Lesson 1: Home Sweet Home

We study this planet we call home, the earth, because of how special it is. No other planet in the solar system is like it. Psalm 115:16 says, "The heavens are the LORD's heavens, but the earth he has given to the children of man." The earth is God's gift to us to explore, to understand, and to rule wisely.

I. Earth's place in the universe

A. Located in the Milky Way Galaxy
B. Earth orbits the sun, which is one of billions of stars

II. Earth's position in the solar system

A. Eight planets orbit the sun: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune
B. Earth is the third planet from the sun in our solar system

III. Gravity & Earth's orbit

A. Gravity is a force that pulls objects toward each other
B. Gravity from the sun keeps Earth in orbit

IV. The Earth's habitability

A. The habitable zone is:
    1. Earth's perfect position in the Solar System, allowing life to flourish on Earth
    2. Ideal distance for heat and light for life on Earth
B. Water is essential for life on Earth
C. Earth's atmosphere is like a blanket that traps heat

Lesson 2: The Spheres of the Earth

When you study earth science, you're studying each of the four spheres of the earth – each one distinct yet all interacting with one another. Join us on our adventure as we uncover the mysteries of the geosphere, hydrosphere, atmosphere, and biosphere!

I. Earth's layers

A. The earth is a sphere: a round, solid figure
B. The earth has multiple layers, each separately referred to as a sphere
C. The earth contains four main layers: geosphere, hydrosphere, atmosphere, and biosphere
D. All the spheres constantly interact with one another

II. The geosphere

A. The earth's solid layer, starting at the crust and extending to the core
B. The crust is the outermost layer
C. Contains rocks, minerals, soil, fossils, mountains, caves, tectonic plates, earthquakes, and volcanoes

III. The hydrosphere

A. All of earth's water, including oceans, lakes, rivers, and glaciers
B. Includes freshwater and saltwater

IV. The atmosphere

A. The layer of gases surrounding the earth
B. Thicker near the surface, thinner as you ascend
C. Helps to explain deserts, rainforests, seasons, clouds, and extreme weather

V. The biosphere

A. All life that exists on Earth
B. Found within all other layers of the earth

Lesson 3: My Place in This World

If you know how to use the map, you might be able to find buried treasure. But more likely you'll be able to use these skills to find various locations you might need to travel. In this lesson, you'll be learning about the four cardinal directions along with special lines on the map called longitude and latitude.

I. Learning to read a map

A. Grids help us to locate and identify points on a map
B. Longitude lines run north-south
C. Latitude lines run east-west

II. The earth's axis and cardinal directions

A. The earth spins around its axis, an imaginary pole running through its center from north to south
B. Four cardinal directions: north, south, east, and west

III. Special latitude and longitude lines

A. The equator divides the earth into the northern and southern hemispheres
B. The prime meridian divides the earth into eastern and western hemispheres

IV. Challenges of representing the earth on a flat map: a flat surface distorts Earth's true shape

Lesson 4: Feeling Dizzy

Can you imagine living in a time when no clocks or calendars existed? How would you know what to do and when? Long ago, people lived without clocks and calendars. In this lesson, you'll discover how humans began to use the lights in the sky to determine the rhythms of hours, days, weeks, and months.

I. Time measurements based on the motions of the earth

A. One revolution of Earth around the sun = one year
B. One moon cycle = one month
C. One rotation of Earth on its axis = one day

II. Division of time into days, weeks, months, and years

A. Days are divided into hours
    1. Initially divided by the Egyptians and Greeks
    2. 24 hours in one day
B. Weeks are divided into 7 days
C. Years are divided into 12 months
D. The names of the days of the week are based on the moon and planets

Lesson 5: A Season for Everything

Why do we have seasons? Why do some places go through winter, spring, summer, and fall, and other places have rainy and dry seasons? The key to understanding why we have seasons can be found in the earth's axis.

