

NEW JERSEY CENTER  
FOR TEACHING & LEARNING

## Progressive Science Initiative®

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NEW JERSEY CENTER  
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## 5th Grade

### Earth Materials and Systems

2015-08-28

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## Table of Contents: Earth's Materials and Systems

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- **Geosphere**
- **Atmosphere**
- **Hydrosphere**
- **Biosphere - Earth's Connected Systems**

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# Geosphere

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## Our Rocky Planet

Earth, like some other planets in our solar system, is composed of rock.



What other planets are considered rocky planets?  
*(move the picture of Earth for the answer)*

Our planet formed over billions of years as small pieces of rock (called asteroids) collided and combined.

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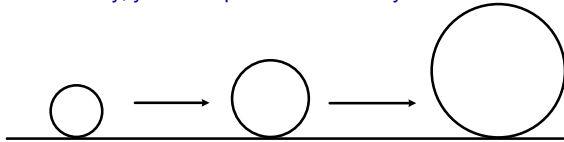
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## The Formation of Earth - A Snowball Effect

Imagine making a snowman on a cold winter day...



What starts as a small snowball grows larger as you roll it and it collects more snow particles. Eventually, you end up with the base of your snowman!



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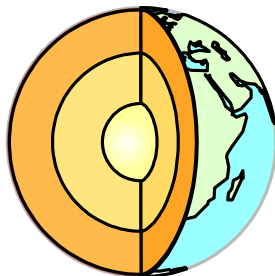
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## Snowball Effect

Just like with a snowball, when Earth formed, the newer particles formed new outer layers. This means that the oldest material can be found in the very center .. in this case, the Inner Core!



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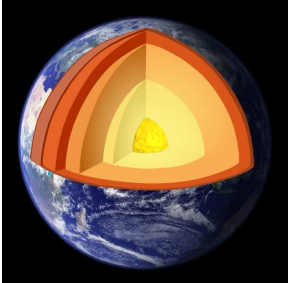
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### The Makeup of Earth

As Earth grew larger, what happened to the force of gravity on the planet?

This also caused the pressure to increase as well and different layers started to form.



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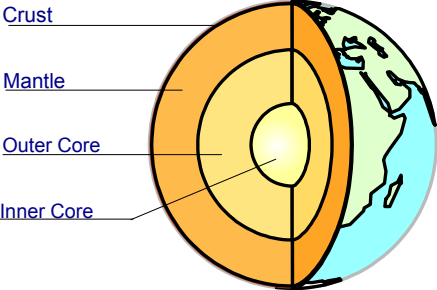
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### The Layers of Earth

Each layer has distinct characteristics that we will see in the upcoming slides. The layers are as follows:



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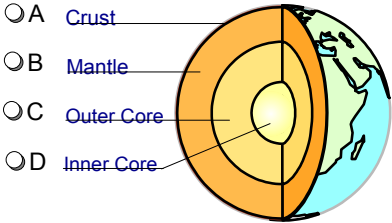
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1 Which layer of Earth would be considered the oldest?



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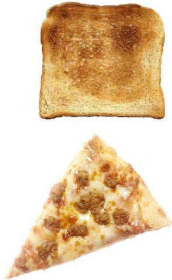
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### Earth's Crust

Even though there are 4 distinct layers of Earth, the **crust** is the only one that can be seen! It is the land that we walk on and that makes up the ocean floor.

The crust is the outermost layer of Earth, much like the crust of a slice of bread or pizza.



Just like these examples, the crust of Earth is also the thinnest portion.

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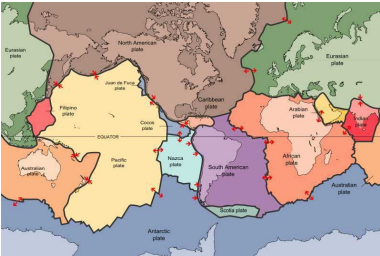
### The Makeup of Earth's Crust

The crust of Earth consists of a shell called the **geosphere**. The geosphere is made up of many large chunks of crust, called **plates**, that fit together like a jigsaw puzzle.

These plates are in constant motion.

In what ways can we see evidence of this movement? Discuss this at your table.

When you are done, move the map to reveal the answer.



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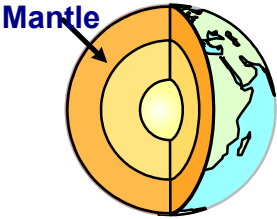
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### Mantle

Go a little deeper into Earth and you will reach the **mantle**.



