

Name: _____

Earth's Systems

EARTH'S SPHERES

- Earth is very _____. There's a lot of processes taking place in or on Earth's air, water and land.
- These processes take place in four different "_____ " of Earth.
- We describe these spheres individually, but they are _____ to each other through _____ and _____ cycles and processes.

GEOSPHERE

- The geosphere describes all the _____ found on and in Earth's _____. Geo means _____.
- Solid rock _____ Earth's surface and is found _____ Earth. It makes up the ocean _____, _____ and landforms.
- The geosphere also includes liquid, _____ rock found within Earth.
- The geosphere includes _____ and _____ found on and within Earth too.

HYDROSPHERE

- The hydrosphere describes all the _____ on Earth. Hydro means "_____."
- The hydrosphere includes _____ includes freshwater found in lakes, rivers, streams and in the ground (groundwater).
- The hydrosphere includes _____ found in the oceans.
- The hydrosphere includes _____ water on Earth. Water is frozen at the polar ice _____ and in _____ found in the mountains.
- The hydrosphere includes water _____ found in the air too.

ATMOSPHERE

- The atmosphere describes the _____ on Earth. It includes the _____ that surround Earth. Atmo means "_____."
- The atmosphere contains _____, which is needed by animals to survive.
- The atmosphere contains _____, which is needed by plants to make food.
- The atmosphere contains _____, which blocks harmful UV light.

BIOSPHERE

- The biosphere describes all the _____ things on Earth. Bio means "_____."

- Living things are found in Earth's _____, on Earth's _____, in the soil and in the _____.
- The biosphere includes _____ and _____, microscopic organisms such as _____ and protists (unicellular organisms) and _____.

ELEMENTS ON EARTH

- Scientists study the abundance of _____ found in Earth's air, water and land.
- *What is the abundance of an element?*

- Scientists study the abundance of elements to learn about what Earth is _____ of.
- If we understand the _____ of Earth, we can better understand how Earth _____ and how and why natural _____ on Earth take place.
- What are two different ways to measure abundance?

- _____
- _____

Abundance of Elements in the Geosphere

- When studying abundance of elements in the geosphere, we focus on elements found in the _____ layer of the geosphere - the _____.
- This is the only layer of the geosphere from which we can obtain _____.
- The most abundant elements (by mass) in Earth's crust are _____ and _____.
- Oxygen and silicon are often found _____ together. Together, they form _____.
- Silica is a _____ that makes up the majority of _____ in the crust. This makes sense since silicon and oxygen are the most _____ elements in the crust.

Abundance of Elements in the Atmosphere

- When studying abundance of elements in the atmosphere, we focus on elements found in the _____ layer of the atmosphere - the _____.
- This layer contains more than _____ of all gas found in the atmosphere.
- The most abundant element in the atmosphere is _____.
- Nitrogen is important because it adds _____ to the atmosphere and creates _____.

Abundance of Elements in the Hydrosphere

- The hydrosphere contains _____. Water is made of _____ and _____.
- One molecule of water is made of _____ hydrogen atoms and _____ oxygen atom. For this reason, the hydrosphere is made of hydrogen and oxygen in a _____ ratio of _____ to _____. This makes sense because there is _____ as many hydrogen atoms as oxygen atoms.
- The table below summarizes the abundance of elements on Earth.

ELEMENT	CRUST (% by mass)	HYDROSPHERE (% by volume)	TROPOSPHERE (% by volume)
Oxygen (O)	46.40%	33.0%	21.0%
Silicon (Si)	28.15%		
Aluminum (Al)	8.23%		
Iron (Fe)	5.63%		
Calcium (Ca)	4.15%		
Sodium (Na)	2.36%		
Magnesium (Mg)	2.33%		
Potassium (K)	2.09%		
Nitrogen (N)			78.0%
Hydrogen (H)		66.0%	
Other	0.66%	1.0%	1.0%

GEOSPHERE

- Recall: What is the geosphere?

- Earth is a sphere. Its interior is made of three *chemically* different layers:

- _____
- _____
- _____

CRUST

- The crust is the _____ or most superficial layer of Earth
- The crust ranges from _____ to _____ km in thickness. The thickest crust makes up the _____. The thinnest crust is found in the _____.
- The crust is _____ and solid. It is mostly made of _____ rocks. *Silicate rocks contain silica-* _____ *and* _____.