I. The earth's tilt

A. The earth is tilted on its axis and is always tilted the same way
    1. Causes different sunlight angles, leading us to experience seasons
    2. Northern and southern hemispheres experience opposite seasons throughout the year

B. Solstices
    1. Summer or June solstice
        a) Occurs when the northern hemisphere is most tilted toward the sun
        b) The northern hemisphere receives the most sunlight it will receive all year and the southern hemisphere receives the least
    2. Winter or December solstice
        a) Occurs when the southern hemisphere is most tilted toward the sun
        b) The southern hemisphere receives the most sunlight it will receive all year and northern hemisphere receives the least

C. Equinoxes
    1. Occurs half-way between the solstices
    2. Occurs when both hemispheres receive equal sunlight

D. The terminator is the line between light and dark on the earth

II. Special areas and lines

A. Tropic of Cancer and Tropic of Capricorn border the tropical regions

B. Arctic Circle and Antarctic Circle mark cold regions near the poles

C. Temperate zones are the areas between the tropics and the arctic areas

Lesson 6: Life Everywhere!

Travel the world and you'll see: there is radically different weather from place to place. Why is that? It all has to do with climate zones: areas where general trends in weather stay the same over a long period of time. This lesson explores the different climate zones we find on Earth and what kinds of conditions we find in those places.

I. Weather vs. climate

A. Weather: short-term, day-to-day changes
B. Climate: long-term, regional weather trends

II. Earth's major climate zones

A. Tropical zone
    1. Between Tropics of Cancer and Capricorn
    2. Hot, humid, rainforests, and savannas
    3. Example: Amazon Rainforest
B. Subtropical zone
    1. Hot and dry
    2. Example: Sahara Desert
C. Temperate zone
    1. Moderate temperatures, 4 distinct seasons, forests and grasslands
    2. Examples: North America and Europe
D. Subpolar zone
    1. Near the Arctic Circle
    2. Cool summers, long cold winters
    3. Example: Northern Canada and Russia
E. Polar zone
    1. Located at the poles
    2. Extremely cold, year-round freezing temperatures
    3. Example: Antarctica

III. Climate influences

A. Proximity to the equator

    1. As you move further from the equator, the temperature gets cooler
    2. As you move closer to the equator, the temperature gets hotter
B. Water
C. Rainfall
D. Topography

Lesson 7: Up, Up, & Away!

The earth's atmosphere is a magnificent place—from the power of lightning to the beauty of auroras. In this lesson, you'll learn the functions of the earth's atmosphere and about each of its layers.

I. Review of Earth's layers

A. Geosphere: Earth's rocks, soil, and minerals
B. Hydrosphere: All water on Earth
C. Biosphere: Areas with living organisms
D. Atmosphere: Blanket of gases surrounding the earth

II. The atmosphere

A. Gases in the atmosphere: 21% oxygen, 78% nitrogen
B. Nitrogen is essential for plant and animal life on Earth
C. Air gets thicker closer to the ground
D. Protects Earth by providing air to breathe, trapping heat, and shielding Earth from space hazards

III. Layers of the atmosphere from innermost to outermost

A. Troposphere (closest to Earth)
    1. Location of weather like rain, wind, tornadoes, hurricanes, and clouds
    2. Temperature decreases with altitude
B. Stratosphere
    1. Calm air, low pressure
    2. Commercial planes fly in the lower part
    3. Contains the ozone layer which blocks the sun's harmful rays
C. Mesosphere
    1. Thinner atmosphere with strong winds
    2. Burns up meteors entering Earth's atmosphere
D. Thermosphere
    1. Absorbs energy from the sun, feels more like outer space
    2. Location of satellites, International Space Station, and the auroras (northern/southern lights)

Lesson 8: Water World

The earth is called the blue planet because, from space, our planet appears blue due to all of the water covering its surface. From oceans to lakes to rivers to streams, water is the most common substance on Earth, and it is what makes life possible.

I. Introduction to water

A. Important for survival
B. Found in three phases: solid ice, liquid, and gas

II. Earth's oceans

A. Oceans cover 140 million square miles
B. Some trenches as deep as 36,000 ft

III. Ocean depths and zones

A. Surface water: warm and comfortable in tropical areas
B. The midnight zone: 3300 ft down
    1. No sunlight, dark, nearly freezing
    2. Special creatures adapted to live in the deep ocean

IV. Types of water on Earth

A. Saltwater
    1. Oceans and some lakes
    2. Most of Earth's water
B. Freshwater
    1. Located in rivers, lakes, ponds, and streams
    2. Sources of freshwater
        a) Groundwater: found within the earth
        b) Clouds: water vapor
        c) Rain
        d) Icecaps and glaciers: ice water

Lesson 9: Surf's Up

The oceans are constantly on the move! In this lesson, we explore the ocean's movements. Waves crash towards the shore. Currents create paths in the sea. And tides cause the waters of the ocean to rise and fall.