Mantle Facts:
Thickest layer of the Earth (nearly 3,000 km)
Made up of "semi-solid" rock (think of Jell-O or pudding!)
Most massive layer (2/3 of Earth's mass)

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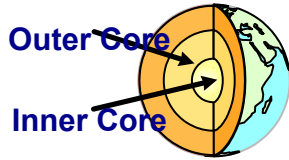
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### The Outer and Inner Core

Outer Core	Inner Core
Only liquid layer of Earth	Solid
Made of iron and nickel	Made of iron and nickel
	Hottest layer and under the most pressure
	About as hot as the Sun's surface (5,400° C)




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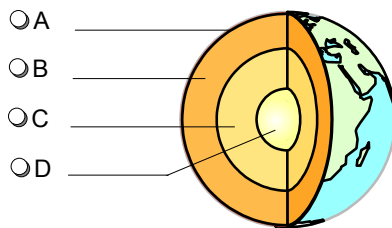
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2 Which layer of Earth is the mantle?




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3 The outer core, although rock, is liquid.

- True
- False

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4 The surface of the Earth called the \_\_\_\_\_ is made up of large \_\_\_\_\_ that fit together like a jigsaw puzzle forming the crust.

- A Mantle & Pieces
- B Pieces & Geosphere
- C Outer Core & Plates
- D Crust & Plates

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### What Makes Up the Layers?

As stated before, our Earth is made up primarily of rock.  
We typically imagine rocks in this form...



...but the truth is that rock comes in many different shapes, sizes, phases and colors.



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### Rocks in Different Forms

The rocks that make up Earth can take the form of solids, liquids and semi-solids. Some rocks can be cold (like a pebble found on the playground) and some can be so hot that it melts into lava or magma!

This image is of lava that has erupted from a volcano.

Lava is incredibly hot rock that has melted.



You can see that as the lava cools down, it begins to turn back into a solid.

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**5 This layer (or layers) of Earth is made up of solid rock.**

- A Crust
- B Mantle
- C Outer Core
- D Inner Core

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**6 This layer (or layers) of Earth is made up of liquid rock.**

- A Crust
- B Mantle
- C Outer Core
- D Inner Core

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**7 This layer (or layers) of Earth is made up of semisolid rock.**

- A Crust
- B Mantle
- C Outer Core
- D Inner Core

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### Soil

Life on Earth relies on a layer of the geosphere called **soil**. Soil is the top-most layer of Earth in which plants grow. It is made up of mixture of organic remains (objects that once were living things), clay, and rock particles.

Without the soil in the geosphere, there would be no *biosphere*, which we will discover in the next section!



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### Sediments

Also scattered about the geosphere are depositions of sediments. These deposits can take on many different forms. What sediments can you think of in your environment?



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### Similar but Different

Soil and sediments are often found mixed together or layered on top of each other. Think about how they are similar and how they are different.



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8 Which of the following choices is NOT considered a part of the soil?

- A Magma
- B Rock Particles
- C Clay
- D Organic Material

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**Atmosphere**

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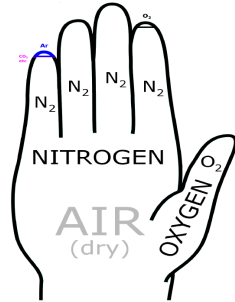
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## Air

The common name for the gases in our atmosphere is **air**. Air mainly consists of Nitrogen (78%) and Oxygen (21%) as well as some water vapor and other elements.

There is an easy way to remember this using your hand. There is roughly four times as much Nitrogen as there is Oxygen in the air.



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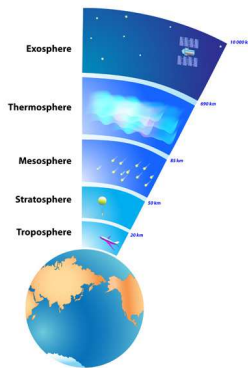
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## Layers of the Atmosphere

Just like the geosphere, the atmosphere is also divided into layers. As you get higher in the atmosphere, the amount of pressure and temperature decreases.



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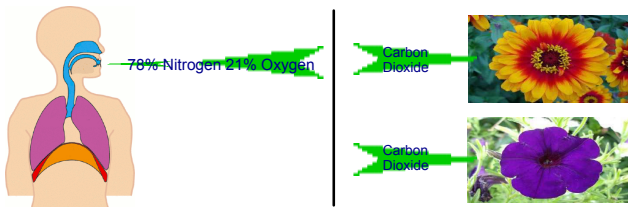
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## Importance of Air

Air is one of the primary things that makes life on Earth possible. Humans and many other animals breathe air. Plants also need the carbon dioxide that is in air to go through **photosynthesis**, which we have learned about previously.



