Earth systems – the big idea guiding questions

Chapter 1 & 2
Earth and Earth Systems review
notes are in purple

- **How can you describe Earth?**
- **What are the composition and the structure of the atmosphere?**
- **How is water distributed in the hydrosphere?**
- **What are Earth's systems?**
- **What are the composition and the structure of the geosphere?**

Scientists divide Earth into systems to help them better understand the planet.

The outermost Earth system is an invisible layer of gases that surrounds the planet.

Below the layer of gases are the systems that contain Earth's water.

The next system, the geosphere is the solid part of Earth, which contains a thin layer of soil covering a rocky center.

The Earth system that contains all living things is the biosphere.

Earth's gravity pulls gases into a layer surrounding the planet. This layer is called the atmosphere.

The atmosphere contains a mixture of nitrogen, oxygen, and smaller amounts of other gases. 78% Nitrogen, 21% oxygen and 1% other gasses

Thermal energy from the Sun heats the atmosphere; however, different parts of the atmosphere absorb or reflect this heat in different ways.

In the bottom layer of the atmosphere, called the troposphere, temperature decreases as you move upward from Earth's surface. Gases flow and swirl in the troposphere, causing weather.

The stratosphere is above the troposphere. In the stratosphere, gases are more stable and form flat layers.

The mesosphere is above the stratosphere. In the mesosphere, the air temperature decreases with increasing altitude.

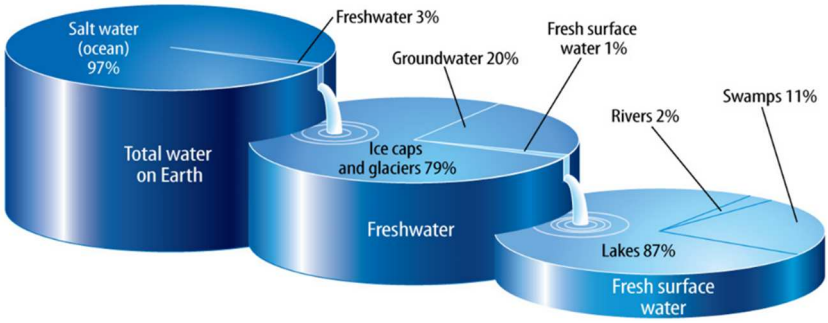
Temperatures increase again as you move further from Earth's surface through the next layer, the thermosphere.

The outer layer of Earth's atmosphere is the exosphere.

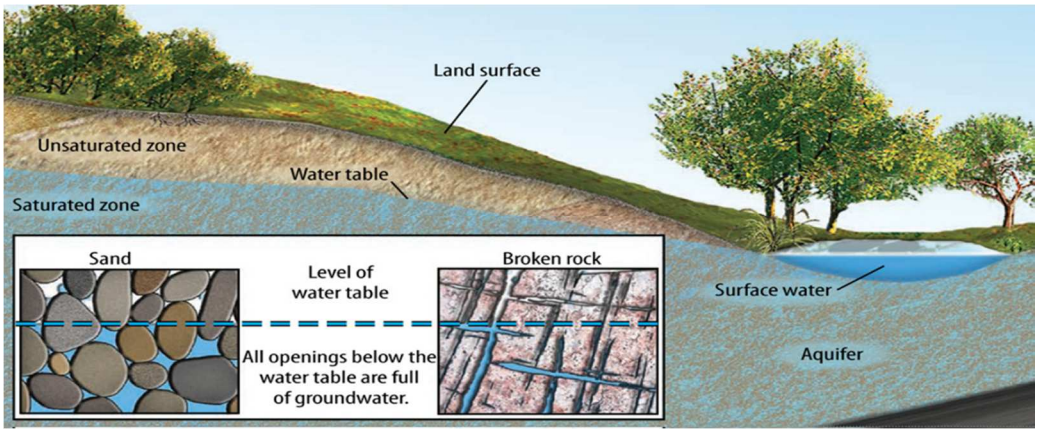
The system containing all Earth's water is called the hydrosphere.