I. Names of oceans

A. Pacific Ocean: largest ocean
B. Atlantic Ocean
C. Indian Ocean
D. Arctic Ocean
E. Southern Ocean

II. Waves

A. Primarily caused by wind
B. Composed of crests and troughs

III. Surface currents

A. Currents are the normal pattern of movement the ocean follows
    1. Flow clockwise in the northern hemisphere
    2. Flow counterclockwise in the southern hemisphere
B. Winds drive ocean currents
C. Warm vs. cold currents

IV. Tides

A. Tides are the periodic rise and fall of the ocean
B. Caused by gravity from the moon and sun
C. The moon's gravitational pull creates bulges of water
D. Earth's rotation causes two high tides and two low tides daily
E. Spring tide: when the sun and moon's gravity align

Lesson 10: High Quality H_2O

In this lesson, we'll be exploring the freshwater locations in the world, from lakes and rivers to glaciers and icebergs and groundwater found deep within the earth.

I. Review of freshwater

A. Any water that is not salty
B. Primary sources of freshwater: lakes, rivers, glaciers, groundwater

II. Lakes and ponds

A. Smaller bodies of water surrounded by land
B. Lentic water: water that is not flowing
C. Wildlife associated with freshwater lakes
    1. Fish like trout, salmon, and bass
    2. Amphibians like frogs and toads
    3. Mammals like beavers and otters
    4. Lakes and ponds are lentic water: water that isn't flowing

III. River and streams

A. Lotic water: water that flows
B. Gravity causes lotic water to flow from higher to lower places

IV. Groundwater

A. Largest source of freshwater
B. Seeps down into the earth from standing rainwater
C. Wells are one of the best ways to access groundwater close to the surface
D. Aquifers: bodies of permeable rock containing groundwater
E. Springs: where aquifers overflow
F. Geysers: springs that erupt suddenly and violently

V. Glaciers and icebergs

A. 75% of the Earth's freshwater
B. Ice caps and ice sheets
C. Icebergs are large chunks of glaciers that break off and float out into the ocean
D. Found on every continent except Antarctica

Lesson 11: Water Works

Water has important characteristics which allow it to go through the water cycle. The water cycle is a never-ending sequence of evaporation, condensation, and precipitation that's vital for life on Earth.

I. States of water

A. Liquid: most common form of water on Earth
B. Solid: ice
    1. Forms when water gets too cold
    2. Glaciers are the primary source of frozen freshwater
C. Gas: Water vapor
    1. Formed when water is heated
    2. Water vapor gathers in the air and forms clouds

II. Molecular structure of water

A. H_2O: 2 hydrogen atoms and 1 oxygen atom
B. Behavior of water molecules in different states
    1. Liquid: molecules flow and slide past each other
    2. Solid: molecules spread out and form a crystal structure
    3. Gas: molecules spread far apart and move quickly

III. Key terms related to the water cycle

A. Freezing: liquid turning into a solid
B. Melting: solid turning into a liquid
C. Evaporation: liquid turning into a gas
D. Condensation: gas turning into a liquid
E. Precipitation: water falling from clouds to the ground

IV. The water cycle

A. The process of water moving between the earth and the atmosphere
B. Steps of the water cycle
    1. Evaporation: water heats up, turns into vapor, and rises
    2. Condensation: water vapor cools and forms clouds
    3. Precipitation: water falls as rain, sleet, snow, or hail

Lesson 12: On Cloud Nine

Look up in the sky and you may see swirls of white in the sky making pictures of animals and castles and all sorts of mythical things. In this lesson, you'll be exploring how these white puffs carry water throughout our atmosphere.

