EL DORADO UNION HIGH SCHOOL DISTRICT
Educational Services

Course of Study Information Page

Course Title: Geology (Course #335)	
Rationale: The Earth is a very small part of the universe, but it is where we live. It provides us with the resources that support our modern society and all the necessary ingredients to maintain life. So, knowledge and understanding of our planet is critical to our survival.	
Course Description: A study of the Earth, its environment, and its past inhabitants. It is an interdisciplinary science that combines geological observations and concepts with those of biology, chemistry, physics, and mathematics.	
Length of Course:	One year
Grade Level:	11th or 12th grade
Credit: Number of units: 10 ❒ Meets graduation requirements ❒ Request for UC "a-f" requirements ❒ College Prep ❒ Elective ❒ Vocational	
Prerequisites:	Algebra, Geometry, Chemistry, Freshman and Sophomore Science
Department(s):	Science
District Sites:	UMHS
Board of Trustees Adoption Date:	2-8-00
Textbook(s)/Instructional Materials:	*Geology*; Tarbuck and Lutgens
Date Adopted by the Board of Trustees:	

EL DORADO UNION HIGH SCHOOL DISTRICT
Educational Services

Geology

TABLE OF CONTENTS

UNIT	UNIT TITLE	PAGE
UNIT 1:	Energy and Matter	6

Supporting ideas

1. The forms of energy most important in geologic processes are (a) kinetic energy, (b) gravitational potential energy, (c) thermal energy, (d) chemical energy, and (e) nuclear energy.
2. Energy can change from one form to another, but energy cannot be created or destroyed.
3. The atom is the smallest unit of an element that possesses the properties of that element.
4. The distinguishing feature of an atom of a given element is the number of protons in the nucleus.
5. Ions are electrically charged atoms produced by the gain or loss of electrons.
6. In many minerals, atoms combine by ionic binding.
7. Matter exists in three states: (a) solid, (b) liquid, (c) gas. The difference in the three states are related to the degree of ordering of the atoms.

UNIT 2: Minerals 7

Supporting ideas

1. Minerals are natural inorganic solids possessing a specific internal structure and a definite chemical composition that varies only within specific limits.
2. The internal structure of a mineral can be expressed by (a) crystal form, (b) cleavage, (c) optical properties and (d) x-ray diffraction patterns.
3. Minerals have definite physical properties as a result of their chemical composition and internal structure.
4. Minerals crystallize under specific conditions of temperature and pressure.

UNIT 3: Igneous Rocks 8

Supporting ideas

1. Magma is molten material that is capable of penetrating into or through rocks of the crust. Two major types of magma are recognized (a) basaltic magma and (b) granite (silicic) magma.
2. The texture of a rock is the size, shape and arrangements of the constituent grains. Texture is important in the study of igneous rocks because it gives us insight into the cooling history of the magma.
3. The major types of texture in igneous rocks are (a) glassy, (b) aphanitic, (c) phaneritic, (d) porphyritic, and (e) pyroclastic.

4. The most important igneous rocks are (a) basalt, (b) granite, (c) andesite, (d) diorite, (e) gabbro, (f) perodotite, and (g) ash-flow tuff.
5. The most abundant extrusive rocks are basalt, which are composed of magma typically extruded from fractures and fissures to produce a series of relatively thin flows that cover a broad area. Volcanic features associated with basaltic flows are aa and pahoehoe flows, columnar joints, shield volcanoes, cinder cones and pillow lava.
6. Volcanic features commonly associated with silicic magma include ash flows, composite volcanoes, and collapse caldera.
7. Batholiths are the largest and most significant intrusive rock bodies. Other intrusive rock bodies include stocks, dikes, sills and laccoliths.
8. Magma originates by partial melting of the lower crust and upper mantle at depths usually between 50 and 200 km.

UNIT 4: Sedimentary Rocks 9

Supporting ideas

1. Two main types of sedimentary rocks are recognized: (a) classic rocks consisting of rock and mineral fragments and (b) chemical or organic rocks consisting of chemical precipitates or organic deposits or both.
2. Stratification is the most widespread and significant structure in sedimentary rocks. Other important sedimentary structures are cross-bedding, graded bedding, ripple marks and mud cracks.
3. The major environments in which sedimentary rocks form are (a) fluvial, (b) alluvial fan, (c) eolian, (d) glacial, (e) deltaic, (f) shoreline, (g) organic reef, (h) shallow marine, and (f) deep marine.