The water in the hydrosphere changes state and is found as a liquid, a solid, and a gas on Earth.

About 97 percent of Earth's water is in the ocean.



Groundwater is water that is stored in cracks and pores beneath Earth's surface.



The frozen portion of water on Earth's surface is called the cryosphere.

The cryosphere consists of snow, glaciers, and icebergs.

About 79% of the planets freshwater is in the cryosphere.

The geosphere is the solid part of Earth, which includes a thin layer of soil and broken rock material along with the underlying layers of rock.

Minerals are naturally occurring, inorganic solids that have crystal structures and definite chemical compositions.

A rock is a naturally occurring solid composed of minerals and sometimes other materials such as organic matter.

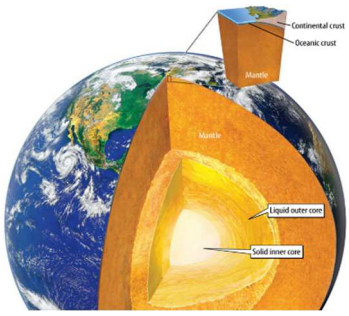
There are three major rock types: igneous, sedimentary, and metamorphic

Igneous rocks form when molten material, called magma, cools and then hardens.

Sedimentary rocks form when forces such as water, wind, and ice break down rocks into small pieces called sediment.

Metamorphic rocks form when extreme temperatures and pressure within Earth change existing rocks into new rocks.

The three basic layers of the geosphere are the crust, mantle, and core. Each layer has a different composition.

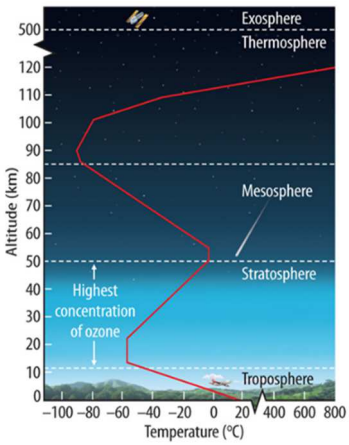


The crust is the brittle outer layer of the geosphere. It is much thinner than the inner layers and is made of rock.

The middle and largest layer of the geosphere is the mantle, made of rocks that are hotter and denser than those in the crust.

The center of Earth is the core, made mostly of metal iron and small amounts of nickel.

Earth is made of four interacting systems: the atmosphere, the hydrosphere, the geosphere, and the biosphere.



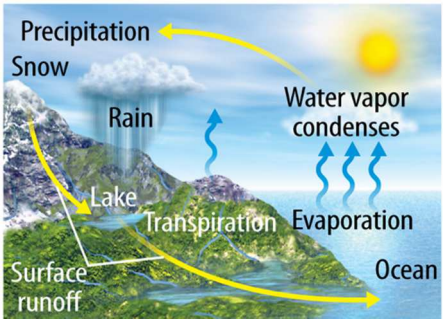
The atmosphere is made mainly of gases and has a layered structure.

The geosphere is made of rock, soil, and metal and also has a layered structure.

Most water in the hydrosphere is in the world ocean 97%

3% of Earth's water is freshwater

Evaporation is the process by which a liquid, such as water, changes into a gas.



Transpiration is the process by which plants release water vapor through their leaves.

Some water vapor also comes from organisms through cellular respiration.

The process by which a gas changes to a liquid is condensation.

Moisture that falls from clouds to Earth's surface is precipitation.

Weather is the state of the atmosphere at a certain time and place.