I. Cloud formation and weather prediction

A. Clouds form in the troposphere
B. Cloud condensation nucleus: a piece of dust that water vapor clings to, beginning the formation of a cloud
C. Clouds are condensed water vapor
D. Precipitation occurs when a cloud gets so full it begins to rain

II. Cloud classification

A. Clouds are classified based on height and shape
B. Key Latin words used in cloud classification
    1. Cumulo: means heap, describes puffy, heaped clouds
    2. Strato: means spread out, describes layered clouds
    3. Cirro: means lock of hair, describes wispy clouds
    4. Alto: means high, refers to middle-level clouds
    5. Nimbo: means rain, associated with rain-bearing clouds

C. Common cloud types

1. Stratocumulus clouds (strato + cumulo)
    a) Puffy cumulus clouds mashed together in a layer
    b) Often appears as a dark layer with bits of blue sky visible
2. Cirrocumulus clouds (cirro + cumulo)
    a) Thin, puffy clouds resembling fish scales
    b) Laid out in rows
3. Altostratus clouds (alto + stratus)
    a) Midlevel, spread out in a gray-blue layer
    b) Sun or moon often shines through them like frosted glass
4. Cumulonimbus clouds (cumulo + nimbus)
    a) Towering, rain-producing clouds with bulging tops

b) Typical thunderstorm clouds, associated with heavy rain, lightning, and hail

Lesson 13: How's the Weather?

Predicting the weather involves observing many things: temperature, air pressure, clouds, and more. In this lesson you'll learn about some of the factors meteorologists look at when predicting the weather.

I. Introduction to weather

A. Scientists who study weather are called meteorologists
B. Weather refers to the day-to-day conditions in the area, including temperature, moisture, wind, and cloudiness
C. Meteorologists look at many factors to predict the weather including temperature, atmospheric pressure, and clouds

II. Predicting weather using air pressure

A. Low pressure leads to clouds and precipitation
B. High-pressure results in clear skies and dry weather
C. Air moving from high to low-pressure areas causes wind

III. Cloud conditions and weather prediction

A. Different types of cloud cover: sunny, mostly sunny, partly sunny/cloudy, mostly cloudy, cloudy
B. Using temperature to predict precipitation types
    1. Warm weather = more likely to rain
    2. Cold weather = more likely to snow

Lesson 14: Raining Cats & Dogs

There are five different types of precipitation: rain, snow, freezing rain, sleet, and hail. In this lesson, you'll learn about the clouds and weather fronts that bring precipitation of all shapes and kinds!

I. Weather fronts

A. Weather fronts are a transition zone between two different air masses
B. Cumulonimbus clouds form at cold fronts
    1. cold air pushes warm air up
    2. creates towering cumulonimbus clouds, resulting in heavy but brief rain
C. Nimbostratus clouds form at warm fronts
    1. warm air moves over cold air
    2. forms widespread nimbostratus clouds, resulting in longer, lighter rain

II. Types of precipitation and their formation

A. Rain: liquid water falling from clouds
B. Snow: vapor turns into ice crystals at 32°F or lower
C. Freezing rain: ground is below freezing while air is warmer, causing rain to freeze on contact
D. Sleet: rain freezes on its way to the ground when the air temperature drops
E. Hail: formed in cumulonimbus clouds by updrafts and downdrafts; water freezes repeatedly, forming layers

III. Lightning

A. Positive and negative charges in cumulonimbus clouds: similar to static electricity with a balloon
B. Has a 54,000°F energy potential, up to 100 strikes per second

Lesson 15: We're Not in Kansas Anymore

When large, rotating columns of air called funnel clouds strike the ground, it becomes known as a tornado. Tornadoes can be very destructive, causing damage to property and loss of life. In this lesson, you'll learn about the clouds and air patterns that cause tornadoes to occur and how scientists classify tornadoes.

