

# Geology

## **Core Ideas/Crosscutting Concepts:**

### **The Beginning**

Earth's place in the universe

History

Ptolemy

Copernicus

Brahe

Kepler's Laws

Origin of the Solar System

Protosun

Protoplanets

Main Sequence Sun

Earth and Moon

Planetary differentiation

Convection currents

Formation of the Moon

Moon's orbit

Phases of the Moon

Moon, Sun and tides

Stars and the elements

Star life cycle

Formation of elements

Meteorites

Origin of the universe

Static universe

Expanding universe

Doppler Effect

Age of the universe

The Big Bang

### **Physical Geology**

Earth's History

Principles to determine relative age

## **Learning Targets:**

### **Physical Geology**

Earth's Resources

Energy resources

Renewable and nonrenewable energy sources and efficiency

## **Core Ideas/Crosscutting Concepts:**

### **Physical Geology**

The geologic rock record

Relative and absolute age

Principles to determine relative age

Absolute age

Combining relative and absolute age data

The geologic time scale

### **The Geological Time Scale**

James Hutton

Radiometric dating

Half lives

Decay curves

Relative dating

Superposition

Cross cutting

Inclusions

Faunal succession

Landscape development

Block diagrams

Geological Time Scale

Pre-Cambrian

Paleozoic

Mesozoic

Cenozoic

### **Mapping & Remote Sensing**

Topographic maps

Geological maps

Cross sections

Aerial photos

Remote sensing

LandSat

### **Learning Targets:**

#### **Physical Geology**

The geologic rock record

Relative and absolute age

Principles to determine relative age

Absolute age

Combining relative and absolute age data

The geologic time scale

### **Core Ideas/Crosscutting Concepts:**

#### **Earths Structure**

Seismic waves

p-waves

s-waves

Surface waves

Refraction

Earths Internal Structure

Outer core

Inner core

Mantle

Moho  
Lithosphere

Gravity & Gravity Anomalies

Isostasy

Earth's internal heat

Earth's magnetic field

Van Allen Belts

Aurora Borealis

Magnetic reversals

**Plate Tectonics**

History of Continental Drift

Paleomagnetism

Fossil Assemblages

Minerals

Tectonic Cycle

Tectonic plates

Plates through time

Plate boundaries

Plate margins

Hot spots

Earthquakes

Seismogram

Seismograph

Travel time

Richter Scale

Mercalli Scale

Environmental impacts

Structural deformation

Tensional

Compressional

Lateral slip

Joints

Faults

Folds

Domes & basins

Orogeny

Sea level changes

Transgressions & regressions

Unconformities

Geological cross sections

## **Learning Targets:**

### **Physical Geology**

Plate Tectonics

Internal Earth

Seismic waves

S and P waves

Velocities, reflection, refraction of waves

Structure of Earth

Asthenosphere

Lithosphere

Mohorovicic boundary (Moho)

Composition of each of the layers of Earth

Gravity, magnetism and isostasy

Thermal energy (geothermal gradient and heat flow)

Historical review

Paleomagnetism and magnetic anomalies

Paleoclimatology

Plate motion

Causes and evidence of plate motion

Measuring plate motion

Characteristics of oceanic and continental plates

Relationship of plate movement and geologic events and features

Mantle plumes

## **Core Ideas/Crosscutting Concepts:**

### **Mineralogy**

Atomic structure

Periodic table

Bonding

Ionic

Covalent

Metallic

States of matter

Nature of minerals

Structure of minerals

Composition of minerals

Physical properties

Identification of minerals

Classification of minerals

### **Igneous Processes**

#### **Rock Cycle**

Igneous processes

Magma chemistry

Bowens Reaction Series

Magma composition

Gases

Distribution of igneous rocks

Texture

Types of igneous rocks

Extrusive/Intrusive

How magmas are different

Magma and plate tectonics

Volcanic eruptions

Gemstones:

Diamonds

Building materials

## **Learning Targets:**

### **Physical Geology**

#### 1 Minerals

Atoms and elements

Chemical bonding (ionic, covalent, metallic)

Crystallinity (crystal structure)

Criteria of a mineral (crystalline solid, occurs in nature, inorganic, defined chemical composition)

Properties of minerals (hardness, luster, cleavage, streak, crystal shape, fluorescence, flammability, density/specific gravity, malleability)

Igneous, Metamorphic and Sedimentary Rocks

Igneous

Mafic and felsic rocks and minerals

Intrusive (igneous structures: dikes, sills, batholiths, pegmatites)

Earth's interior (inner core, outer core, lower mantle, upper mantle, Mohorovicic discontinuity, crust)

Extrusive (volcanic activity, volcanoes: cinder cones, composite, shield)

Bowen's Reaction Series (continuous and discontinuous branches)

## **Core Ideas/Crosscutting Concepts:**

### **Sedimentary Processes**

#### **Origin of sedimentary rocks**

#### **Types of sedimentary rocks**

Clastics

Evaporites

Biological

Stratification

Cross bedding

Graded bedding

Surface features

#### **Processes**

Weathering

Transport

Deposition

Compaction

## **Learning Targets:**

### **Physical Geology**

Sedimentary

The ocean

Division of sedimentary rocks and minerals (chemical, clastic/physical, organic)

Depositional environments

Streams (channels, streambeds, floodplains, cross-bedding, alluvial fans, deltas)

Transgressing and regressing sea levels

## **Core Ideas/Crosscutting Concepts:**



## **Metamorphic Processes Processes**

Temperature  
Pressure  
Chemistry  
Distribution

Sources of heat  
Regional  
Contact

Chemically active fluids

Conditions  
Low grade  
High grade

Hydrothermal alterations

Texture  
Foliated  
Non-foliated

Regional metamorphism

Contact metamorphism

## **Atmosphere & Climate Layers of atmosphere**

Atmosphere  
Barometric pressure  
Water vapor

Energy and motion

Air pollution

Water  
Movement of water  
Water supply

Oceans  
Patterns of movement

Composition  
Thermal structure  
Density  
Bottom profile  
Currents  
Currents over time  
Upwelling

