Hydrosphere

http://www.geography4kids.com/files/water_intro.html

Water, Water, Everywhere

Water is everywhere on Earth. About seventy percent of the surface of the Earth is covered by water. If you were an alien visiting the planet, you would see a giant blue sphere from space (especially on the Pacific Ocean side). Not only is water everywhere, but all life depends on water. The tiniest bacteria and the largest dinosaurs have all needed water. The **hydrosphere** is the world of water that surrounds all of us.

Because water is so important, it makes up an entire section of the earth sciences. You will probably hear the term "**hydro**" many times. The prefix "hydro" has origins in ancient Greek. You will learn about hydrologists that study water and the way it is used and circulated across the planet. Hydrology is the study of water. That water may be at the bottom of the ocean or in clouds found in the **atmosphere**. Anything related to water is a part of the hydrosphere.

Importance of Liquid Water

Water is in the air, on the land, between the rocks, and in every living thing. Water, in its purest form, is the compound **H_2O**. There are two **hydrogen** (H) atoms bonded to one **oxygen** (O) atom. Generally, you won't find pure water. There are usually other compounds, ions, or particles **mixed** with water. While water may move and carry other substances with it, you need to remember that the small water molecules are the things that make life on Earth possible.

Liquid water makes the Earth a special place. Our planet has a very nice temperature range that allows water to remain in a liquid state. If we were a colder place like Pluto, all of the water would be permanently frozen and solid. On the other hand, if we were on a very hot planet, all of the water would be in a gas state. **Water vapor** and solid water are relatively useless to the organisms of Earth.

Things get interesting when you start to have a system with solid, liquid, and gas states of water. Because all of the states exist on Earth, they are all important to scientists. There are solids in the deep **glaciers**, liquids of the **oceans**, and the vapor state of **clouds**. While there might not be a lot of life in or on those glaciers, they will eventually melt. Once they melt, they start to affect all of the life on Earth. All of the physical states are equally important because they are all connected.

The Life of a Water Molecule

Let's say you're a water molecule. For this example we'll assume you are staying a water molecule and not combining with other compounds. We're going to have you move through the **hydrologic cycle**. You'll start by sitting on the surface of the Pacific Ocean. All of a sudden you are filled with energy, **evaporate**, and move up into the atmosphere.

Winds are moving and you see yourself flying over the ocean towards land. Things start to get cold and all water vapor around you begins to **condense**. You all clump together and now you're too heavy to stay in the clouds. You fall to the surface in a raindrop. If you are one of the first drops to fall, you might be **absorbed** into the soil. If you are at the end of a storm, you might wind up in **runoff** and drain into a **river**. From that river you could flow all the way back to the ocean and start your journey over again.

How much time does your journey take? Scientists think that if you are lucky enough to evaporate into a cloud, you spend about ten days floating around the atmosphere. If you're unlucky enough to be at the bottom of the ocean, **percolate** into an **aquifer**, or get stuck in a glacier, you might spend tens of thousands of years without returning to the hydrologic cycle. As of 2013, the oldest ice ever found was about 800,000 years old. That's a long time to stay out of the water cycle.

https://oceantoday.noaa.gov/watercycle/

NOAA Video Transcript

You may think every drop of rain falling from the sky, or each glass of water you drink, is brand new, but it has always been here, and is a part of the water cycle. At its most basic, the water cycle is how water continuously moves from the ground to the atmosphere and back again. As it moves through this cycle, it changes forms. Water is the only substance that naturally exists in three states on Earth – solid, liquid, and gas.

Over 96% of total global water is in the ocean, so let's start there. Energy from the sun causes water on the surface to evaporate into water vapor – a gas. This invisible vapor rises into the atmosphere, where the air is colder, and condenses into clouds. Air currents move these clouds all around the earth.

Water drops form in clouds, and the drops then return to the ocean or land as precipitation - let's say this time, it's snow. The snow will fall to the ground, and eventually melts back into a liquid and runs off into a lake or river, which flows back into the ocean, where it starts the process again.

That's just one path water can take through the water cycle. Instead of snow melting and running off into a river, it can become part of a glacier and stay there for a long, long time. Or rain can seep into the ground and become groundwater, where it's taken up by plants. It can then transpirate to gas directly through the leaves and return to the atmosphere. Or, instead of being taken up by the plant, the groundwater can work its way up to a lake, river, spring, or even the ocean.

As you can see, the water cycle can be a very complicated process. And all its paths through Earth's ecosystems are complex and not completely understood.