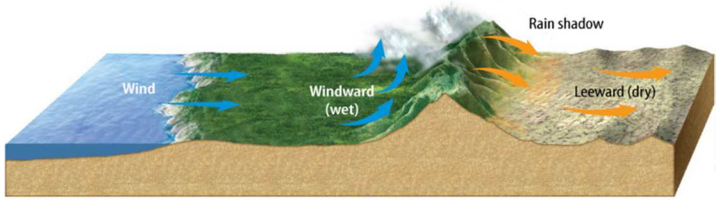
Weather is influenced by conditions in the geosphere and the hydrosphere.

Scientists describe weather using air temperature and pressure, wind speed and direction, and humidity.

Climate is the average weather pattern for a region over a long period of time.

As wind blows over an ocean, it creates surface currents that transport the thermal energy in water from place to place.

Mountains can affect the amount of precipitation an area receives—a phenomenon known as



the rain-shadow effect.

Rock Cycle

The rock cycle is the series of processes that transport and continually change rocks into different forms.

As rocks move through the rock cycle, they might become igneous rocks, sedimentary rocks, or metamorphic rocks.

Uplift is the process that moves large bodies of earth materials to higher elevations.

Rocks on earth's surface are exposed to the atmosphere, the hydrosphere, the cryosphere, and the biosphere.

Glaciers, wind, and rain break down rocks into sediment through a process called weathering.

Eroded sediments are deposited, forming layers of sediment.

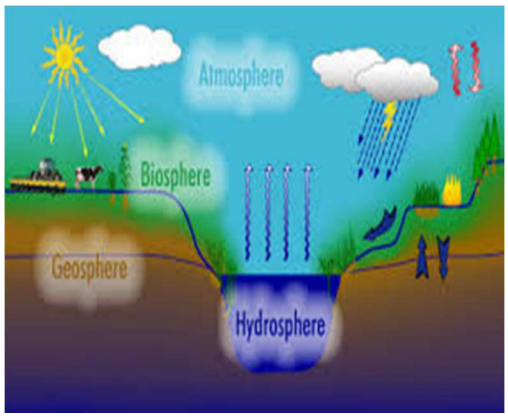
As more layers of sediment are deposited, compaction and cementation produces sedimentary rocks.

Metamorphic rocks form when rocks are subjected to high temperatures and pressure, usually far beneath Earth's surface.

Earth's systems interact and function together as one unified system—planet Earth.

In the water cycle, water continually moves through the hydrosphere, the cryosphere, the atmosphere, the geosphere, and the biosphere.

Weather and climate are influenced by interactions between the atmosphere and the other Earth systems.



In the rock cycle, rocks continually change from one form to another.

Earth is a constantly evolving system with interactions between the biosphere, atmosphere, hydrosphere, cryosphere, and geosphere that are driven by internal and external energy processes.

Earth is made of the biosphere, the atmosphere, the hydrosphere, the cryosphere, and the geosphere.

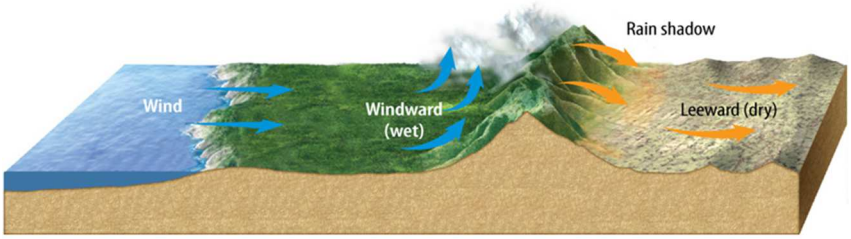
The atmosphere has a layered structure that includes the troposphere, the stratosphere, the mesosphere, the thermosphere, and the exosphere. It is made of nitrogen 78%, oxygen 21%, and trace gases.

Water is found on Earth in oceans, lakes, and rivers and as ice and groundwater.

The geosphere is made of soil, metal, and rock. It has a layered structure that includes the crust, the mantle, and the core.

The water cycle shows how water moves between reservoirs of the hydrosphere, the atmosphere, the geosphere, and the biosphere.

Weather and climate are influenced by transfers of water and energy among the atmosphere, the geosphere, and the hydrosphere.



