Chapter 21 Planet Earth

Section 1: Earth's Interior and Plate Tectonics
Section 2: Earthquakes and Volcanoes
Section 3: Minerals and Rocks
Section 4: Weathering and Erosion

Section 1: Earth's Interior and Plate Tectonics

<u>Key Terms</u>

Crust
Mantle
Core
Lithosphere
Plate Tectonics
Magma
Subduction
Fault

Section 1: Earth's Interior and Plate Tectonics

What is Earth's Interior Like?

Earth is divided into four different layers the crust, mantle, outer core, and inner core.

Crust is the thin solid outer most layer of Earth. It is made up of hard, solid rock. Beneath the ocean is the oceanic crust.

Continental crust is about 20-40 km thick

Oceanic crust is about 5-8 km thick

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Mantle is a layer of rock between the crust and core. The mantle is almost 2900 km thick and makes up about 80% of Earth's volume.

The mantle maybe solid near the crust but a few hundred km down it becomes "plastic."

Core is the center part of Earth and is divided into two regions the inner and outer core.

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The core is made up of iron and nickel with inner being solid and the outer liquid.

Earth's interior gets warmer with depth

Crust	- 175°C	or	347°F
Mantle	- 1250°C	or	2280°F
Core	- 6000°C	or	10,800°F

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The mass and pressure do not allow the outer core to change into gas so it remains liquid. The atoms in the inner core are forced together to form solids by the mass and pressure.

Radioactive elements contribute to Earth's high internal temperature.

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Plate Tectonics

By studying maps, Alfred Wegener found that continents' coastlines seemed to fit together.

He called this supercontinent Pangaea

Using fossil evidence, he showed that 200 million years ago the same kinds of animals lived on continents that are now oceans apart.

Evidence was discovered in the middle of the ocean that helped explain the mechanisms of continental drift.

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Alignment of oceanic rocks supports the theory of moving plates.

As molten rock pours out onto the ocean floor iron minerals such as magnetite align themselves parallel to Earth's magnetic field.

Since Earth changes its magnetic field about every 200,000 years, there are bands of magnetic rock. These magnetic bands are symmetrical on either side of the Mid-Atlantic Ridge.

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Since the bands are younger near the ridge and older away from the ridge this suggest the crust is moving.

The lithosphere is approximately 100 km thick and is made up of the crust and rigid upper mantle. It has seven large pieces and several small pieces called tectonic plates.

Plate tectonics is the theory that explains how the outer parts of Earth change through time.

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Tectonic plates move about 1 to 16 cm per year.

One hypothesis suggests that plates movement results from convection currents in the asthenosphere. The plates of the lithosphere "float" on top of the asthenosphere.

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Plate Boundaries

Divergent boundaries occur where two plates move apart, creating a gap between the plates.

Mid-ocean ridges are mountain ranges at divergent boundaries in the oceanic crust.

Magma is liquid rock produced under Earth's surface.

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Convergent boundaries occur between oceanic plates and continental plates where the oceanic plates slide underneath the continental plates.

Subduction is the process by which one lithosphere plate moves beneath another as a result of tectonic forces.

Subduction of ocean crust generates volcanoes

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Colliding tectonic plates create mountains

A fault is a crack in Earth created when rocks on either side of a break move. Transform fault boundaries are horizontal movement of rocks along fault plate boundaries.

Section 2: Earthquakes and Volcanoes

Key Terms

Focus
Epicenter
Surface Waves
Seismology
Richter Scale
Vent

Section 2: Earthquakes and Volcanoes

What are Earthquakes?

Earthquakes occur at plate boundaries and release energy as seismic waves.

Focus is the area along a fault at which the first motion of an earthquake occurs.

Epicenter is the point on Earth's surface directly above an earthquake's focus

Section 2: Earthquakes and Volcanoes

Energy from earthquakes is transferred by waves.

There are three types of waves produced by Earthquakes. Longitudinal (Primary P), transverse (secondary S), and surface waves.

Longitudinal waves originate from the focus and travel in all directions. They move faster through rocks than other waves and are first to reach recording stations.

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Transverse waves are the second type of waves and travel slower than longitudinal waves.

Surface waves are seismic waves that can move only through solids. They move only across Earth's surface. Surface waves cause more destruction than P and S waves.

Section 2: Earthquakes and Volcanoes

Measuring Earthquakes

Seismology is the study of earthquakes and a seismograph is a device used to record earthquakes.

Three seismograph stations are necessary to locate the epicenter of an earthquake.

Geologists use seismographs to investigate Earth's interior.

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Waves change speed and direction whenever the density of the material changes. The differences in velocity suggest that Earth's interior consist of several different densities.

The Richter scale is a measurement of earthquakes. It does not determine the destruction caused by earthquakes.

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The amount of damage depends on several factors, such as the distance between populated areas and the types of construction used in buildings.

Section 2: Earthquakes and Volcanoes

Volcanoes

Vent is an opening at the surface of Earth through which volcanic material passes.

Shield volcanoes have mild eruptions. They are some of the largest volcanoes.

Composite volcanoes have trapped gas. They are made up of alternating layers of ash, cinders, and lava. Eruptions alternate between flows and explosive activity that produces cinders and ash.

Section 2: Earthquakes and Volcanoes

Cinder cones are the most abundant volcanoes. They have violent eruptions and vast quantities of hot ash and lava. They are only active for a short time and then become dormant.

An underwater volcano is called a seamount.

Most volcanoes occur at convergent plate boundaries about 75 %. Volcanoes around the Pacific Ocean line in a zone known as the Ring of Fire.