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9 Earth's atmosphere is primarily made up of which two gases? (choose 2)

- A Oxygen
- B Nitrogen
- C Carbon Dioxide
- D Water Vapor

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10 Which layer of Earth's Atmosphere do we live in?

- A Stratosphere
- B Troposphere
- C Mesosphere
- D Exosphere

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### Science Job: Meteorologist

The study of Earth's atmosphere is called **meteorology**. You are likely to see a meteorologist on the nightly news.

Meteorologists compare temperature readings, winds, pressure in the atmosphere, precipitation (rain/snow) patterns, and other variables to predict the weather.




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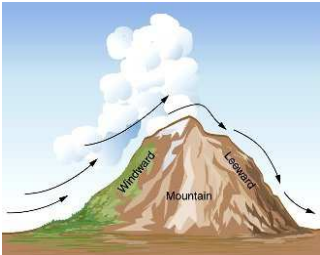
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### Wind and Clouds

Winds and clouds in the atmosphere interact with the landform to determine weather patterns.

**Lifting** occurs when mountains push the air upwards. Taller mountains push the air high enough to where the air reaches its saturation point and then precipitates.



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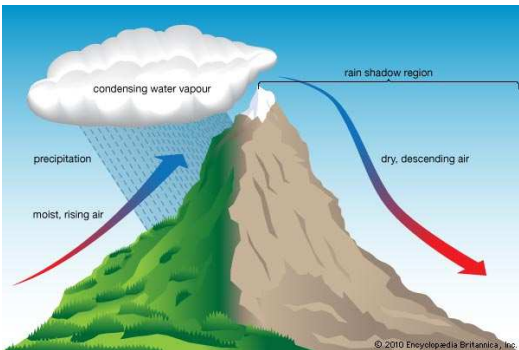
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### Rain Shadow Effect

As clouds are pushed upwards the moisture condenses and is released as precipitation. The clouds release all their precipitation creating a rain shadow on the opposite slope.



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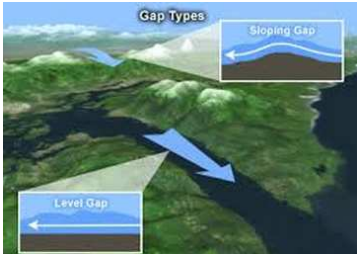
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### Wind Funnel

Just as mountains can force wind and clouds upwards, they also funnel the wind. Wind that encounters a blockage moves through the path of least resistance. Wind funnels often see high speed winds.



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11 Landforms can impact the weather and climate.

- True
- False

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12 Location 4 on the map is an example of which of the following?



- A Lifting
- B Landform Breeze
- C Rain shadow Effect
- D Wind Funnel

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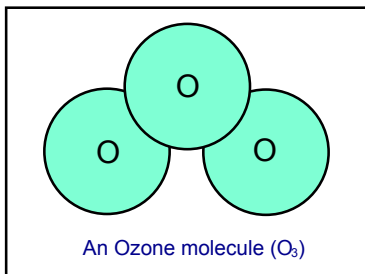
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### Ozone Layer

Another important gas in our atmosphere (although there isn't very much of it) is **ozone**. Ozone ( $O_3$ ) is found mainly in a layer of the atmosphere called the **ozone layer**. The ozone layer starts about 9 miles (14.5 km) above Earth's surface.



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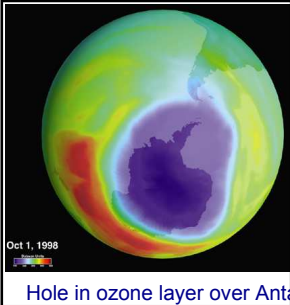
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### Ozone Layer

This gas is so important because it has the unique ability to absorb the Sun's ultraviolet radiation.

The ozone layer protects animals and plants from getting too much of the Sun's dangerous **ultraviolet (UV) rays**.

Without this protection, conditions would be very hazardous. Areas that have seen a decrease in ozone have seen a large increase in skin cancer. Why?



Hole in ozone layer over Antarc

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### Water Vapor

Water vapor is another gas in our atmosphere which has a significant impact on temperature.