Rocks continually change form as they move through the rock cycle. Processes such as weathering and erosion are examples of interactions among Earth systems.

Weathering and soil Chapter 2

What natural processes break down rocks and begin soil formation?

How does weathering break down or change rock?

How do mechanical processes break big rocks into smaller pieces?

How do chemical processes change rocks

The mechanical and chemical processes that change objects on Earth's surface over time are called weathering.

Over thousands of years, weathering can break rock into smaller and smaller pieces, such as sand, silt, and clay.

When physical processes naturally break rocks into smaller pieces, mechanical weathering occurs.

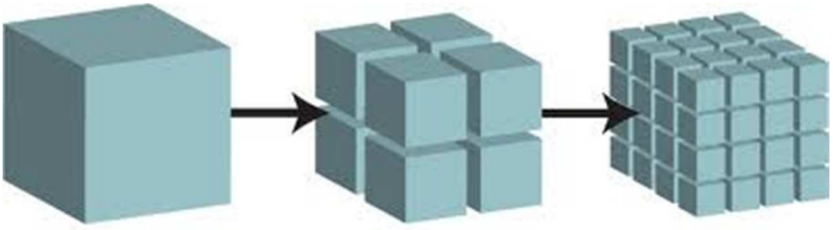
The chemical makeup of a rock stays the same during mechanical weathering.

Mechanical weathering can be caused by ice wedging, abrasion, plants, and animals.

An example of mechanical weathering is when the intense heat of a forest fire causes nearby rocks to expand and crack.

When something is broken into smaller pieces, it has a greater surface area.

Surface area is the amount of space on the outside of an object.



As rock breaks into smaller pieces, overall surface area increases.

Chemical weathering changes the materials that are part of a rock <u>into new materials.</u>

Water is important in chemical weathering because most substances dissolve in water.

The process of dissolving breaks up the minerals in the rock into small pieces. The small pieces mix with water to form a solution and are washed away from the rock.

Acids are also agents of chemical weathering and cause more chemical weathering than pure water does.

Oxidation combines the element oxygen with other elements or molecules.

The product of oxidation is called an oxide.

When rocks that contain iron oxidize, a layer of iron oxide forms on the outside surface.

The environment helps determine the rate of weathering.

Mechanical weathering occurs fastest in locations that have a lot of temperature changes.

Chemical weathering is fastest in warm, wet places.

The type of rock being weathered also affects the rate of weathering and determines what kinds of products result.

Devil's Tower is the remains of a volcano where the magma chamber cooled and hardened. What happened to the rest of the mountain?

Weathering is the mechanical and chemical processes that change things over time.

Mechanical weathering does not change the materials that make up rocks. It breaks up rocks into smaller pieces.

Chemical weathering is the process that changes the minerals that are part of every rock into new materials.

Oxidation and reaction with an acid are both examples of chemical weathering.

Soil – Guiding questions

- **How is soil created?**
- **What are soil horizons?**
- **Which soil properties can be observed and measured?**
- **How are soils and soil conditions related to life?**

Soil is a mixture of weathered rock, decayed organic matter, mineral fragments, water, and air.

Organic matter is the remains of something that was once alive.

Decomposition is the process of changing once-living material into dark-colored organic matter.

Soil contains gases that fill the soil pores–the small holes and spaces in soil.

The sizes of pores change with differences in particle size.

Inorganic matter in soil is formed by the mechanical and chemical weathering of rocks into fragments.

The term inorganic describes materials that have never been alive.

Parent material is the starting material of soil.