Waves

Climate  
Climate zones  
Climate change

## **Learning Targets:**

### **Physical Geology**

Metamorphic

Pressure, stress, temperature and compressional forces

Foliated (regional), non-foliated (contact)

Parent rock and degrees of metamorphism

Metamorphic zones (where metamorphic rocks are found)

## **Core Ideas/Crosscutting Concepts:**

### **Physical Geology**

Glacial Geology

Glaciers and glaciation

Evidence of past glaciers (including features formed through erosion or deposition)

Glacial deposition and erosion (including features formed through erosion or deposition)

Data from ice cores

Historical changes (glacial ages, amounts, locations, particulate matter, correlation to fossil evidence)

Evidence of climate changes throughout Earth's history

Glacial distribution and causes of glaciation

Types of glaciers – continental (ice sheets, ice caps), alpine/valley (piedmont, valley, cirque, ice caps)

Glacial structure, formation and movement

### **Depositional Environments I**

Clastics vs. carbonates

#### **Aeolian**

Migration & transport

Types

#### **Alluvial fans**

#### **Lacustrine**

#### **Evaporates**

Marine

Non marine

Salt domes

Playa

Sabkhas

#### **Fluvial**

Braided & meandering

Levees & floodplains

Cutbanks & point bars

#### **Groundwater**

Unconfined

Confined

Karst

Geysers & hot springs

#### **Glacial**

Valley

Piedmont

Continental

Flow

Deposits

Pleistocene glaciers

Isostatic rebound

Sea level change

## **Depositional Environments II**

### **Deltas**

Distributary  
Crevasse splays  
Wave, fluvial, tidal impacts  
Bedforms

### **Shoreline**

Longshore currents  
Beaches & barrier islands

### **Shallow marine**

Carbonate platforms  
Bahamas  
Sabhkas  
Reefs

### **Coral reefs**

Geometry  
Types  
Changes through time

### **Deep marine**

Planktonic oozes  
Turbidites  
Bouma cycle

### **Deep sea fans**

## **Learning Targets:**

### **Physical Geology**

Pressure, stress, temperature and compressional forces

Foliated (regional), non-foliated (contact)

Parent rock and degrees of metamorphism

Metamorphic zones (where metamorphic rocks are found)

Division of sedimentary rocks and minerals (chemical, clastic/physical, organic)

Depositional environments

Transgressing and regressing sea levels

## **Core Ideas/Crosscutting Concepts:**

### **Geomorphology**

#### **Weathering**

#### **Weathering**

Physical

Chemical

Biological

Weathering & climate

#### **Soils**

Factors of formation

Profiles

Texture & structure

Classification

#### **Mass movement**

Soil creep

Landslides

Flows

Slumps

Falls

Causes

Cincinnati issues

#### **Landforms**

### **Historical Geology: Pre-Cambrian and Paleozoic**

Pre-Cambrian divisions

Pre-Cambrian climate

Snowball Earth

Fossil preservation

Pre-Cambrian fossil record

Cambrian radiation

Ordovician Period

Mass extinction

Silurian Period

Devonian Period  
Mass extinction

Mississippian Period

Pennsylvanian Period

Permian Period  
Mass extinction

## **Learning Targets:**

### **Physical Geology**

Soil and sediment

Desertification

Mass wasting and erosion

Sediment contamination

## **Core Ideas/Crosscutting Concepts:**

### **Historical Geology: Mesozoic and Cenozoic**

Mesozoic

Triassic

Mass extinction

Jurassic

Cretaceous

Cenozoic

Tertiary

Paleocene

Eocene

Oligocene

Miocene

Pliocene

Quaternary

Pleistocene

Holocene

## **Learning Targets:**

### **Physical Geology**

The geologic time scale

Comprehending geologic time

Climate changes evident through the rock record

Fossil record

Soil and sediment

Desertification

Mass wasting and erosion

Sediment contamination

## **Core Ideas/Crosscutting Concepts:**

### **Resources: Renewable and Non-Renewable**

#### **Non-renewable**

Resource depletion curve

Reserves vs. resources

#### **Oil & Natural Gas**

Initial discovery

Origin

Source rock

Reservoir rock

Trap

Structural traps

Stratigraphic traps

Fracking

Resources

Distribution

Mapping, seismic

Wireline surveys

#### **Coal**

Origin

Sequence

Distribution

Mining methods

Pollution

**Uranium**

Roll fronts

Recovery

Reserves

**Minerals**

Examples

**Renewable****Biomass**

Sources

Potential

**Solar**

Passive

Active

Low temperature

High temperature

Photovoltaic

**Geothermal**

Low temperature

High temperature

**Hydropower**

Dams

Tidal

Wave action

**Wind**

Resources

**Hydrogen**

Fuel cell

Sources

**Learning Targets:****Physical Geology**

Earth's Resources

Energy resources

Renewable and nonrenewable energy sources and efficiency

**Physical Geology**

Earth's Resources

Energy resources

Renewable and nonrenewable energy sources and efficiency



**Physical Geology**  
Earth's Resources

Energy resources

Renewable and nonrenewable energy sources and efficiency

**Core Ideas/Crosscutting Concepts:**

Renewable and Non- Renewable Resources (continued)  
Main Concepts

1. Future Energy Supply

**Learning Targets:**

**Physical Geology**  
Earth's Resources

Energy resources

Renewable and nonrenewable energy sources and efficiency