Water vapor is water in gas form. Water vapor, like many gases, is invisible, but you still see often in the form of steam.



If you're too hot, your body cools off by sweating.

As the sweat evaporates off your body and forms water vapor, it carries the excess heat with it into the air.

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### Water Vapor and Heat

The same thing happens on the surface of Earth.

As water evaporates from Earth's surface, heat is carried into the atmosphere.



Chena Hot Springs, Alaska

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**13 A hole in the ozone layer will not harm Earth.**

- True
- False

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**14 Evaporation of water cools Earth.**

- True
- False

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## Hydrosphere

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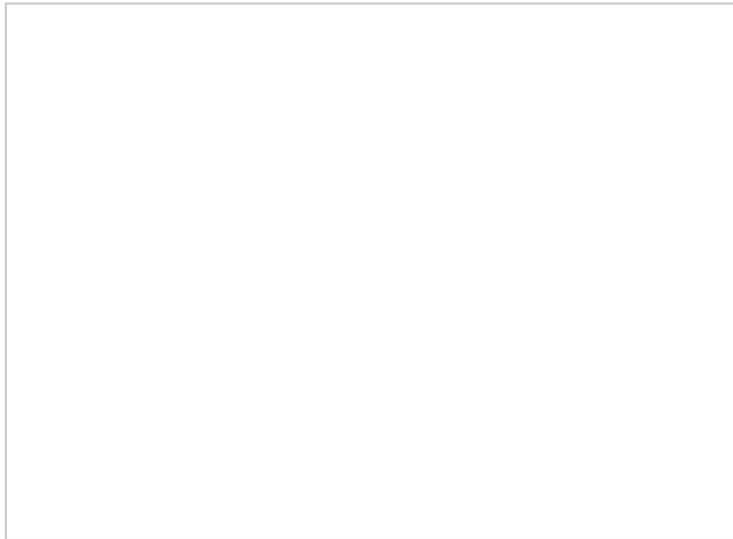
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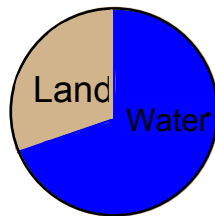
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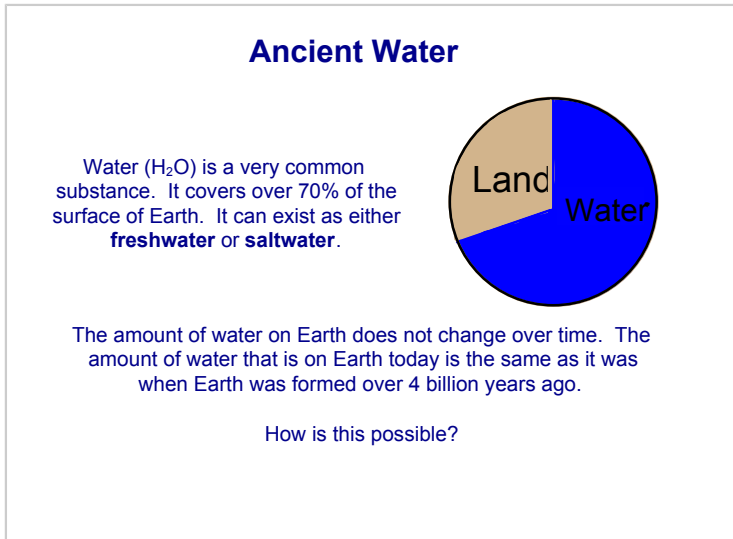
### Ancient Water

Water (H<sub>2</sub>O) is a very common substance. It covers over 70% of the surface of Earth. It can exist as either **freshwater** or **saltwater**.



The amount of water on Earth does not change over time. The amount of water that is on Earth today is the same as it was when Earth was formed over 4 billion years ago.

How is this possible?



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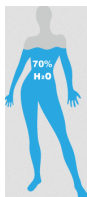
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### Water Sustains Life

