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Educational Services

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Contents

Chapter 1 5

Lesson 1 - Layers of the Earth..... 6
Lesson 2 – States of Matter..... 10
Lesson 3 – Convection 13
Lesson 4 – Plate Tectonics 16
Lesson 5 – Earthquakes..... 19
Lesson 6 – Volcanoes 21
Lesson 7 – Types of Volcanoes 25
Lesson 8- The Rock Cycle 29

Chapter 2 32

Lesson 1 – Weathering 33
Lesson 2 – Erosion 37
Lesson 3 – Deposition 41
Lesson 4 – The Journey of a Mountain..... 45
Lesson 5 – Earth's Topography..... 49
Lesson 6 – How to Read a Map 53
Lesson 7 – How to Draw a Map..... 57
Lesson 8- Soil Health and The Nitrogen Cycle .. 60

Chapter 3 61

Lesson 1 - Thermal Energy – Radiation 62
Lesson 2 – Earth's Water Cycle 65
Lesson 3 – Ocean Currents 67
Lesson 4 – Major Features of the Ocean Floor 70
Lesson 5 – Ocean Habitats..... 74
Lesson 6 – Tides 76
Lesson 7 – Waves 80
Lesson 8- Coral Reefs 82

Chapter 4 83

Lesson 1 - Layers of the Atmosphere 84
Lesson 2 – Weather Basics 88
Lesson 3 – Air Pressure..... 91
Lesson 4 – Storms 94
Lesson 5 – Hurricanes 97
Lesson 6 – Weather Forecasting 100
Lesson 7 – Carbon Cycle – Global Warming..... 103

Chapter 5 104

Lesson 1 - Gravity..... 107
Lesson 2 – Seasons 110
Lesson 3 – Phases of the Moon 112
Lesson 4 – Solar Energy..... 116

Chapter 1

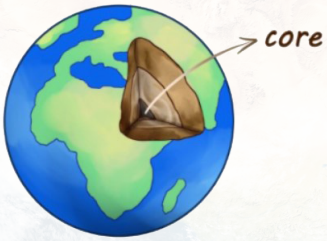
Lesson 1.1- Layers of the Earth

When you think of what Earth looks like you probably picture roads, buildings, parks, lakes, and loads of other things you can see wherever you go. But have you ever wondered what happens below the surface that you're familiar with? What would you find if you dug and dug thousands of miles deep? Just lots of mud? Well, you are about to discover that there is a whole lot more than just plain old dirt down there! So if you ever plan on digging through all 4,000 miles of Earth down to the center, plan to meet some pretty interesting layers.

Ever cut into an onion? If you weren't crying too hard, you may have noticed that underneath the outer brown peel there are lots of layers. Earth is kind of like an onion in that sense. Just as on the outside of an onion there is a peel, on the outside of Earth there is the land and water we see. We call this the **exterior**. Earth's **interior** (inside) is made up of many layers, like the inside of an onion. Earth's interior is divided into 3 main layers: **core**, **mantle**, and **crust**. For each, we will investigate its position, temperature, depth, state (solid, liquid or gas), and **composition** (what it's made of).

CORE:

Position-



Temperature: 7,200ºF- 13,000ºF

Depth: 1,800 miles

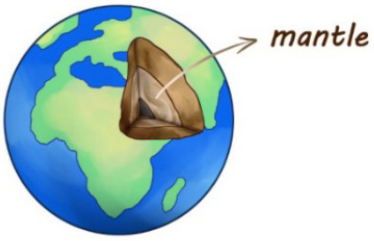
State: Inner core is solid, outer core is liquid

Composition: Iron, nickel, oxygen, and sulfur

Earth's core can be divided into the inner core and the outer core. The inner core is a huge metal ball found at the very center of the earth. The outer core flows around it as liquid metal, creating our planet's magnetic field. And boy is it hot down there—it's up to 6,000 times hotter than our atmosphere!

MANTLE:

Position-



Temperature: 2,500ºF-5,500ºF

Depth: 465 miles

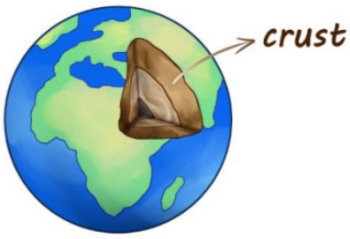
State: Liquid/solid

Composition: Iron, oxygen, silicon, magnesium, and aluminium

The mantle is like a river of rock. It's so hot that the rock remains melted and is able to flow. This is our layer that likes to swirl and be on the move! Like the core, the mantle can also be divided into upper and lower layers. The upper mantle is cooler and is made of a more liquidy substance than the lower mantle.