I. Tornado formation and characteristics

A. What is a tornado?
    1. A rotating column of wind under a storm
    2. Funnel clouds become tornados when they touch the earth
    3. Typically lasts about 10 minutes

B. Tornado wind speeds
    1. Range from 65-85 mph to over 200 mph
    2. Movement speed can range from stationary to 70 mph

C. Tornadoes form from updrafts in cumulonimbus clouds which create spinning air and supercell thunderstorms

II. Tornado classification

A. Ranked by severity on the Fujita scale (F-Scale) from F0 to F5

B. Enhanced Fujita scale: EF scale is used in the USA and Canada

C. Damage descriptions by EF rating
    1. EF0: light damage (shingles blown off roof)
    2. EF1: moderate damage (mobile homes flipped)
    3. EF2: Considerable damage (roofs ripped off)
    4. EF3: Severe damage (large vehicles moved)
    5. EF4: Devastating damage (homes destroyed)
    6. EF5: Incredible damage (total destruction of neighborhoods)

III. Tornado-prone areas

A. Tornado Alley in the USA: includes Texas, Oklahoma, Kansas, and Nebraska

B. Tornado Corridor in South America: includes Argentina, Uruguay, and southern Brazil

Lesson 16: The Eye of the Storm

Hurricanes are huge storms with rotating winds that form over warm tropical waters. In this week's lesson, we'll be exploring these powerful storms that have the potential to cause great destruction when they approach land.

I. Hurricane formation and characteristics

A. Hurricanes: a tropical cyclone with rotating winds over 74 mph
   1. Forms over warm tropical or subtropical waters
   2. Has a calm center called the "eye" surrounded by powerful winds
   3. Rotate counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere

B. Formation of hurricanes
   1. Cumulonimbus clouds build up, forming a towering structure with a rotating center
   2. Low-pressure areas cause high-pressure air to spiral in, leading to rotating winds
   3. Evaporation from warm ocean waters fuels the storm

C. Size and impact
   1. Can be over 300 miles wide
   2. Bring heavy rain, flooding, and dangerous storm surges
   3. Damage extends far beyond the path of the storm

II. Hurricane classification: Saffir-Simpson Hurricane Scale

A. Category 1: 74-95 mph, some damage to roofs, mobile homes, and trees

B. Category 2: 96-110 mph, extensive damage to homes, trees uprooted, and power outages

C. Category 3: 111-129 mph, major damage, flooding destroys small structures

D. Category 4: 130-156 mph, catastrophic damage, roofs and walls ripped off, most trees and poles fall

E. Category 5: 157+ mph, massive destruction, many areas uninhabitable for months

III. Hurricane-prone areas

A. North Atlantic is prone to hurricanes
B. Pacific Ocean is prone to typhoons
C. Indian Ocean is prone to cyclones

Lesson 17: Peeling Back the Layers

In this lesson, we'll be studying the layers of the earth under our feet. We'll be exploring the outside crust, traveling deeper to the hot mantle, and going all the way to the blazing hot inner metal core of the earth to learn more about the world God made.

I. The crust

A. The outermost layer of the earth
B. Average is 30 miles thick
C. Composed of rock making up the ground, mountains, valleys, and ocean floors

II. The mantle

A. Approximately 1,800 miles thick
B. Most of the earth is part of the mantle
C. Divisions
    1. Upper mantle: mostly solid rock
    2. Lower mantle: very hot, softer rock due to heat and pressure
D. Affects the formation of volcanoes, tsunamis, and mountains

III. The core

A. Divisions
    1. Outer core
        a) Thickness: over 1,300 miles
        b) Made of liquid metal (iron and nickel)
        c) Temperature: between 7,200 and 9,000 degrees
    2. Inner core
        a) Solid due to immense pressure
        b) Made of iron and nickel
B. Creates the Earth's magnetosphere, which protects us from harmful solar radiation

Lesson 18: It's Elementary

If you take a look around you, you'll notice rocks come in many different shapes, colors, and sizes. It's the minerals that make up the rocks that give each rock its unique characteristics. That's what you'll be studying in this lesson.

I. Minerals

A. Solid, inorganic crystal substances found in nature
B. Geologist: a scientist who studies rocks and minerals
C. Examples of minerals: quartz and calcite
D. Rocks consist of multiple minerals combined together

II. Characteristics of rocks and minerals

A. Rock classification is based on types of minerals
B. Key properties for identifying rocks and minerals
    1. Color
    2. Streak test
    3. Hardness (using Mohs hardness scale)
        a) 10 = very hard rock
        b) 1 = very soft rock

III. The role of minerals in everyday life

A. Minerals are found in the human body
B. Practical uses of minerals: roads, construction, toothpaste

Lesson 19: Rock On!