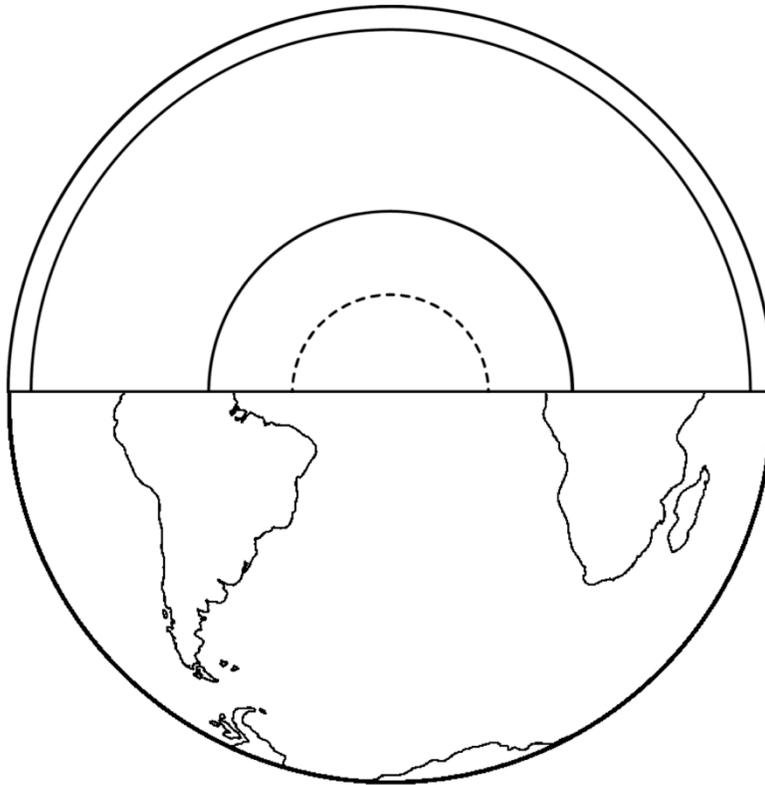
MANTLE

- The mantle is the _____ layer of Earth.
- The mantle is approximately _____ thick. This is the _____ layer of Earth.
- The mantle is made of _____ rock.
- The mantle is made of _____ rocks and minerals. These rocks and minerals are rich in _____ and _____ compared to rock in the crust.
- The rock is not the same _____ in the mantle.
- In the upper mantle, the rock is like _____ plastic.
- In the lower mantle, the rock is like _____ plastic.

EARTH'S CORE

- The core is the _____ layer of Earth.
- The core is believed to be made of _____ and _____.
- We often separate the core into a _____ outer core and _____ inner core.
 - The outer core is approximately _____ thick. It is made of hot, _____ iron and nickel. It surrounds the _____ core.
 - The inner core is approximately _____ thick. It made of _____ iron and nickel. It is extremely hot in the inner core but because the _____ is so strong, the rock is _____.

- *Label the different layers of the geosphere in the diagram below.*



GEOSPHERE

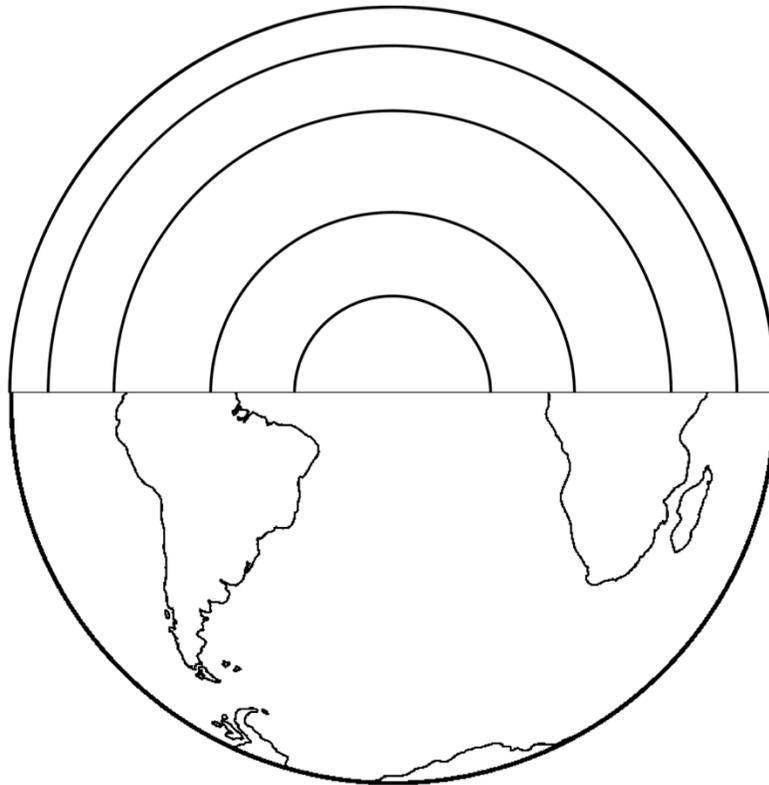
- Scientists can divide Earth's interior in a different way when studying the _____ *properties* of Earth.
- When studying the physical properties of the geosphere, we divide Earth into 5 layers:

- _____
- _____
- _____
- _____
- _____

- Describe the different layers of "physical earth" in the table below.

Layer of Physical Earth	
Lithosphere	
Asthenosphere	
Mesosphere	
Outer Core	
Inner Core	

- *Label the layers of "physical earth" in the diagram below.*



TYPES OF CRUST

- Recall: The surface of Earth is covered with a layer of solid/rigid rock called _____.
- The crust is variable. Its _____ fluctuates between _____ and _____ km and its _____ differs slightly.
- There are two main types of crust on Earth:
 1. _____
 2. _____
- *Compare and contrast oceanic and continental crust in the table below.*

Oceanic Crust	Continental Crust

IMPORTANCE OF CRUST

- Understanding the composition of crust is important to _____ plates.
- Tectonic plates are slabs of _____ covered with _____. Tectonic plates can be covered with _____ or _____ crust (or both).
- The type of crust on top of the plates can help determines what happens when tectonic plates move towards each other or _____.
- When a tectonic plate covered in oceanic crust _____ or collides with a tectonic plate covered in continental crust, the oceanic plate _____ or _____ below the continental plate because it's _____.