Parent material is made of the rock or sediment that weathers to form the soil

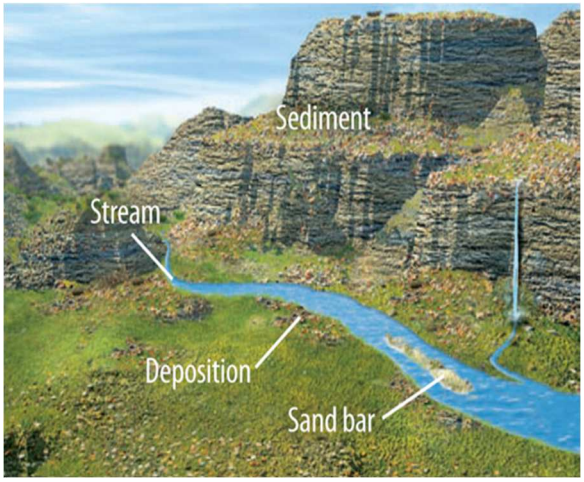
The average weather of an area is its climate.

If the parent material is in a warm, wet climate, soil formation can be rapid.

Topography is the shape and steepness of the landscape.

The topography of an area determines what happens to water that reaches the soil surface.

Water running downhill can carry soil with it, leaving some slopes
bare of soil.



Biota is all of the organisms that live in a region.

Biota in the soil help speed up the process of soil formation in various ways.

Organisms can be involved in decomposition of organic matter or form passages in soil for water to move through.

Rock and soil are affected by organism activity.

Mature soils develop layers as new soil forms on top of older soil.

As time passes, weathering is constantly acting on rock and sediment, making soil formation a constant, but slow, process.

Horizons are layers of soil formed from the movement of the products of weathering.

Each horizon has characteristics based on the type of materials it contains. The three horizons common to most soils are identified as A-horizon, B-horizon, and C-horizon. The top, organic layer is called the O-horizon and the un-weathered, bedrock layer is the R-horizon.

How soil is described and measured

Soil Properties	
Color	Soil can be described based on the color, such as how yellow, brown, or red it is; how light or dark it is; and how intense the color is.
Texture	The texture of soil ranges from boulder-sized pieces to very fine clay.
Structure	Soil structure describes how the particles are held together. Structure can be grainy, blocky and even prism shaped.
Consistency	The hardness or softness of a soil is the measure of its consistency. Consistency varies with moisture. For example, some soils have a soft, slippery consistency when they are moist.

Soil Properties	
Infiltration	Infiltration describes how fast water enters a soil.
Soil moisture	The amount of water in soil pores is its moisture content. Soil scientists determine soil moisture by drying samples in an oven at 100°C.
pH	Most soils have a pH between 5.5 and 8.2. Soils can be more acidic in humid environments.
Fertility	Soil fertility is the measure of the ability of a soil to support plant growth. Soil fertility includes the amount of certain elements that are essential for good plant growth.
Temperature	On the ground surface, soil temperature changes with daily cycles and the weather. Soil temperature in lower layers changes less.

Some properties of soil can be determined just by observation.

The amount of sand, silt, and clay in a soil can be estimated by feeling the soil.

Many soil properties can be measured more accurately in a laboratory.

Plant growers can observe how well plants grow in the soil to get information about soil nutrients.

The type of soil formed depends partly on climate.

The inorganic matter in soil is made up of weathered parent material. The organic matter in soil is made by the decomposition of things that once lived.

The five factors of soil formation are parent material, topography, climate, biota, and time.

Soil contains horizons, which are layers formed from the movement of the products of weathering. Most soil contains A-, B-, and C-horizons.

Physical and chemical weathering are destructive forces that break down rocks, which begins the formation of soil.

Weathering acts mechanically and chemically to break down rocks.

Through the action of Earth processes such as freezing and thawing, mechanical weathering breaks rocks into smaller pieces.

Chemical weathering by agents such as water and acids change the materials in rocks into new materials.

Five factors–parent material, climate, topography, biota, and time–affect the formation of soil.

Horizons are soil layers formed from the movement of the various products of weathering.

Soil can be characterized by properties such as the amount of organic matter and inorganic matter.

Plants depend on certain characteristics of soil, such as organic matter and amount of weathering.