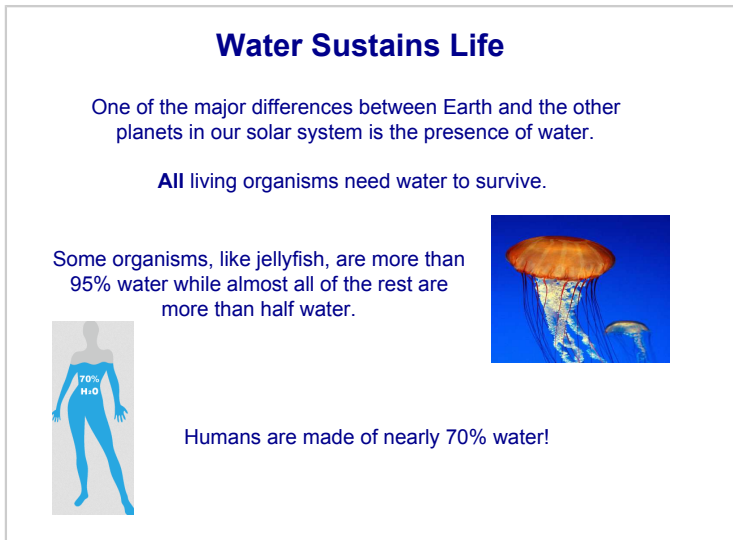
One of the major differences between Earth and the other planets in our solar system is the presence of water.

**All** living organisms need water to survive.

Some organisms, like jellyfish, are more than 95% water while almost all of the rest are more than half water.



Humans are made of nearly 70% water!



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### Where is the Water?

We have already learned about where water can be found in our atmosphere (in the form of water vapor), but where else can it be found?

Discuss places you can find water on Earth with your table and prepare to share your answers.



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### Earth's Vast Oceans

Of all the water on Earth, 97.5% is contained within the oceans (saltwater).

Only 2.5% of Earth's water is fresh. This means that only 2.5% of all water on Earth is usable for drinking, cooking, washing and other purposes!



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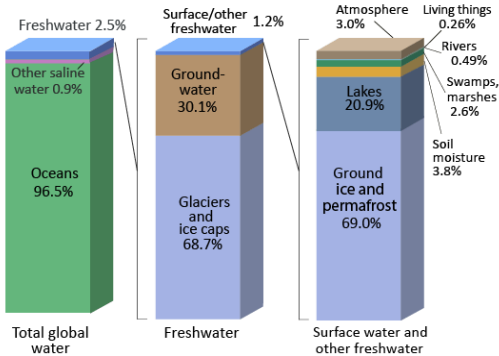
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### Water is a Precious Resource

Looking at where and how the 2.5% of freshwater on Earth is stored it become evident that there isn't that much after all.



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### Fresh Water

After oceans, the largest supply of water on Earth can be found in a form of freshwater.

However, this water supply does not look like the usable water found on the right!



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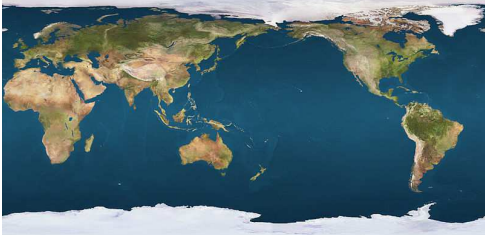
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### Glaciers



Glaciers are large bodies of thick ice that are found primarily near the North and South poles, such as in Antarctica and Greenland. Circle the glaciers on this picture above.

Nearly 69% of Earth's fresh water is trapped in glaciers (1.74% of Earth's total water).

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### Frozen Water

Similar to glaciers, water becomes trapped in snow or ice. Why don't we run out of water in the winter?



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### Groundwater

The final place you can find fresh water on Earth would be underground. About 30% of the fresh water on Earth exists as **groundwater** (less than 1% of the total water). This water gets underground by soaking into Earth.



Almost anywhere on Earth, you can dig down, and find fresh water.. you may even have well water at home!

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### Surface Water

Representing only 1.2% of the total freshwater water on available on earth, surface water is some of the most visible. It includes areas such as swamps, rivers, lakes and marshes.



Surface water that is extremely important to the lives of all land dwelling animals.

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**15** Of all the water on Earth, approximately how much is fresh?

- A 3%
- B 8%
- C 10%
- D 15%

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**16 What type of water is most prevalent on Earth?**

- fresh water
- salt water
- evaporated water
- frozen water

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**Activity: Graphing Water**

Water is one of the most important substances on Earth, but only a small fraction of the water on Earth can be used by humans.

This activity will have us graph the amounts and percentages of salt water and fresh water that can be found on Earth.



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**Hydrosphere in Action**

Early in this section, we said that the amount of water that exists today is the same amount that has always been on Earth. This is because the water on Earth cycles between all of the different forms we have learned about!



Click above to see the Water Cycle in action

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17 Which of the following is not part of the hydrosphere?

- Glaciers
- Ozone Layer
- Water Vapor
- Groundwater

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### Ocean Observations

Have you ever been to the ocean?