WATER ON EARTH

- The _____ includes water on, over and under Earth's surface.
- Water is the most _____ substance on Earth's surface.
- Water covers more than _____ of Earth.
- *Why is water the most vital and needed substance on Earth?*

1. _____
2. _____
3. _____

- Water is the only substance on Earth that is naturally found as a:
 - _____ (_____ makes up glaciers and the polar ice caps)
 - _____ (_____ water is found in oceans, lakes and rivers)
 - _____ (water _____ is found in the atmosphere)
- There are two kinds of water on Earth:
 1. _____
 2. _____

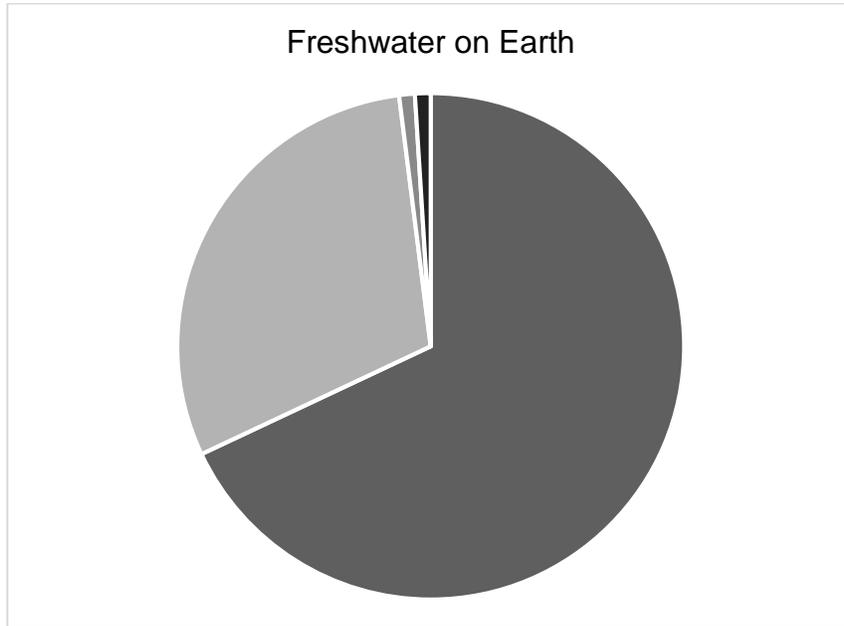
SALTWATER

- The majority (_____) of water on Earth is _____.
- Saltwater is only found in _____ form on Earth.
- Saltwater is found in the _____ and _____.
- Saltwater has a higher _____ than freshwater. This is why it's easier to _____ in the ocean than in a lake.
- Saltwater has a higher _____ and lower _____ point than freshwater.
- Saltwater is important to _____ habitats. Many different organisms live in marine habitats.
- The _____ _____ is the most diverse marine habitat.
- Saltwater also is important to the _____ cycle.

FRESHWATER

- Only a _____ amount (~3%) of water on Earth is _____.
- Freshwater is found in _____, _____ and _____ form on Earth.
- Most freshwater is _____ in glaciers and ice caps.
- Freshwater is found in the _____ as water vapor. Water vapor condenses to form _____ and _____.
- Freshwater is found in _____, _____ and streams and below Earth's surface as _____ too.
- Humans can only _____ freshwater. We get most of our drinking water from _____.

- Other living things need freshwater in order to _____ too. _____ is *NOT* drinkable.
- Freshwater plays a role in the _____ cycle.
- *Labe the different sections of the graph to show where freshwater is found on Earth.*

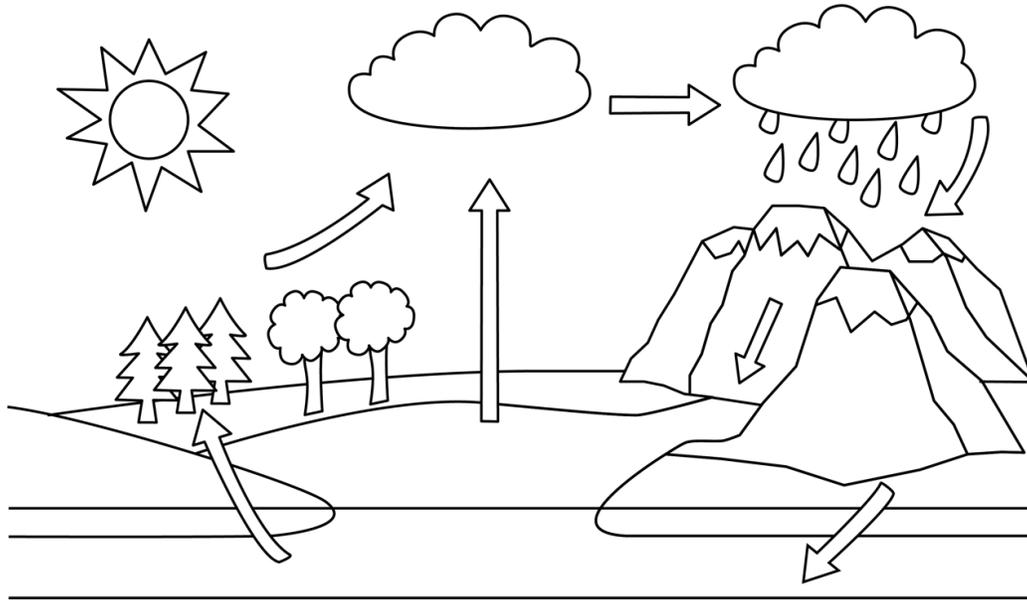


THE WATER CYCLE

- Water in the _____ (water vapor), in the _____ and in _____ of water moves around Earth.
- We call the movement of water around Earth the _____.
- What are seven important processes to the water cycle?