Rocks are getting recycled all the time, both up on the surface and deep underground, sometimes very quickly other times very slowly. We'll be examining the three types of rocks and the cycle God uses to recycle them over and over again throughout history.

I. The three types of rock

A. Igneous rock
   1. Formed when cooled magma or lava solidifies
   2. Types of igneous rock
      a) Granite (common in mountains)
      b) Pumice (light and can float)

B. Sedimentary rock
   1. Formed when layers of sediment are layered and compressed
   2. Examples:
      a) Sandstone (seen in cliffs)
      b) Limestone (forms in caves and certain mountains)
      c) Many rock formations

C. Metamorphic rock
   1. Formed when rock is exposed to high heat and pressure
   2. Examples:
      a) Marble: metamorphized limestone used in sculptures
      b) Quartzite: used in construction

II. The rock cycle

A. All types of rock are interconnected

B. Processes of the rock cycle
   1. Magma crystallizes into igneous rock
   2. Igneous/sedimentary rock breaks into sediment and forms sedimentary rock
   3. Sedimentary/igneous rock transforms into metamorphic rock under heat and pressure
   4. Metamorphic/sedimentary rock can melt back into magma

C. Rocks are continuously recycled through the rock cycle

Lesson 20: The Plates of the Earth

While it may seem like the ground you're standing on is stationary, it's not. You'll learn in this lesson how the earth's crust is broken up into pieces and those pieces are constantly moving and shifting, floating on top of the earth's mantle.

I. Continental movement

A. Continents can be rearranged and fit together like puzzle pieces
B. Continental Drift Theory states that all continents used to be connected
    1. Theory was not initially well received by scientists
    2. Now scientists believe Earth used to consist of one supercontinent called Pangaea
    3. Fossil evidence connecting continents
    4. Rock formations are similar across continents
C. Seafloor spreading causes the continents to be pushed apart

II. Plate Tectonics

A. Theory that the Earth's crust can be broken up into puzzle-like pieces called tectonic plates
B. Types of tectonic plates
    1. Continental plates
    2. Oceanic plates
C. Tectonic plate boundaries occur where two plates meet
    1. Some plates smash into each other
    2. Some move apart from each other
    3. Some plates rub up against each other

Lesson 21: Who's at Fault?

When two or more tectonic plates meet, we have a boundary. These boundaries interact with one another in different ways causing many of the features we see on Earth and causing a number of natural disasters we experience as well. We'll continue to explore plate tectonics and the movements of convergent, divergent, and transform boundaries.

I. Convergent boundaries

A. Occurs where two plates push together
B. Types:
    1. Continental vs. continental: forms mountains
    2. Oceanic vs. oceanic: forms trenches
    3. Continental vs. oceanic: forms volcanoes

II. Divergent boundaries

A. Occurs where two plates split apart
B. New crust forms as magma rises

III. Transform boundaries

A. Occurs where two plates slide past one another
B. Major cause of earthquakes

Lesson 22: Blow Your Top

The movement of the earth's tectonic plates causes some of the world's most destructive disasters. In this lesson, we'll be taking a look at volcanoes. We'll explore how the movements of the plates cause lava to spew from the earth, throwing with it rocks, ash, and gases.

I. Introduction to Volcanoes

A. Volcanoes are openings in the earth's crust where gases, lava, rock, and ash flow
B. Types of volcanoes based on shape:
    1. Wide mountains
    2. Cratered hills
    3. Tall peaks
C. Occur at divergent boundaries (plates moving apart) and convergent boundaries (plates coming together)
D. Oceanic plate subduction leads to magma rising
E. Most occur deep in the ocean and if they erupt many times and can eventually create islands
F. Types of volcanoes based on activity:
    1. Active: erupts regularly
    2. Dormant: long periods without eruption (Mount Kilimanjaro)
    3. Extinct: no future eruptions expected (Ben Nevis)

II. The Ring of Fire

A. Region where approximately 75% of volcanoes are located
B. Line of volcanoes outlining tectonic plate boundaries
C. Located in the Andes, Cascades, Aleutian Islands, and Japan

III. Types of material released during volcanic eruptions

A. Lava: magma that rises above the earth's crust
B. Gases, which can be deadly
C. Rock and ash can be thrown into the air
D. Volcanic ash is rich in minerals and offers fertile soil for agriculture

Lesson 23: Shake, Rattle, & Roll

Earthquakes can be so small you might not even feel them or large enough to topple buildings. These vibrations caused by the shifting of the tectonic plates of the earth's crust are the focus of this week's lesson.