UNIT 5: Metamorphic Rocks 10

Supporting ideas

1. During metamorphism, new crystals grow in the direction of least stress and commonly produce planar structures called foliation, within the rock body.
2. Rocks with only one mineral, such as limestone or quartz sandstone, do not develop food foliation, but instead develop a granular texture with large crystals.
3. The major types of metamorphic rocks are (a) slate, (b) schist, (c) gneiss, (d) quartzite, (e) marble, (f) amphibolite.
4. Most metamorphic rocks originate in the roots of folded mountain belts where conditions such a deep burial, compressive stress form converging plates and proximity to magma cause temperatures to rise. The amount of pore fluid increases and causes chemical reactions to become more vigorous. This in turn causes the unstable minerals to break down and new minerals to grow in their place. The directed stress from the converging plates causes foliation.

UNIT 6: Geologic Times 11

Supporting ideas

1. Interpretation of past events in the earth's history are based on the principle that the laws of nature do not change with time.
2. Relative dating is determining the chronological order of a sequence of events. It is based on the principles of (a) superposition, (b) faunal succession, (c) cross-cutting relations, and (d) inclusions.

3. The standard geologic column was developed largely from studies of rocks in Europe.
4. Absolute time, or finite time, designates specific duration in units such as hours, days or years. In geology, finite time is measured with radioactive clocks.

UNIT 7: Evolution of Landforms 12
Supporting ideas
1. The style of local landform that develops on the shields, platforms or mountain belts is controlled mainly by climate.
2. Structural features such as horizontal strata, inclined strata, folds, faults and basins are commonly expressed topographically by different erosion.
3. The landforms of North America result from the hydro logic system operating on the major tectonic provinces of the continent.

UNIT 8: Plate Tectonics 13
Supporting ideas
1. The theory of continental drift was first proposed in the early 1900's and is supported by a variety of geologic evidence.
2. Newly discovered patterns of paleomagnetic reversals in the rocks of the ocean floor provide “proof” of sea floor spreading.
3. Recent deep-sea drilling shows that the age and nature of oceanic sediment are best explained by the plate tectonic theory.
4. The lithosphere is divided into a series of plates, which move in the convection cells within the mantle.

UNIT 9: Volcanism 14
Supporting ideas
1. Most volcanic activity occurs in seismic zones and is clearly associated with plate motion.
2. The type of volcanic activity depends on the type of plate boundary.
   a. Basaltic magma is generated along divergent plate boundaries by partial melting of the asthenosphere and is typically extruded in quiet fissure eruptions.
   b. Granitic magma is generated at convergent plate margins by the partial melting of basalt and sediment of the oceanic crust, and is typically extruded in more violent eruptions.
   c. Intra plate volcanic activity probably occurs as a result of local hot spots in the mantle.

UNIT 10: The Earth’s Seismicity 15
Supporting ideas
1. Seismic waves are vibrations in the earth caused by the rupture and sudden movement of rocks that have been strained beyond their elastic limits.
2. Three type of seismic waves are produced by an earthquake shock: (a) primary or P waves, (b) secondary or s waves, and (c) surface waves.
3. Earthquakes along the oceanic ridges originate to shallow depths. At converging plate margins, earthquakes occur in a zone inclined downward from the trench toward the continent or island arc.

4. The velocities at which P and S waves travel through the earth indicate that the earth has a solid inner core, a liquid outer core, a thick mantle, a soft asthenosphere and a rigid outer lithosphere.

UNIT 11: Crustal Deformation 16

Supporting ideas

1. Crustal deformation is well documented by recent movement along faults, by raised beaches and by deformed rock bodies.
2. Folds in rock strata range in size from microscopic wrinkles to large flexures hundreds of kilometers long.
3. Faults are fractures along which slippage or displacement has occurred. The three basic types of faults are (a) normal, (b) thrust, and (c) strike slip.
4. Unconformities are major discontinuities in rock sequence that indicate crustal movement resulting in interruptions in the rock forming processes.

UNIT 12: Evolution of the Continents 17

Supporting ideas

1. Mountain building and the growth of continents involve the following sequence of events.
   a. Erosion concentrates minerals of low density (Quartz, clay, calcite) as sediment, which accumulates in shallow marine environments along the continental margin.
   b. The transfer of material by erosion and deposition causes isostatic imbalance and the continental margin subsides under the weight of the newly deposited sediment. Eventually, a thick sequence of shallow marine sediments accumulates along the continental margins to form a geocline.
   c. The collision of lithospheric plates deforms the geocline into a folded mountain belt. Folds and thrust faults are the dominant structures in the upper part of mountains, at depth, metamorphism and partial melting occur.
2. The roots of a series of ancient mountain belts form the Canadian Shield. This example thus supports the theory of continental growth by accretion.
3. Continents re-split where spreading of the lithosphere occurs beneath the continental crust. A system of rift valleys develops that ultimately fragments the continent and forms a new ocean basic.
4. Each continental fragment then acts as a separate center for further accretion and continental growth.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #1: Energy and Matter