- _____
- _____
- _____
- _____
- _____
- _____
- _____

- Label the different processes of the water cycle on the diagram below.



- Describe the different processes of the water cycle in the table below.

Water Cycle Process	
Evaporation	
Transpiration	
Condensation	
Precipitation	
Collection	
Infiltration	
Absorption	

WATER AROUND EARTH

- Water cycles through all of Earth's _____ - the geosphere (land), hydrosphere (water), atmosphere (air) and biosphere (living things).

Water cycling through the geosphere

- Water that is found in the geosphere includes water found in and on the _____.
- Water flows along Earth's _____. As part of the water cycle, some of this water _____ the ground. In the ground, water can _____ in "pools" to form groundwater.
- Water can be _____ out of the ground (soil) by plants.

Water cycling through the hydrosphere

- When we talk about water cycling through the hydrosphere, we often refer to water on Earth's _____.
- Water _____ in rivers, lakes and the ocean. Water in these bodies of water will _____ as part of the water cycle.

Water cycling through the atmosphere

- Liquid water on Earth's surface _____ to become water vapor.
- Water vapor is part of the _____. Water vapor condenses to form _____ and _____ in the atmosphere.

Water cycling through the biosphere

- Water is vital to _____ things (the biosphere).
- Water in the ground can be absorbed by _____. This water will be used by plants. Some water in the plant will _____ through holes in the leaves.
- Water is also taken in by _____. Animals _____ water and excrete water they don't use. Water that is _____ by animals will reenter the water cycle.

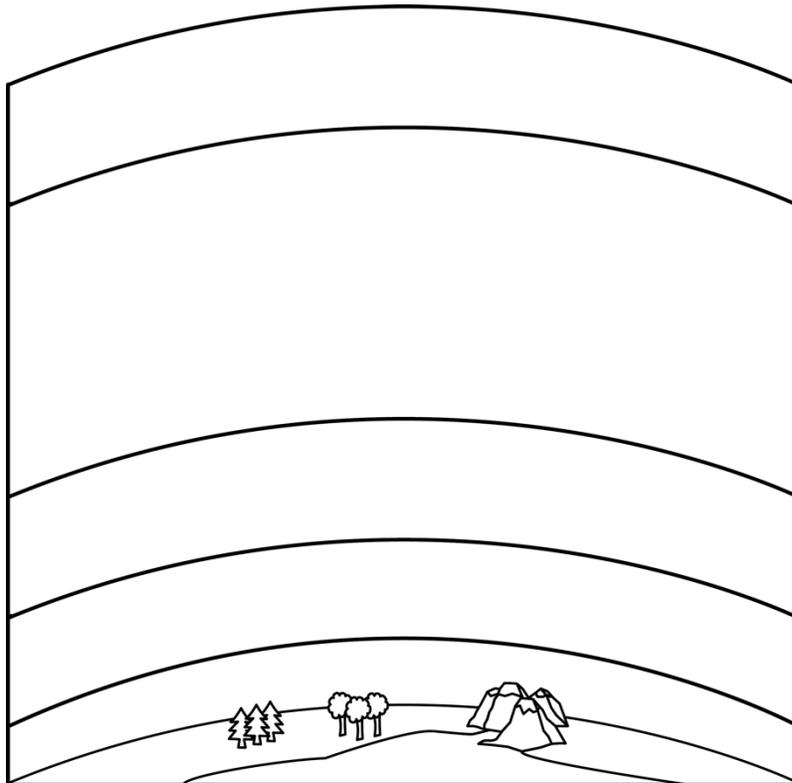
ATMOSPHERE

- The atmosphere is made of a " _____ " of _____ that surrounds the Earth.
- The shell is extremely _____, especially compared to the size of Earth.
- The atmosphere is not _____. There are distinct _____ within the atmosphere, each with a different set of characteristics and properties.
- *What are the 5 layers of the atmosphere?*
 1. _____
 2. _____
 3. _____
 4. _____
 5. _____

- Describe the different layers of the atmosphere in the table below.