Water is essential to life on Earth, and fresh water is a limited resource for a growing world population. Changes in the water cycle can impact everyone through the economy, energy production and use, health, recreation, transportation, agriculture, and drinking water. And that's why understanding of the water cycle has become one of NOAA's Grand Science Challenges. NOAA studies all aspects of the water cycle – ocean, weather, precipitation, climate, ecosystems – and our impacts on it.

Atmosphere

https://www.youtube.com/watch?v=usDNAMNE3Eg

A Cozy Blanket Around The Earth

The atmosphere looks like a blanket of gas when you look at it from space or the ground. The Greek word, “atmos,” refers to “air/vapor/gas.” When scientists started to examine the atmosphere, they noticed that there were different parts and different layers. There are layers of different molecules, temperatures, and pressures. Overall, the atmosphere is made up of a few main molecules. The air above you is made of 78% nitrogen (N_2), 21% oxygen (O_2), 0.9% argon (Ar) and 0.04% carbon dioxide (CO_2). That's it. The rest of it is made of things called trace elements. Those trace elements include water vapor, ozone, and other particles and molecules floating around.

Exosphere

The **exosphere** is the outermost layer of our atmosphere. *“Exo”* means *outside* and is the same prefix used to describe insects like grasshoppers that have a hard shell or “exoskeleton” on the outside of their body.

The exosphere is the very edge of our atmosphere. This layer separates the rest of the atmosphere from outer space. It’s about 6,200 miles (10,000 kilometers) thick. That’s almost as wide as Earth itself. The exosphere is really, really big. That means that to get to outer space, you have to be really far from Earth.

The exosphere has gases like hydrogen and helium, but they are very spread out. There is a lot of empty space in between. There is no air to breathe, and it’s very cold.

Thermosphere

The **thermosphere** is the hottest layer. There is a huge amount of energy in this layer. The source of that energy is the solar radiation from space hitting the thermosphere. There are very high temperatures because of all the excited atoms zipping around. Something interesting you should know is that even though the temperature is very high (very excited atoms), there is actually very little heat.

Heat happens when energy is transferred from one atom to another. In the thermosphere there is such a low pressure (the molecules are spread out) that there is very little heat transfer.

Mesoosphere

The **mesosphere** is directly under the thermosphere. The prefix “Meso” means middle in Greek. The mesosphere has a lower temperature and is the coldest of all the layers in the entire atmosphere. This is the middle layer of the atmosphere. A lot of space debris, including old satellites and meteors, burn up in this layer.

Stratosphere

The next layer down is the **stratosphere**. This is a layer with a very large temperature change. It changes from cold to warm, almost to 0 degrees Celsius (which is warm for the atmosphere).

The real importance of the stratosphere is the ozone layer. Those ozone (O_3) molecules absorb large amount of UV (ultra-violet) radiation from the Sun. A chemical reaction takes place when an ozone molecule absorbs the UV radiation. The energy is then radiated as IR (infra-red) radiation, and that is what heats up the layer. Without the ozone, UV light would flood the surface of the Earth and the temperature of the stratosphere would be much cooler.

Troposphere

At the bottom of the atmosphere, where most of the life on the surface exists, is the **troposphere**. “Tropos” means change. The troposphere is the only atmospheric layer that can support life. The higher layers have filtered out the harmful radiation, and there are large amounts of water vapor which turn into the clouds we see. The clouds in the troposphere have multiple roles. They are a part of the weather we experience as well as help to regulate the temperature on the surface.

This is the layer where clouds develop, birds fly, and **pollution** collects. Yes, the troposphere is where humans most pollute the atmosphere. It's right where we live. The pollution goes into the troposphere and rarely leaves until it falls to the ground or is mixed into the oceans. Some pollutants called CFC's make it into the stratosphere and break down the ozone layer.

Geosphere

https://www.youtube.com/watch?v=VMxjzWHbyFM

The prefix, "geo," is a Greek word meaning "earth/land/country." The geosphere is considered that portion of the Earth system that includes the Earth's interior, rocks and minerals, landforms and the processes that shape the Earth's surface. This sphere includes all the stuff that make up the crust and the core of the earth. It includes everything natural and lifeless that make up the surface of the earth.

Examples of things that make up the geosphere are all the rocks and sand particles from dry land to those found at the bottom of the oceans. They also include the mountains, minerals, lava and molten magma from beneath the earth's crust.