GOAL: To prove and demonstrate that all geologic processes operating on or within the earth involve transformation of energy and changes of matter from one state to another. Without energy, no motion and no change would occur.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Cite familiar examples of how the following forms of energy operate in the hydro logic or tectonic systems: kinetic, gravitational potential; thermal, chemical and nuclear.	Illustrate with diagrams. View video.
Describe the basic structure of the atom and explain the characteristics of protons, neutrons, and electrons.	Draw diagrams to illustrate atomic structure.
Define the following: (a) ion, (b) isotope, and (c) ionic bonding.	Illustrate with drawings.
List some of the more important characteristics of (a) gases, (b) liquids, and (c) solids.	Draw charts and diagrams to illustrate characteristics.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #2: Minerals

GOAL: To prove and demonstrate that minerals are natural inorganic solids and constitute the fundamental building blocks. They grow and are destroyed as matter is changed to and from the solid state. They are the products of specific physical and chemical environments. Minerals thus contain important clues to the origin and history of rocks in the earth's crust.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Give a brief but accurate definition of a mineral.	Identify minerals with hand lens and thin section.
Explain how minerals grow and are destroyed.	Draw diagrams and charts.
Describe some of the more significant physical properties of minerals.	Perform tests on minerals to determine properties.
List the major rock forming minerals and their physical properties.	Identify and test different minerals according to their unique properties.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #3: Igneous Rocks

GOAL: To prove and demonstrate that igneous rocks are formed by the cooling and crystallization of magma, and as a result, they have distinctive textures, composition, and field relations that tell us something about their origins.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Explain briefly the importance of texture in rock identification and interpretation or origin.	Identify igneous rocks by texture, using hand lens and thin section. Look at igneous rock environments.
Describe the characteristics and significance of the following rock textures: (a) glassy; (b) aphanitic; (c) phaneritic; (d) porphyritic; and (e) pyroclastic.	Identify igneous rocks by reviewing their texture. View video and slides of different igneous rock environment.
Define and identify the following rock types: (a) basalt, (b) granite, (c) andesite, (d) diorite, (e) gabbro, (f) ash-flow tuff, and (g) peridotite.	Identify igneous rock properties using hand lens and thin section properties. Analyze the chemistry of igneous rocks.
Describe the characteristics and significance of the following: (a) aa, (b) pahoehoe, (c) columnar joints, (d) cinder cones, (e) pillow lava, (f) composite volcanoes, (g) shield volcanoes, (h) collapse caldera, (i) batholiths, (j) stocks, (k) dikes, (l) sills, and (m) laccoliths.	Watch slide show on different characteristics and identify the same.
Explain how basaltic magma is generated at divergent plate margins and how granitic magma is generated at converging plate margins.	Prepare diagram to illustrate.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #4: Sedimentary Rocks

GOAL: To prove and demonstrate that sedimentary rock forms at the earth's surface as a result of the activity of the hydro logic system. Their origin involves erosion of pre-existing rock material, transportation of that material by water, ice, or wind and subsequent deposition of the material.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Describe the distinguishing characteristics of conglomerate, sandstone, siltstone, shale, limestone, dolostone and rock salt.	Identify sedimentary rocks using hand lens and thin section. Look at sedimentary rock environments. Analyze the chemistry of sedimentary rocks.
Explain how a transgression-regression of the sea produces a cycle of sandstone-shale-limestone-shale-sandstone.	Prepare a diagram to explain transgression-regression. Look at cross sections.
Describe the major types of sedimentary structures.	Review slides on topic.
Describe the characteristics of sediment that typically accumulates in the major types of sedimentary environments.	Draw diagrams, identify rocks seen in such environments. Field trip.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #5: Metamorphic Rocks

GOAL: To prove and demonstrate that metamorphic rocks result from changes in temperature, pressure and the chemistry of pore fluids within the rock body. These changes develop a new rock with distinctive new minerals, new textures and new structures.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Describe the distinguishing characteristics of metamorphic rocks and identify them.	Identify metamorphic rocks using hand lens and thin section. Look at different metamorphic rock environments. Analyze the chemistry of metamorphic rocks.
Identify from hand specimens samples of the main types of metamorphic rocks.	Identify and illustrate sedimentary rocks.
Explain how changes in temperature, pressure and chemistry result in metamorphism.	Prepare diagrams and graphs.
Explain how metamorphism results from the tectonic system.	Use diagrams and graphs. View video.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #6: Geologic Time