I. Earthquake Terminology

A. Seismology: the study of earthquakes
B. Seismologist: a person who studies earthquakes
C. Seismic waves: waves of energy from earthquakes
D. Seismograph: an instrument that measures seismic waves
E. Seismogram: a record of seismic wave activity
F. Epicenter: a point on the earth's surface directly above the earthquake source where the strongest tremors are felt

II. Causes of earthquakes

A. Convergent boundaries
    1. Plates push together and get stuck
    2. Megathrust earthquakes happen when plates snap back into place
B. Divergent boundaries
C. Transform boundaries
    1. The most common cause of earthquakes
    2. Plates get stuck, tension builds, and releases suddenly
D. Earthquakes can occur in the middle of tectonic plates if faults or cracks occurs within a plate
E. Most earthquakes originate from the Ring of Fire

III. Richter scales

A. Developed by Charles F. Richter in 1935 to measure the intensity of an earthquake
B. Each level is 10 times stronger than the previous level

Lesson 24: Wall of Water

Tsunamis are giant walls of water that strike land and destroy everything in their path. We'll be exploring the causes of these devastating, colossal waves in this lesson of Earth Science Explored Elementary.

I. Introduction to Tsunamis

A. A tsunami is a giant, dangerous wave, typically caused by underwater earthquakes or volcanoes
B. Can cause damage and destruction many miles inland from the ocean
C. Can move up to 500 miles per hour
D. Sensors on the seafloor alert scientists of impending tsunamis

II. Cause of Tsunamis

A. Most tsunamis are caused by earthquakes
    1. Underwater earthquakes: energy from tectonic plate compression is sent through the water
    2. The magnitude of the earthquake impacts the size of the tsunami
B. Other natural events can indirectly cause tsunamis including:
    1. Landslides
    2. Volcanoes
    3. Large amounts of rock falling into the ocean

Lesson 25: Break It Down

In this lesson, we'll learn about powerful processes that shape the earth we live on —weathering and erosion. From unique rock formations to huge trenches to vast sand dunes, the evidence of weathering and erosion is all around us.

I. Weathering

A. The gradual breakdown of rocks over time
B. A slow process that can be sped up by natural catastrophes
C. Types of weathering
    1. Physical weathering: mechanical breakdown of rocks including hitting, scraping, and rubbing
    2. Chemical weathering: breakdown by chemicals from things like acid rain and bacteria

II. Erosion

A. The picking up and moving of rocks from one place to another
B. Wind and water are the key forces behind erosion
C. Erosion can be gradual or catastrophic
    1. Slow, daily erosion
        a) Shapes landforms over long periods
        b) Caused by wind, water, and ice
    2. Catastrophic erosion events
        a) Rapid erosion can be seen on beaches after storms
        b) Hurricanes can cause rapid erosion

Lesson 26: Clear as Mud

Dirt might not seem like anything special, but it's vital for life. In this lesson, you'll explore what soil's made of, the five factors that are responsible for making soil unique in different locations, and why we need soil.

I. What is soil?

A. Minerals made from eroded rocks
B. Organic materials from living and decomposed organisms
    1. Fallen leaves
    2. Decomposing plants
    3. Animal waste
C. Pores: spaces that hold water and gases for plant and organism survival

II. Types of soil

A. Sandy soil: drains quickly, good for root vegetables
B. Silty soil: holds water but drains well, suitable for many vegetables
C. Clay soil: retains water, best for shallow-rooted plants
D. Loam soil: optimal mix, supports a variety of plants

III. Factors affecting soil composition

A. Parent material: original rock composition in an area
B. Climate: average weather over time
C. Living organisms: plants, animals, and microbes
D. Topography: shape of the land
E. Time: soil changes with long-term weathering and organic decay

IV. Importance of soil

A. Soil helps to purify air and water
B. Habitat for organisms like earthworms, insects, and microbes
C. Foundation for plant life

Lesson 27: Relics of the Past

Fossils are exciting because they give us clues as to what the world was like long before we were on Earth. Come explore this thrilling topic with us as we dig up fun facts about the different types of fossils we find hidden here on Earth.

