & Company, 2022.

Extensive college text for helping to visualize and understand geologic processes. Accessible information in Chapters 2, 3, and 4 is most helpful for this unit.

Mitchell, Brooks. “Learn the Basics of Geology.” ThoughtCo, February 18, 2019. https://www.thoughtco.com/geology-basics-4140422.

Appendix on Implementing District Standards

Kindergarten Next Generation State Standards

Students who demonstrate understanding can:

K-PS3-1. Make observations of the effects of sunlight on Earth’s surface. Examples of Earth’s surface could include sand, soil, rocks, and water. Assessment of temperature is limited to relative measures such as warmer/cooler.

Through this standard, students gain an understanding of temperature along with examples of what the Earth’s surface is comprised of. This unit extends those understandings to go below the surface and learn how these same materials are throughout the layers of the Earth. The students will have had an opportunity to understand how high temperatures can occur, caused by the sun. This understanding can be applied during Activity One, that the temperature below the surface is hot enough to turn rocks into liquid.

K-PS3-2. Use tools and materials to design and build a structure.

In this unit, students make two structures to show their understanding. In Activities Three and Four, students demonstrate what they have learned about Earth’s layers and show their design skills in creating models that show those layers.

Science and Engineering Practices:

Planning and Carrying Out Investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Make observations (firsthand or from media) to collect data that can be used to make comparisons.

Constructing Explanations and Designing Solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

In this unit, students employ these practices as they work through the set of activities that ask them to build knowledge starting with the book, *The Street Beneath My Feet* and progressing to building models based on observations, evidence of natural phenomena, and designing from experience.

Endnotes

[1] Louv, Richard. Last Child in the Woods: Saving our children from nature-deficit disorder

[2] Mitchell, Brooks. “Learn the Basics of Geology.”

[3] Mitchell, Brooks. “Learn the Basics of Geology.”

[4] https://gml.noaa.gov/education/info_activities/pdfs/TBI_earth_spheres.pdf.

[5] https://gml.noaa.gov/education/info_activities/pdfs/TBI_earth_spheres.pdf.

[6] Image by brgfx on Freepik

[7] https://gml.noaa.gov/education/info_activities/pdfs/TBI_earth_spheres.pdf.

[8] https://gml.noaa.gov/education/info_activities/pdfs/TBI_earth_spheres.pdf.

[9] Image by Freepik

[10] Dobrijevic, Daisy. “Earth’s Layers: Exploring Our Planet Inside and Out,” 2022.

[11] Dobrijevic, Daisy, 2022

[12] Dobrijevic, Daisy, 2022

[13] Dobrijevic, Daisy, 2022.

[14] Marshak, Stephen. Earth: Portrait of a Planet, pp. 60-61.

[15] Dodd, Carly. “What Are the Layers of the Earth?” WorldAtlas, December 16, 2020.

[16] Marshak, Stephen, p. 61-63.

[17] Dodd, Carly, 2020.

[18] Dodd, Carly, 2020.

[19] Marshak, Stephen, p. 63.