The Earth itself (contrary to Christopher Columbus) is not a perfect sphere. Mountains and valleys give the geosphere its shape.

The geosphere interacts with all other earth spheres undergoes infinite processes constantly and that, in turn, modifies other spheres. One example of the continuous process is the rock cycle.

Biosphere

http://www.geography4kids.com/files/land_intro.html

The word "Bio-" is a Greek word that means "life". The biosphere is all living components of the earth (humans, plants, animals, bacteria, fungi, protists and all microscopic organisms on land, in the air and in the oceans). It also includes all organic matter (remains of living creatures that have not yet decomposed).

The living biosphere depends on the other three spheres. The hydrosphere provides moisture or water to plants and animals, the geosphere provides the solid surface on which animals and plants grow and also provides heat from beneath the earth. The atmosphere provides the gasses (nitrogen, oxygen and carbon dioxide) needed by living things. The atmosphere also provides the screen from the sun's UV radiation and helps us receive just enough of the sun's heat.

Many factors affect the biosphere and our life here on Earth. There are large factors such as the distance between the Earth and the Sun. If our planet were closer to the Sun, it might be too hot to support life. Smaller factors also act on the biosphere. If you were to watch a piece of land that was only one square mile (or kilometer), you would see the influence of climate, daily weather, and **erosion**. These smaller factors change the living space and organisms must react accordingly. For example, how would a family of gophers react if their burrow gets washed away in a mudslide? The smallest of factors in the biosphere work on a molecular level. Tiny organisms, such as bacteria and fungi, are constantly working to break down organic and inorganic materials. These guys are decomposers. They break down decaying plant and animal material.

http://www.ducksters.com/science/ecosystems/food_chain_and_web.php

The Food Chain

Every living thing needs energy in order to live. Everytime animals do something (run, jump) they use energy to do so.Animals get energy from the food they eat, and all living things get energy from food. Plants use sunlight, water and nutrients to get energy (in a process called photosynthesis). Energy is necessary for living beings to grow.

A food chain shows how each living thing gets food, and how nutrients and energy are passed from creature to creature. Food chains begin with plant-life, and end with animal-life. Some animals eat plants, some animals eat other animals.

A simple food chain could start with grass, which is eaten by rabbits. Then the rabbits are eaten by foxes. The grass is known as a producer. It produces its own food. The rabbit and the fox are consumers, they consume their food.

A food web consists of all the food chains in a single ecosystem. Each living thing in an ecosystem is part of multiple food chains. Each food chain is one possible path that energy and nutrients may take as they move through the ecosystem. All of the interconnected and overlapping food chains in an ecosystem make up a food web.

Interactions Between Earth's Spheres

https://www.youtube.com/watch?v=R-Iak3Wvh9c&t=1s

The Hydrosphere, Atmosphere, and the Geosphere:

One way that the hydrosphere and the geosphere interact is through the processes of weathering and erosion. Weathering is the process where rock is worn away or broken down into smaller and smaller pieces. There are two types of weathering: mechanical weathering and chemical weathering.

Mechanical weathering physically breaks up rock. One example is called frost action or frost shattering. Water gets into cracks and joints in bedrock. When the water freezes it expands and the cracks are opened a little wider. Over time pieces of rock can split off a rock face and big boulders are broken into smaller rocks and gravel. This process can also break up bricks on buildings.

Chemical weathering decomposes or decays rocks and minerals. An example of chemical weathering is water dissolving limestone.

Once the rock has been weakened and broken up by weathering it is ready for erosion. Erosion happens when rocks and sediments are picked up and moved to another place by ice, water, wind or gravity.

When ice melts or wind and water slow down they can't carry as much sediment. The sediment is dropped, or deposited, in landforms.

https://www.youtube.com/watch?v=UXh_7wbnS3A

The Hydrosphere and the Atmosphere:

There are many ways that each of the spheres interact and affect each other. Let's take a look at how they work together at the beach!

The beach is the perfect place to closer look at what pieces of our environment make up the *hydrosphere* and which are parts of the *atmosphere*.

The beach is, of course, right next to the ocean, and since the ocean holds most of the water on our planet it's the biggest part of the hydrosphere. The rivers that flow into the ocean are also a big part, and so is the rain that's just starting to fall on our beach. Well, that's a bummer. But check this out: while the rain is part of the hydrosphere, the clouds it came from are actually part of the atmosphere. And the wind that pushes the waves around is part of the atmosphere, too. Even though we can't see it, the atmosphere is all around us in the form of the air that we breathe.