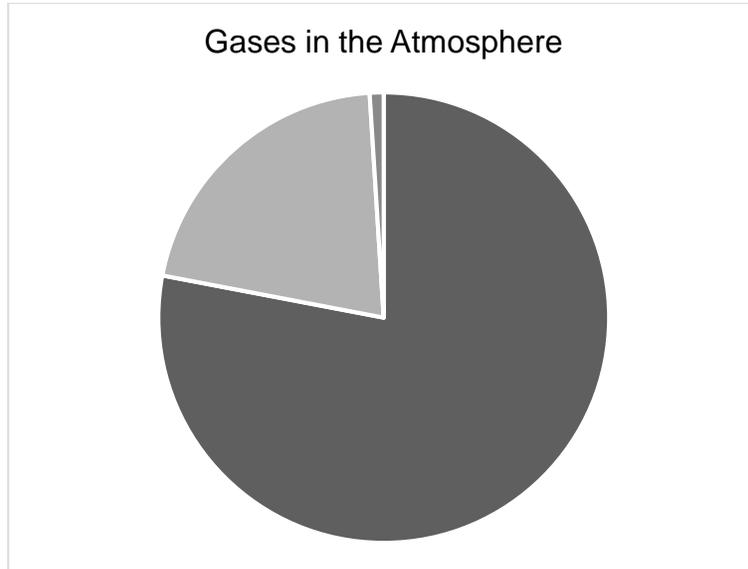
Atmosphere Layer	
Troposphere	
Stratosphere	
Mesosphere	
Thermosphere	
Exosphere	

- Label the different layers of the atmosphere in the diagram below.



ATMOSPHERIC GASES

- Nearly 99% of the atmosphere is made of _____ and _____.
- There are other _____ gases found in air. We will consider several of them in addition to nitrogen and oxygen.
- *Label the sections of the graph to show composition of gases in the atmosphere*



Nitrogen in the Atmosphere

- The majority of the atmosphere is made of _____.
- Nitrogen is important to the atmosphere because it helps create air _____.
- Too much or too little nitrogen in the atmosphere _____ air _____.

Oxygen in the Atmosphere

- The second most abundant gas in the atmosphere is _____.
- Oxygen is vital to _____ things. Without oxygen, animals and other organisms would _____.
- However, too much oxygen is _____ to some living things.

Argon in the Atmosphere

- _____ is the third most common gas in the atmosphere - although its abundance is extremely _____.
- Its importance to the atmosphere is _____. For this reason, we often forget about this gas in the atmosphere.
- _____ is a trace gas found in the atmosphere. It is important to plants and _____.

Carbon Dioxide in the Atmosphere

- CO₂ is a _____ gas. A greenhouse gas is a gas that helps keep Earth _____. Too little carbon dioxide is harmful to _____ and could cause temperature on Earth to _____. Too much CO₂ could cause Earth to become too _____.

Water Vapor in the Atmosphere

- _____ is a trace gas found in the atmosphere, although its percent abundance _____ greatly.
- Water vapor is important to the _____ cycle.
- Water vapor is the most important _____ gas that keeps Earth _____.
- Too little water vapor could cause Earth to become _____. Too much could cause Earth to become too _____.

Ozone in the Atmosphere

- _____ is a trace gas. It most important to the formation of the _____ in the stratosphere.
- The ozone layer blocks _____ light. Too little ozone creates _____ in the ozone layer, allowing more _____ light to reach Earth's surface.
- Too much ozone is _____ to living thing.

Other Trace Gases in the Atmosphere

- *What are other trace gases found in the atmosphere?*

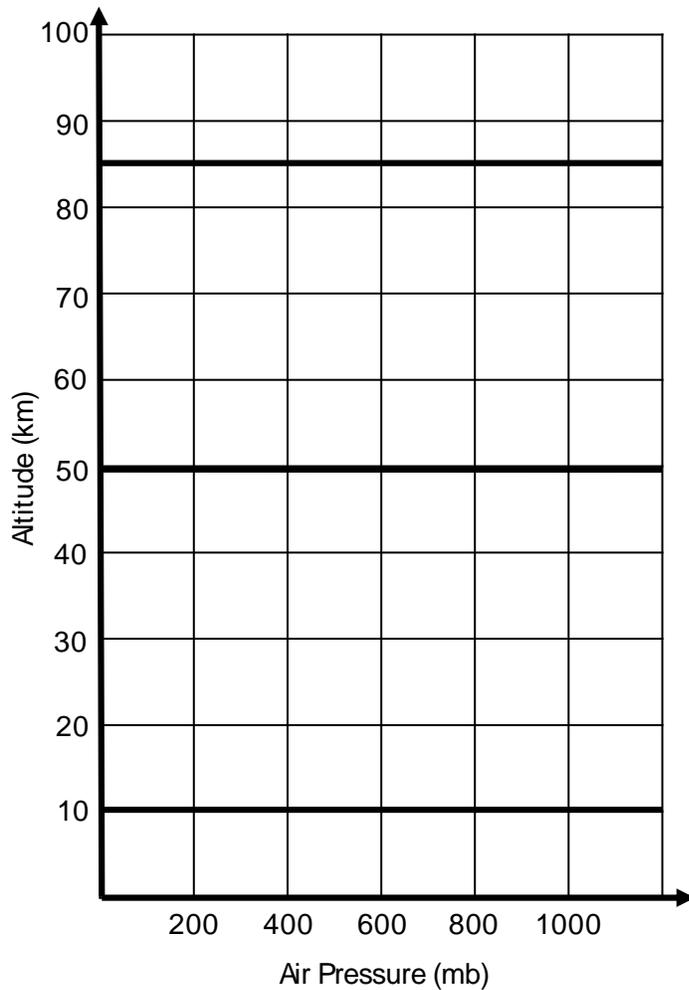
- The composition of air in each atmospheric layer _____. For example:
 - _____
 - _____

ATMOSPHERIC PRESSURE

- *What is air pressure?*

- We most often measure atmospheric pressure in _____ (Pa), _____ (mb) or inches of _____ (in Hg).
- Atmospheric pressure _____ as attitude increases.