If so, what did you observe? If not, what have you heard about the ocean?

What did it feel like? What did it taste like? What other observations did you make using your 5 senses?

*Take 2 minutes and share with a classmate your experience with the ocean.*

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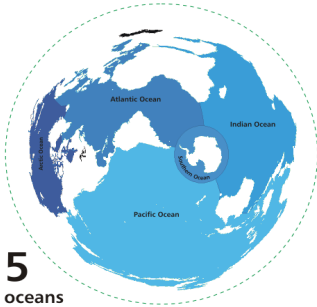
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### How Many Oceans Are There?

Scientists have divided the seas of the Earth into 5 different oceans:

- |           |
|-----------|
| Atlantic  |
| Pacific   |
| Indian    |
| Arctic    |
| Antarctic |



but since they are connected...

They are really all a part of one world ocean!

**5**  
oceans

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### Importance of Oceans

Earth's oceans are home to the greatest diversity of animal and plant life. Oceans supports almost 50% of all the species on Earth and produce almost 50% of Earth's oxygen.



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### Supporting Life

Oceans support the some of the Earth's largest and most varied ecosystems. These ecosystems are home to wide diversity of organisms and are essential to the overall health of the ocean.

Can you identify the different ocean ecosystems?

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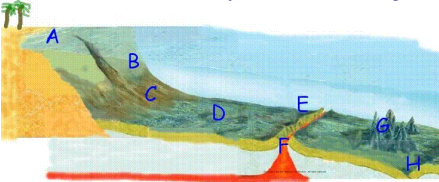
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### Ocean Landforms

The ocean also plays a role in creating and shaping landforms. Waves shape beaches, cliffs and caves.



Beneath the ocean are landforms that similar to the features on land. What are some of the landforms you see in the diagram below?



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**18 Oceans are home to what percentage of Earth's know species?**

- 50%
- 33%
- 25%
- 75%

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**19 Which of the following is correct about ocean landforms?**

- Ocean landforms are not similar to features found on land.
- The ocean floor is virtually flat and void of any landforms.
- Landforms found in the ocean are similar to those features found on land.
- Landforms stop when land is underwater.

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### Ocean Temperatures

The further you travel away from the Equator, the ocean waters generally become colder.



Near the Equator, surface water temperatures can be as high as 80° Fahrenheit (27° Celsius).

Near the poles, the temperature in the ocean drops to a chilly 28° Fahrenheit (-2° Celsius).



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### Climate Control

Water responds to temperature change more slowly than does land. It takes longer to heat water, and longer for it to cool down. Therefore, locations near the oceans experience milder climate changes.



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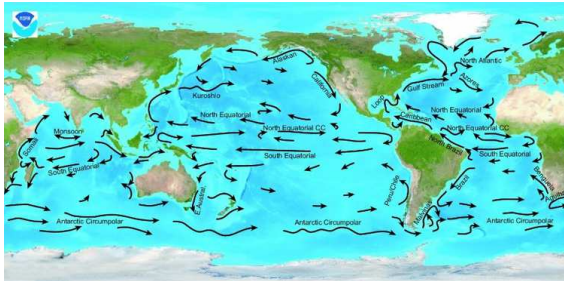
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### Oceans Impact on Weather

Even if you are hundreds of miles from the nearest ocean your weather is impacted by the Earth's oceans. Energy from the sun is absorbed, stored and transported by the oceans which affects temperature, precipitation and wind.



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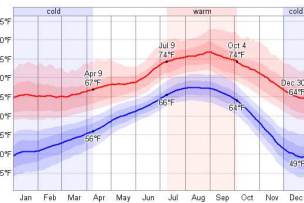
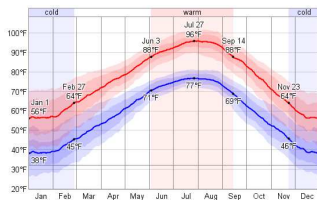
### Oceans Impact on Climate

Oceans ability to absorb and store heat helps to regulate the climate, create strong winds and produce precipitation.

Examine the two graphs. Which climate would you expect to be located near an ocean and why? Click to reveal the locations.

City 1

City 2



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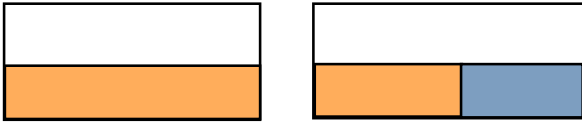
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### Lab: How Does Water Affect the Environment?