CRUST:

Position-



Temperature (average): 72°F

Depth: Up to 43 miles below the surface

State: Solid

Composition:

- Continental crust (the land we live on) is made of granite, sedimentary rocks, and metamorphic rocks.
- Oceanic crust is made up of iron, oxygen, silicon, magnesium, and aluminum.

The crust is the layer right beneath our feet. Imagine the round earth were like a pizza pie and you sliced a triangle piece out of it. What would the round, outer edge of your slice be called? You got it—crust! It is thicker on dry land where it is known as continental crust and thinner under the oceans where it's called oceanic crust.

Magnetic Properties Of The Core:

Back when we had spoken about Earth's core, we mentioned that the flow of liquid metal in the outer core creates Earth's magnetic field. What exactly is this magnetic field? If you are picturing a baseball field that magically gets the ball to meet the bat like a magnet, then you have got a great imagination but it can use a bit more of an explanation.

A **magnetic field** is an area where the **attraction** and **repulsion** (pull and push) of a magnet can be felt. So imagine you pull a magnet off your fridge and then slowly bring the magnet back toward the fridge. When you begin to feel the magnet tugging toward the fridge as if it wants to jump onto it, that means you have entered its magnetic field. Those flowing metals in Earth's core create a giant magnetic field across the planet. Every magnet has centers of force, known as poles, at each of its ends. That's why the North Pole and the South Pole are highly magnetic; they are at the two ends of Earth.

Ever been lost in a jungle? Chances are, you used a compass to get out. And if you didn't, you may want to pack one before your next safari trip; they are so cool! The needle of a compass is magnetic. It will always point toward the magnetic North Pole. So wherever you are, you can always pull out a compass and figure out all your directions.

The mantle is like a river of rock. It's so hot that the rock remains melted and is able to flow. This is our layer that likes to swirl and be on the move! Like the core, the mantle can also be divided into upper and lower layers. The upper mantle is cooler and is made of a more liquidy substance than the lower mantle.

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Lesson 1.1- Layers of the Earth

Word Match:

1. Exterior	Innermost layer of Earth
2. Interior	An outer surface
3. Core	What something is made of
4. Mantle	The layer of Earth right beneath our feet
5. Crust	An inner surface
6. Composition	The push of a magnet
7. Magnetic field	The pull of a magnet
8. Attraction	The layer between core and crust
9. Repulsion	The area where magnetism exists

Observations

Draw the filed lines that you observe around the bar magnet.

Carefully, rub the needle against the bar magnet. Repeat this several times in the same direction. Push the needle into the cork. Now, place your cork into the bowl of water. Draw what you see. Now, compare the homemade compass to the compass you were provided with. Draw the compass next to your homemade compass.

My Compass

Provided Compass

Lesson 1.2- Thermal Energy and Conduction

States of Matter:

You matter, I matter. In fact, not only do we all matter, but we are all made of matter too!

What is Matter?

Matter is anything that takes up space. That means tables, chairs, trees, water, and yes, even YOU are matter! Air is matter, too. You don't think air takes up space? Try blowing up a balloon and you will see that it sure does!

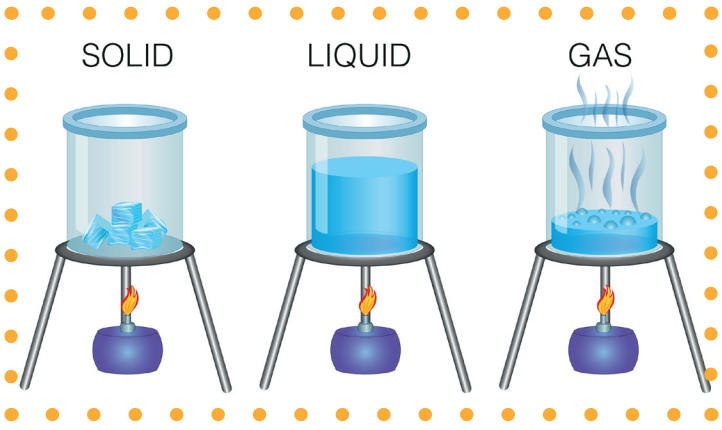
The tiny particles that make up matter are called **atoms**. They are so small that you can't even see them with a regular microscope. Clusters of atoms bound together are called **molecules**. Depending on how tightly packed the molecules are in a piece of matter, the state of the material can be determined.