Section 2: Earthquakes and Volcanoes

Underwater volcanoes occur at divergent plate boundaries.

Mantle plumes are volcanoes that occur in middle of plates and many lead to a chain of islands.

Section 3: Minerals and Rocks

Key Terms

Mineral
Igneous Rock
Weathering
Sedimentary Rock
Metamorphic Rock

Section 3: Minerals and Rocks

Structure and Origins of Rocks

All rocks are composed of minerals

Minerals are naturally occurring, nonliving substances that have a composition that can be expressed by a chemical formula.

There are about 3500 known minerals in Earth's crust with no more than 20 of these minerals found in rocks

Section 3: Minerals and Rocks

Rocks may be porous, granular, or smooth; they may be soft or hard and have different densities or colors

Molten rock cools to form igneous rock

The more quickly the rock cools, the less the crystals will grow

Section 3: Minerals and Rocks

Extrusive igneous rock cools on Earth's surface (Basalt)

Intrusive igneous rock forms from magma that cools while trapped beneath Earth's surface (Granite)

Crystals in intrusive igneous rock are larger than those in extrusive igneous rocks.

Remains of older rocks and organisms form sedimentary rocks

Section 3: Minerals and Rocks

Weathering is the natural process by which atmospheric and environmental agents, such as wind, rain, and temperature changes, disintegrate, and decompose rocks. As pieces of weathered rocks begin to accumulate they are compressed or cemented to form sedimentary rock.

Loose sediment forms rocks in two ways with both needing precipitation.

Section 3: Minerals and Rocks

The 1st way is layers of sediment get compressed from weight above, forming rocks.

The 2nd way is minerals dissolved in water seep between bits of sediment and “glue” them together.

Sedimentary rocks are named according to the size of the fragments they contain

Pebbles	-	Conglomerate
Sand	-	Sandstone
Mud	-	Mudstone

Section 3: Minerals and Rocks

Limestone is found in areas that were once beneath water.

Rocks that undergo pressure and heating without melting form metamorphic rock

Metamorphic rocks are rocks that form from other rocks as a result of intense heat, pressure, and chemical processes. Metamorphic comes from the Greek word Metamorphosis which means to change.

Section 3: Minerals and Rocks

Limestone turns into marble

Mudstone or shale turns into slate

Old rocks in the rock cycle form new rocks

The sequence of events in which rock can be weathered, melted, altered, and formed is described by the rock cycle.

Section 3: Minerals and Rocks

How Old Are Rocks?

Rocks form and change over millions of years. It is difficult to know the exact time when a rock formed. The relative age of rocks can be determined using the principle of superposition.

Principle of Superposition

Assuming no disturbance in the position of the rock layers, the oldest will be on the bottom, and the youngest will be on top.

Section 3: Minerals and Rocks

Radioactive dating can determine a more exact, or absolute, age of rocks

The radioactive elements that make up minerals in rocks decay over billions of years. By determining the rate of decay of the element we can determine the age of rocks.

Section 4: Weathering and Erosion

Key Terms

Acid Precipitation
Erosion
Deposition

Section 4: Weathering and Erosion

There are two types of weathering process: Physical and Chemical

Physical, or mechanical, weathering breaks rocks into smaller pieces but does not alter their chemical compositions.

Chemical weathering breaks down rock by changing its chemical composition

Ice can break rocks.

Section 4: Weathering and Erosion

A common kind of mechanical weathering is called frost wedging. This occurs when water seeps into cracks or joints in rocks and then freezes. Over time this process forces the rocks to split apart.

Water volume increases by 10% when it freezes.

Plants can also break rocks.

Section 4: Weathering and Erosion

The roots of plants can act as a wedges as the roots grow.

Chemical Weathering

The results of chemical weathering are not as easy to see as those of physical weathering, but chemical weathering can have a great effect on the landscape over millions of years.

Carbon dioxide can cause chemical weathering

Section 4: Weathering and Erosion

When carbon dioxide dissolves in water the result is carbonic acid.

The carbonic acid weathers rocks. For example, calcite, the major mineral in limestone, reacts with carbonic acid to form calcium bicarbonate

Water plays a key role in chemical weathering. Minerals react chemically with water and are carried to lower layers of rocks by a process of leaching.

Section 4: Weathering and Erosion

Water also carries dissolved oxygen that reacts with minerals that contain metal such as iron. This is called oxidation

Acid precipitation can slowly dissolve minerals

Acid precipitation is precipitation, such as rain, sleet, or snow, that contains a high concentration of acid, often because of pollution in the atmosphere.

Section 4: Weathering and Erosion

Erosion

Erosion is the removal and transportation of weathered and no weathered materials by running water, wind, waves, ice, underground water, and gravity.

Water erosion shapes Earth's surface and is the most effective physical weathering agent.

There is a direct relation ship between the velocity of the water and the size and amount of sediment it can carry.

Section 4: Weathering and Erosion

Deposition is the process in which eroded material is laid down.

As rivers slow at the continental boundaries, large deposits of sediment are laid down. These areas are called deltas.

Deltas contain rich soils and are good agricultural areas.

Section 4: Weathering and Erosion

Oceans also shape Earth by waves crashing onto land.

Glaciers erode mountains

The constantly moving ice mass carves the surface it rest on, often creating U-shaped valleys

Wind can also shape the landscape

Section 4: Weathering and Erosion

Sediment by wind creates a sandblast effect, smoothing Earth's surface and eroding the landscape

As land is pushed upward in places, small surface cracks form. These cracks are eroded by water, ice, and wind until narrow free standing rock formations, called fins, are formed.

As wind weathers the sediment from fins some collapse while others form arches.