- This makes sense because atmospheric pressure is due to the _____ of air. As you increase in altitude, there is _____ air above you and thus, _____ pressure exerted.
- Draw a line in the graph to show how air pressure changes with altitude.



- Atmospheric pressure significantly _____ as you increase in altitude in the _____.
- This makes sense because nearly _____ of the mass of the atmosphere (all the gases in the atmosphere) are found in the _____.
- Atmospheric pressure at sea level is _____.
- Atmospheric pressure at _____ elevations is noticeably less. The air is "_____ " at these locations. Air pressure at the top of Mount Everest is _____.
- Atmospheric pressure is practically _____ above the stratosphere.

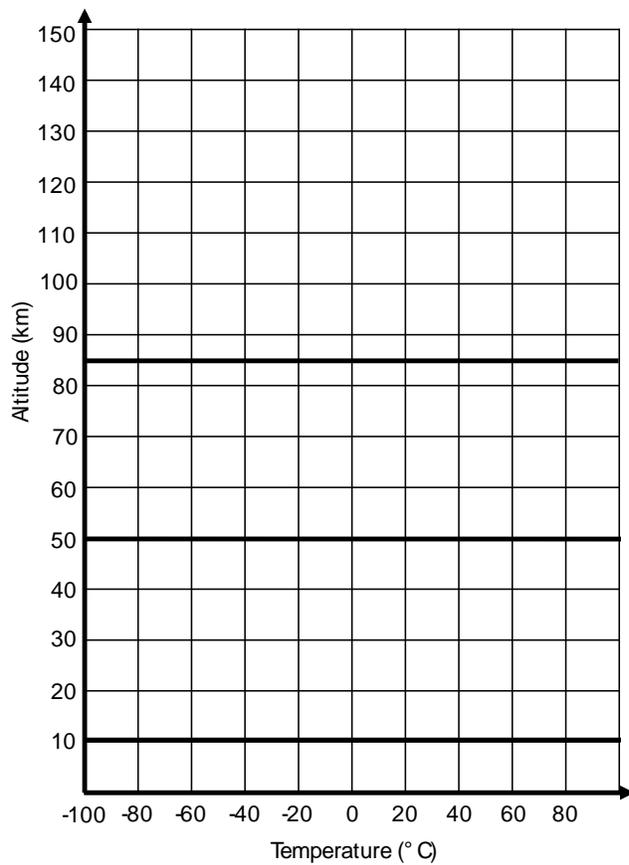
ATMOSPHERIC TEMPERATURE

- Atmospheric _____ is a measure of how warm or cold the atmosphere is.
- We measure temperature in degrees _____.

- Atmospheric temperature _____ as altitude increases.
- Describe how temperature varies in each layer of the atmosphere in the table below.

Atmosphere Layer	
Troposphere	
Stratosphere	
Mesosphere	
Thermosphere	

- Draw a line on the graph to show how temperature varies with altitude.



CLOUDS

- *What are clouds?*

- Clouds are important to study because they help us predict _____.

- There are three main cloud groups based on altitude:

1. _____

2. _____

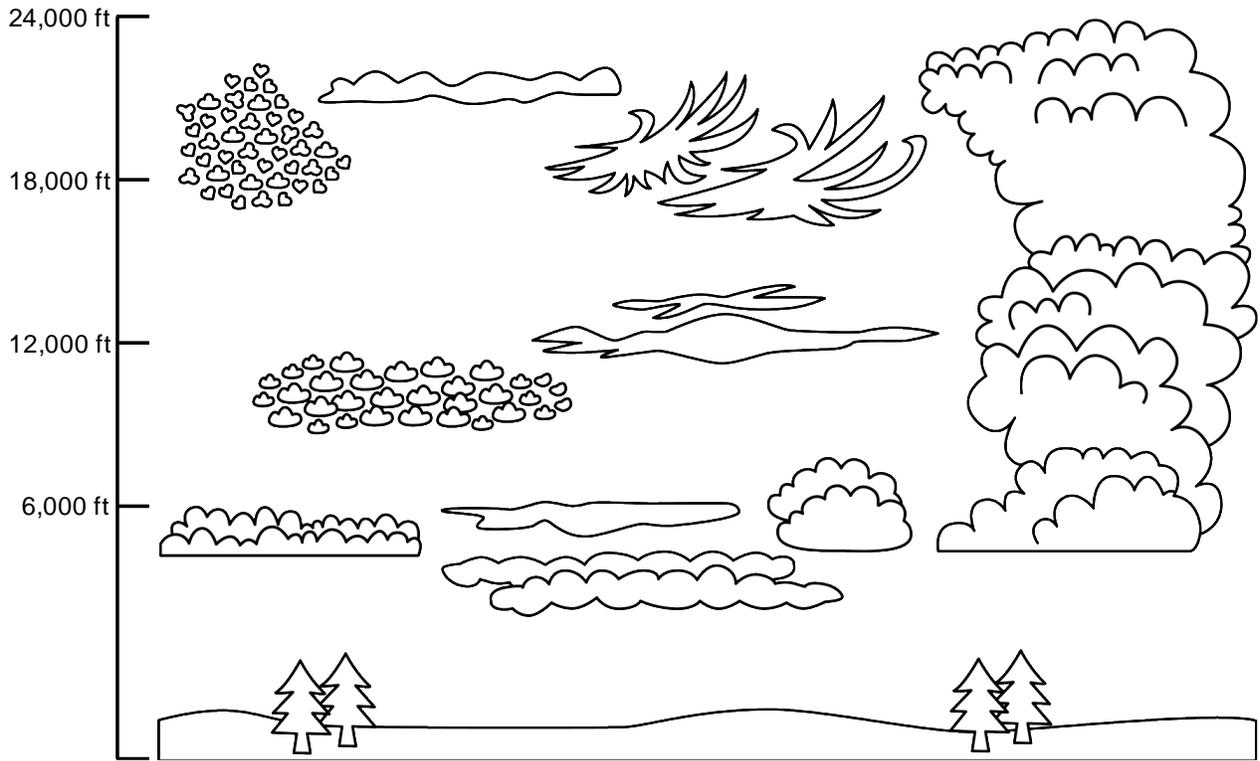
3. _____

- *Describe the different types of clouds in the table below.*

	Type of Cloud	
Cirrus Clouds	Cirrus	
	Cirrocumulus	
	Cirrostratus	
Alto Clouds	Altostratus	
	Alto cumulus	
Stratus Clouds	Stratus	
	Stratocumulus	
	Nimbostratus	

Vertical Clouds	Cumulus	
	Cumulonimbus	

- Label the different clouds in the diagram below.



WIND CURRENTS

- What is wind?

- We describe wind by its _____ and _____.
- The _____ of wind is how fast the air moves.
- The _____ of wind is the way in which the wind blows. Most often, we describe the direction of wind by *where the wind is* _____.

What creates wind?

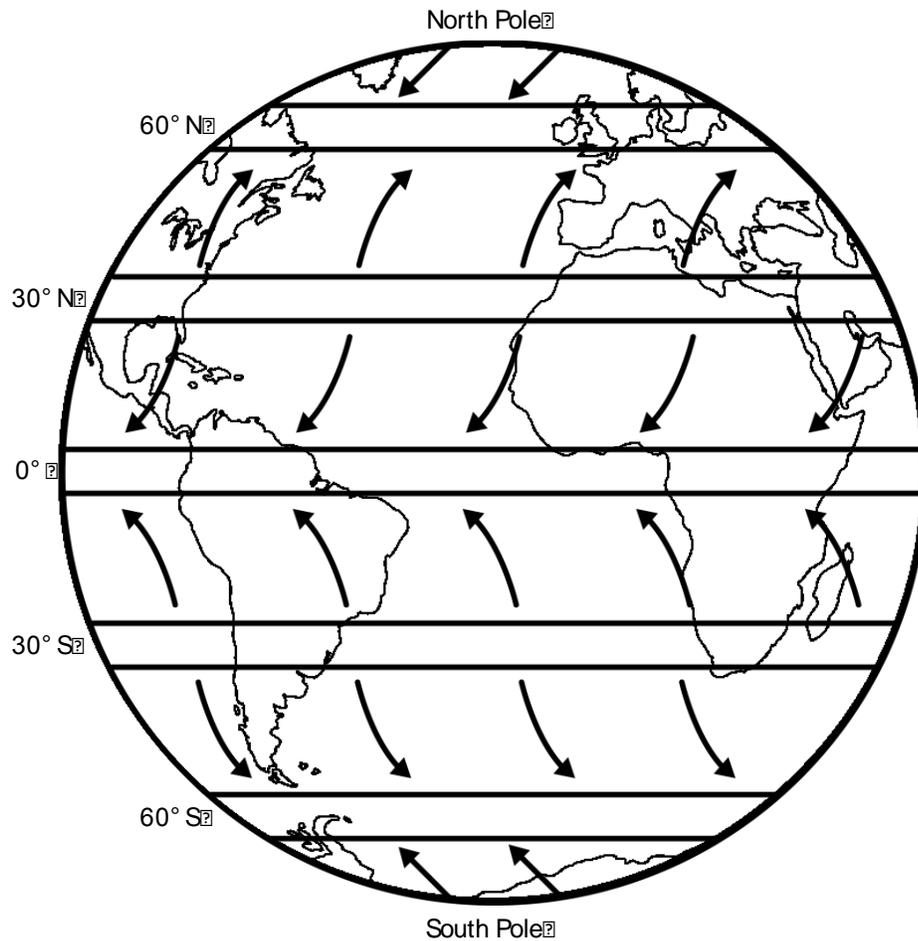
- Wind is due to _____ of Earth by the sun.

- The equator receives _____ rays from the Sun. Here, air is _____ and _____.
- The air moves to _____ regions high in the atmosphere about 30° North and South.
- At 30° N and 30° S, the cool air _____.
- Some air moves back towards the _____ and some moves towards the _____.
- We describe the direction of wind as it blows along Earth's _____.
- On Earth's surface, wind blows from regions of _____ pressure to _____ pressure.