We have learned that areas near water experience milder climate changes, which means that temperatures in these areas will not change as much.

This lab will have us comparing two environments: one that is located near water and one that is not. How will the temperatures differ at these two locations?



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20 Which of the following is **not** correct about the oceans impact on weather and climate.

- Oceans absorb, store and transport energy from the sun.
- Oceans only impact the weather of areas that boarder them.
- Oceans support a wide diversity of life.
- Landforms similar to those on land can be found beneath the oceans.

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21 Which location on the map would experience the most temperate climate?

- A
- B
- C
- D



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# Biosphere - Earth's Connected Systems

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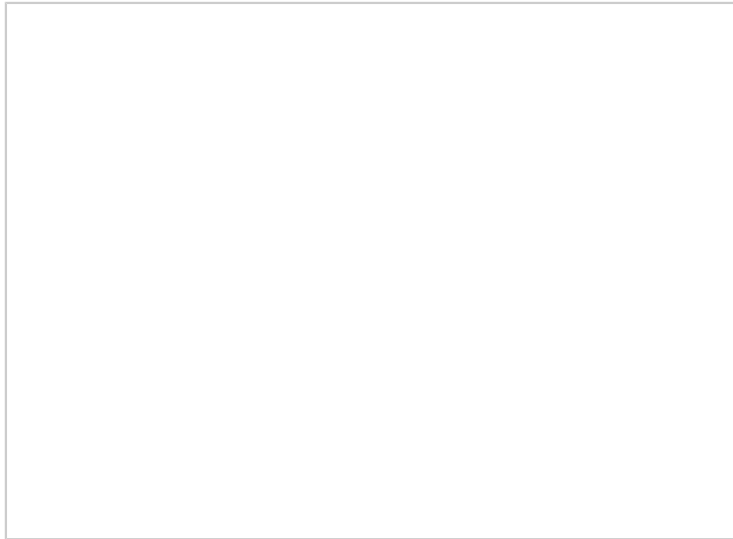
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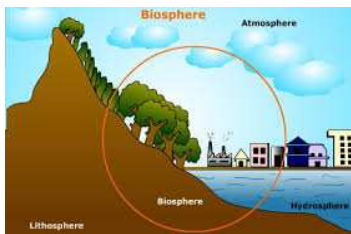
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## Our Living World

The biosphere includes the far reaches of the Earth, from underwater thermal vents, to dark caves, to mountain tops all to the upper limits of the atmosphere and everything in between. All life on Earth can be found somewhere in the biosphere.



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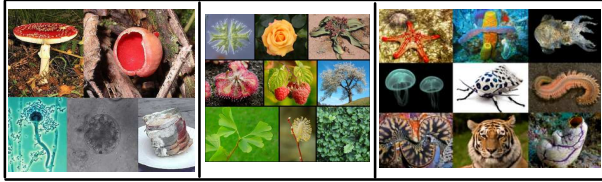
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## Members of the Biosphere

All life on Earth falls into categories known as **kingdoms**, including Animals, Plants, Bacteria and Fungi among others. On the Earth today there are over 300,000 different types of plants and millions of different kinds of animals. Each living thing is a member of the biosphere.



Fungi

Plants

Animals

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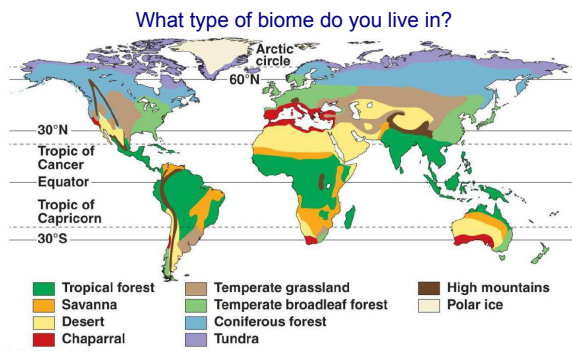
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## Biomes

The biosphere on earth varies greatly from one region to the next. **Biomes** are regions of the planet with similar climate and types of plants and animals. Biomes are classified as either terrestrial (land) or aquatic (water) biomes.



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**22 The biosphere only includes Earth's animals which live on the land.**

- True
- False

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**23 Which of the following is not a biome?**

- Troposphere
- Rainforest
- Desert
- Tundra

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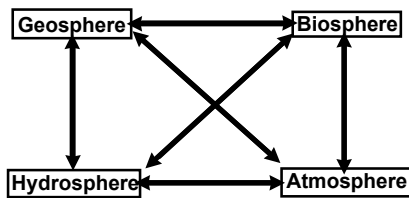
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**Earth's Connected Systems**

The spheres, while listed separately, are far from separate. There is no distinct boundary or border between them.