A **state** is the form in which the particles of matter exist. There are three main states of matter: solid, liquid, and gas.

The molecules of a **solid**, like rock, are packed tightly together and don't really move around. Meaning, that solids keep their original shape and size no matter what you do to them. For example, if you take a book out of a small box and place it in a bigger box, the book will stay the same.

In **liquids**, such as water, the molecules aren't as tightly packed. Liquids will stay the same size no matter what you do to them, but they are also able to change shape. That's why water poured from a narrow cup into a wide bowl will flow to fill its shape.

A **gas**, such as the air we breathe, has neither a set size, nor a set shape. The molecules are very spread apart and are able to move around freely. The same gas that can be put in and fill a big container can also be squeezed into a smaller container.



Energy is the ability to do work.

So what determines which state a piece of matter will be in? That depends on the amount of energy between the molecules. Think about a morning when you wake up with lots of energy. What does that make you want to do? Run around the yard! Jump on a trampoline! Climb up a mountain! Move, move, MOVE! **Energy** is power, or the ability to do work. The molecules in a solid have very little energy. They don't really want to move around so they just stay put, like you might do on the couch when you are feeling low on energy. Liquids, though, contain more energy, so they like to splash around. Gasses have lots of energy! Gas molecules love to bounce around and take up as much space as possible.

Heat:

Heat is a form of energy. Think about how you felt that morning when you ran around the yard, jumped on a trampoline, and went climbing. I'll bet you were hot and sweaty! You felt energetic, you moved, and you felt hot. The molecules that make up matter are the same in that way. If they have energy, they will move around and release heat. When a substance is heated , its molecules begin to move faster and farther apart. This can lead to a state change. And we're not talking about moving from New York to Alabama. These are states of matter! Let's take a look at water.

Water is a unique substance that can exist in all three states: solid, liquid, and gas.

Water can actually exist in all three states: as solid ice, as liquid water, and as gaseous vapor. **Water vapor** is water existing as a gas. Imagine you pull a few ice cubes out of the freezer and place them in a cup. What would eventually happen? You got it— it'll all turn to water! The heat of the room caused the tightly packed molecules of the solid ice to move faster and spread further apart, turning it into liquid. The water has experienced a state change. Now take water and place it in a pot on the stove. When the water begins to boil the liquid turns to gas! As the water heats up, the molecules move even faster and farther apart than before. What you'll begin to see is the formation of steam, or vapor, rising out of the pot and spreading through the air. Water in gas form no longer has that set shape of an ice cube or the flowy consistency of a liquid. Rather, it takes the form of tiny molecules that want to jump and spread all over the place.

On a hot day, a bike tire looks overinflated, while on a cold day, it looks deflated.

Besides for state changes, other interesting things can happen to matter when it's heated up. Take a bike tire, for example. What is that tire filled with? Yup, air is the correct answer. And as you know, the air in that tire is made up of gas particles that are moving around and trying to spread far apart from each other. But, on a really hot day, things get even more exciting in there. The molecules move even faster and even farther apart than before! So what you may notice is that the bike tire expands, or becomes bigger and looks fuller. This is not because more gas has entered the tire; it remained sealed the whole time. But due to the high temperature, the gas has expanded and is taking up space. Can you imagine what might happen on a really cold day? You got it— the tire begins to look a little flat. Without heat, the molecules move around more slowly and settle in more closely together. In other words, the gas contracts, or becomes smaller and takes up less space.

One more point to investigate here is how heat is transferred. There are three ways that heat can move from one object to another: conduction, convection and radiation. Let's take a look at conduction.

Conduction is the transfer of heat within an object, or between two objects that are touching. For example, when a metal spoon is placed in a cup of hot tea, some of the heat of the tea will transfer onto the spoon, making it hot, too.

A spoon left in a hot tea will heat up via conduction.

Word Match:

1.	***Matter***	Atoms bound together
2.	***Atom***	Become bigger
3.	***Molecule***	Matter that has no set size or shape
4.	***State***	The form in which something exists
5.	***Solid***	Anything that takes up space
6.	***Liquid***	Matter that has a set size and shape
7.	***Gas***	The ability to do work
8.	***Energy***	Matter that has a set size but no set shape
9.	***Water vapor***	Water in a gas form
10.	***Expand***	Become smaller
11.	***Contract***	Tiny particle that makes up matter