Wind Belts & Prevailing Winds

- There are two types of _____ that wrap around Earth:
 1. Low and wet belts: There are _____ low and wet belts at 0°, 60°N and 60°S. At these latitudes, winds _____ to create belts of _____ pressure and _____ air.
 2. High and dry belts: There are _____ high and dry belts at 30°N and 30°S. At these latitudes, wind _____ to create belts of _____ pressure and _____ air. These latitudes are associated with _____.
- Wind blow between these _____.
- There are 3 prevailing winds that we consider:
 1. _____: Between 0° and 30°, winds blow towards the _____. We call these trade winds. Between 0° and 30°N, wind blows from the _____ and so these winds are called Northeast Trade Winds. Between 0° and 30°S, wind blow from the _____ and so these winds are called Southeast Trade Winds.
 2. _____: Between 30° and 60°, winds blow towards the _____. We call these winds westerlies because they blow from the _____.
 3. _____: Between 60° and 90°, winds blow from the _____ towards the _____. We call these winds Polar Easterlies because they blow from the _____.

- Label the low/wet and high/dry belts and the prevailing winds on the diagram below.



Wind Currents & the Seasons

- Wind patterns vary with the _____.
- The Earth _____ differently during each season and different latitudes on Earth receive the most _____ sunlight. This in turn affects the wind _____ on Earth.

CORIOLIS EFFECT

- Wind that blows north and south is always _____ or curved due to the _____ of Earth.
- We call this effect the _____.
- The Earth rotates from _____ to _____.
- Because the Earth is round, the _____ of Earth's rotation is _____ around the equator than at the poles.

- The difference in speed causes fluids, like _____ and _____, that move north and south across Earth's surface to _____.
- The Coriolis effect causes winds in the _____ hemisphere to spin _____ or deflect to the right.
- The Coriolis effect causes winds in the _____ hemisphere to spin _____ or deflect to the left.
- *Illustrate on the Earth below how the Coriolis effect causes winds to spin different in the Northern and Southern Hemisphere.*



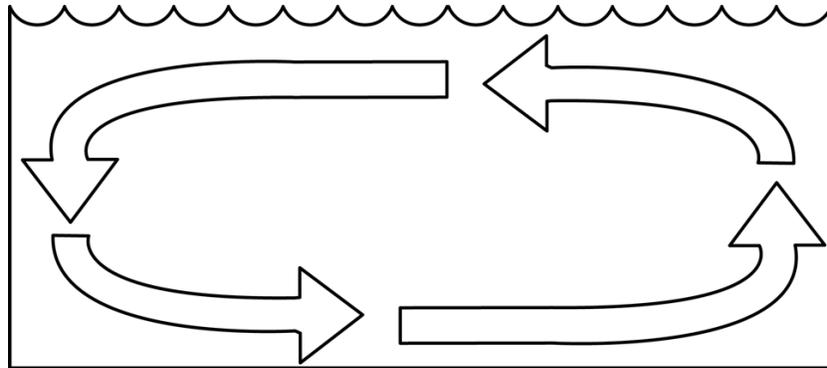
OCEAN CURRENTS

- *What is an ocean current?*

- _____ ocean currents occur on the surface of water.
- _____ ocean currents occur hundreds of feet below the ocean surface.
- Ocean currents can be _____ or _____.
- _____ currents flow away from the equator.
- _____ currents flow towards the equator.
- Many ocean currents _____ with each other, creating large systems of rotating ocean currents. Warm currents “_____ into” cold currents and vice versa.

- We call a circular pattern of ocean currents a _____.
- There are _____ major ocean gyre on Earth.
- Gyre often coexist with _____ patterns that move in a similar way.
- *What four factors can influence ocean currents?*
 1. _____
 2. _____
 3. _____
 4. _____
- Surface currents are often caused by the _____.
- Air _____ on the surface of water causes water to move in the same _____ as the wind.
- The Coriolis effect influences the direction of ocean _____.
- The Coriolis effect causes ocean currents in the Northern hemisphere to flow _____. It causes ocean currents in the Southern hemisphere to flow _____.
- Temperature and density create _____ currents within the ocean.
- Here's how *temperature* influences currents:
 1. Ocean water at the equator receives _____ rays of sunlight, which _____ the water.
 2. The warm water flows north and south to _____ regions, transferring _____ to these regions.
 3. Water _____ in the colder regions.
 4. The cool water flows back _____ the equator, where it can be _____ by direct sunlight again.
- _____ contributes to convection currents.
- Cold water is _____ than warm water.
- At the poles, very _____ water sinks and moves along the _____ the ocean to _____ regions such as the equator.
- At warmer regions, the water _____ up, becomes _____ dense and rises.

- Complete the diagram below to show how temperature and density create currents within the ocean.



- Together, temperature and density create a “_____” which helps move ocean water around the _____ and between the major ocean _____.
- Surface currents are _____. Deep ocean currents are _____.
- Ocean currents can significantly impact _____. Warm water that moves north causes _____ regions to be warmer.
- Ex: Water near the equator is pulled _____ and across the Atlantic Ocean towards _____. This current causes Western Europe to be _____ than it would be if the current did not exist.

Reflection Questions

1. How is the geosphere, hydrosphere, atmosphere and biosphere connected to each other?

2. How do we study the geosphere and atmosphere similarly?

3. How does the Coriolis effect influence both wind and ocean currents?

4. How would wind and ocean currents change if the Earth was evenly heated?