I. Introduction to Fossils

A. Any preserved remains or impressions of once-living organisms
B. Most fossils are found in sedimentary rock
C. Can include bones, shells, or imprints

II. Types of fossils

A. Trace fossils
    1. Indirect evidence of an organism's activity
    2. Examples: footprints, burrows, feces
B. Impression fossils: indents left by an organism, later filled with sediment
C. Petrified remains: organic material replaced by minerals over time
D. Preserved remains
    1. Original material of the organism is preserved without mineral replacement
    2. Can be preserved in amber, tar, or ice

Lesson 28: All Over This Land

From mountains and hills to plateaus and plains to mesas and canyons—the earth is covered in unique landforms. In this lesson, you'll learn about many of the unique landforms created from the movements of the earth's plates along with weathering and erosion.

I. Introduction to Landforms

A. Natural earth surface features shaped by tectonics, weathering, and erosion
B. Topography is the physical arrangement of Earth's land

II. Minor landforms

A. Small, localized features
B. Examples:
    1. Buttes: isolated flat-topped hills with steep sides
    2. Sand dunes: wind-shaped hills of sand
    3. Arches: rock formations with openings from water/wind erosion
    4. Coves: curved coastal areas with partial water enclosure
    5. Peninsulas: land with water on three sides
    6. Canyons: deep valleys between steep cliffs
    7. Badlands: dry, eroded areas with steep slopes and sparse vegetation

III. Major landforms

A. Large formations occupying significant areas
B. Examples:
    1. Mountains
        a) Steep slopes, high peaks
        b) Formed by tectonic plate collision or dormant volcanoes
    2. Hills
        a) Smaller, less steep than mountains
        b) Formed by tectonic activity, shaped by erosion
    3. Plateaus
        a) Elevated, flat terrain
        b) Formed from magma beneath Earth's crust lifting land without breaking through
    4. Plains
        a) Flat, wide land stretches with minimal elevation
        b) Covers roughly one-third of Earth's land surface

Lesson 29: Into the Land

In this lesson, you'll discover a whole new world under your feet. We'll journey deep underground to explore caves and learn about their unique features and how they are formed through the process of erosion.

I. Introduction to Caves

A. Natural underground chambers formed in the earth's surface
B. Most caves are formed from limestone through weathering and erosion by acidic water

II. Types of caves

A. Volcanic caves (lava tubes): formed from flowing lava cooling and creating a hollow tube
B. Sea caves: created by waves eroding coastal rock formations
C. Solution caves (caverns): formed by acidic water dissolving limestone
    1. Some of the largest caves in the world
    2. Common formations
        a) Stalactites: formed when mineral builds up over time and hang from the ceiling
        b) Stalagmites: formed when mineral builds up over time on the ground
        c) Columns: formed when stalactites and stalagmites meet

Lesson 30: Under the Water

In our last lesson, we'll dive to the bottom of the ocean to take a look at underwater landforms. From undersea mountains to enormous rift valleys and hydrothermal vents, you'll be in wonder at God's amazing underwater creations.

I. The ocean floor and its landforms

A. The ocean floor is the land under the ocean water
B. Regions of the ocean floor
    1. Continental shelf looks like the landform it's connected to
    2. Continental slopes drop very deep
    3. Abyssal plain: vast, flat areas
    4. Hadal zone: deep, V-shaped trenches
C. Other common oceanic landforms
    1. Oceanic plateaus
    2. Underwater volcanoes and mountains

II. Unique ocean floor landforms not found on land

A. Oceanic ridges, located at divergent plate boundaries
B. Hydrothermal vents
    1. Microorganisms feed on vent minerals
    2. Vent ecosystem supports unique animals like tube worms and Pompeii worms