Each portion has an affect on the others.



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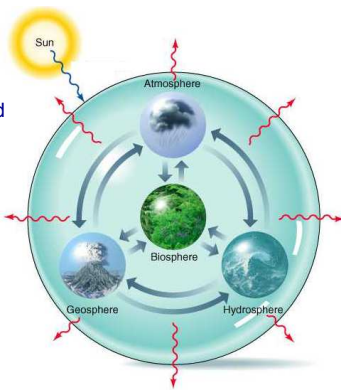
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**Sphere Interactions**

Interactions between different spheres impact life within the biosphere. These interactions are continuously occurring all over the planet, during both the daytime and nighttime.

When warm ocean waters transfer heat and moisture into the air and its met with spiraling winds a hurricane is created. This is an example of interactions between the atmosphere and the hydrosphere.



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## Interpreting Interactions

Sphere interactions typically occur when the geosphere interacts with air, water or life. These interactions move matter or energy from one sphere to another.

What sphere interactions do you observe?




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## Sphere Interactions

Can you think of examples of interactions between spheres that impact the biosphere?

Fill in answers on the chart.

	Atmosphere	Geosphere	Hydrosphere
Atmosphere		Volcano	
Geosphere			
Hydrosphere	Hurricanes		

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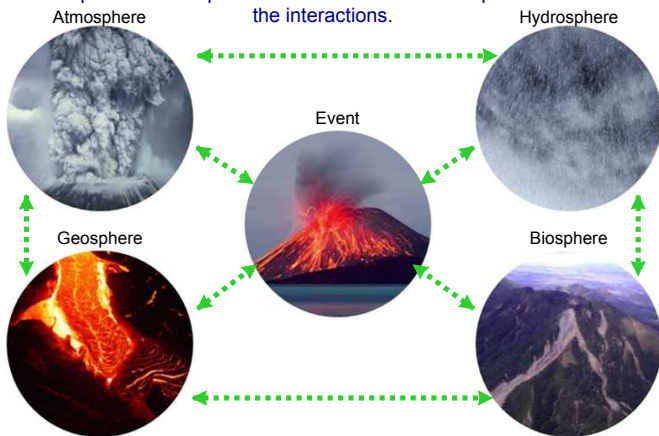
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## Earth's Sphere Interactions

Events in one sphere impact all the other spheres. Let's explore the impact of the eruption of a volcano. Click each sphere to reveal the interactions.




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24 What type of interaction is occurring in the picture?



- Geosphere & Hydrosphere
- Hydrosphere & Biosphere
- Biosphere & Atmosphere
- Atmosphere and Hydrosphere
- All of the above

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### Human Impact

Humans play a very important role in the biosphere.  
What kingdom are humans a part of?

Humans have a large impact on other aspects of the biosphere as well as the hydrosphere, geosphere and atmosphere.



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### Examining Human Impact

Human activities on the surface affect each of Earth's systems and how they interact with one another.

How has the mining of the oil impacted the spheres of the Earth?



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**25 Which of the following is an example of a human impact on the biosphere?**

- Rain falling on a street
- An earthquake hitting a major city
- Construction of a dam on a river
- All of the above

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### Impact of Rain on Landscapes

The hydrosphere is responsible for shaping and changing landscapes on earth. Rainfall creates run off and causes erosion. Some of the most spectacular landscapes on earth have been created by rain.




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### Impact of Rain on the Biosphere

The amount of rain primarily determines what types of organisms live in a region. Examine the two different biomes and the impact of the amount rain they receive. What conclusions can you draw about the impact of rainfall on the biosphere?



Rainforest	Desert
250 cm or more of rainfall annually	Less than 25 cm of rainfall annually
Contains more that half of the Earth's plants and animals	Contains less than 2% Earth's plants and animals
Covers 15% of the Earth's surface	Covers 33% of the Earth's surface

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**26** Could a change in the biosphere affect the atmosphere? Be prepared to defend your answer!

Yes

No

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**27** Which of the following areas would likely support the most amount of plant and animal life?

A



B



C



D



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### Activity: Sphere Interactions

This activity will explore how energy is transferred between organisms. We will use organisms commonly found in a forest.



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