GOAL: Although geologic time may seem to be incomprehensibly long, nature contains many measuring devices or "clocks" by which we can determine the time frame of past events in the earth's history.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Explain the meaning of uniformitarianism.	Readings.
Explain the meaning of relative time and describe the methods by which relative dates are determined.	Relative dating lab using cross sections.
Recall from memory the standard geologic column: (a) precambrian; (b) paleozoic; (c) mesozoic; (d) cenozoic.	Draw diagrams of the geologic time scale. Use cross sections to understand time sequences.
Explain the basis of radiometric measurements of time.	Radiometric lab and video.
Explain the evidence of the fossil record using the Geologic Time Scale.	Identify fossils and their place on the time scale, especially marker fossils.
Explain the evidence of the fossil record.	Use time scale and rock record to explain fossil record. Use cross sections. Interpret geologic maps.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #7: Evolution of Landforms

GOAL: According to the theory of plate tectonics, two basic systems of regional landscape development can be recognized: (1) the evolution of shields as a result of erosion and isostatic adjustment of folded mountain belts, and (2) broad upwards or depressions of the shield and stable platforms, which cause rejuvenation of steam erosion or expansion of shallow seas over the continent.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Describe the major types of landforms resulting from the evolution of a mountain belt into a segment of the shield.	View video and slides, diagrams and drawings of mountain belt evolution. Interpret geologic maps.
Explain how uplift or subsidence of the shield or stable platform results in rejuvenation of steam erosion or expansion of a shallow sea over the continent.	View video and slides. Use drawings and diagrams.
Explain the origin of cliff and slope topography, mesas, buttes, hogbacks, columns and national arches.	View video and slides. Use drawings and diagrams. Field Trip. Interpret geologic maps of the topography.
Describe the major landforms developed on (a) the Colorado Plateau; (b) the Coastal Plains; (c) the Black Hills and the Ozarks; (d) the Valley and Ridge province; (e) the Basis and Range province, and (f) the Columbia Plateau.	View video and slide. Use drawings and diagrams. Field trip. Analyze and interpret geologic maps of the major landforms.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #8: Plate Tectonics

GOAL: The theory of plate tectonics was developed during the 1950's and 1960's as a result of new knowledge obtained concerning the topographic, magnetic and seismic characteristics of the oceanic crust. The theory explains the earth's dynamics as a result of the motion of rigid lithospheric plates, which are moved by convection in the upper mantle. New oceanic crust is created where plates are pulled apart; mountains and islands arc from where plates converge.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Describe how the theory of continental drift is supported by (a) geographic "fit"; (b) paleontologic evidence; (c) matching structures and type of rock on the continental margins; (d) evidence of Paleozoic glaciation, and (e) evidence of paleoclimates.	Use of diagrams and drawings. Interpret geologic maps of plate movement.
Explain how paleomagnetism supports the theory of plate tectonics.	Use of maps and drawings.
Describe the characteristics of the lithospheric plates and the major processes operating along their boundaries.	View video and slides. Use maps and diagrams.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #9: Volcanism

GOAL: Volcanic activity is one of the major products of the tectonic system and is closely associated with plate motion.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Explain how basaltic magma is generated at divergent plate margins.	Use diagrams and maps. Identify volcanic rocks.
Describe briefly the type of eruption produced at divergent plate margins.	Diagrams and charts.
Explain how granitic or andesitic magma is generated at convergent plate margins.	Identify volcanic rocks. Use diagrams and charts. Analyze the chemistry of volcanic magma.
Describe briefly the types of volcanic eruption that typically occur at convergent plate margins.	View video. Use of maps and diagrams.
Explain the origin of intraplate volcanism and the origin of chains of volcanic islands and seamounts.	Use diagrams and maps. View video and slides.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #10: The Earth's Seismicity

GOAL: Earthquakes are concentrated along plate boundaries and indicate the direction of present plate motion. In addition, seismic waves provide the most important data on which scientists base our modern concepts of the internal structure of the earth.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Explain the motion of P, S and surface seismic waves.	Use of springs. Diagrams and charts.
Describe the type of seismicity produced at divergent plate margins, at convergent plate margins and in the interior of a plate.	Use of charts and diagrams.
Visualize the paths of P seismic waves in the interior of (a) a homogeneous planet and (b) a planet that increases in density toward the center.	Diagrams and charts. Density lab.
Draw a simple diagram showing the paths of P waves and S waves in the earth.	Diagrams and charts.
Draw a graph showing the velocity of seismic waves at depth and explain what this graph indicates about the earth's internal structure.	Diagrams and charts. Field trip.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #11: Crustal Deformation

GOAL: Rocks in the continental crust have been compressed into folds, warped into broad domes and basins and fractured by faults. This deformation is an important result of the tectonic system and further indicates that the earth has been a dynamic planet throughout essentially all of its history.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
List evidence of recent crustal deformation.	Field trip. View video. Analyze and interpret diagrams and geologic maps.
Explain the use of diagrams, dip and strike, the basic geometric features of folds and the major type of faults.	Use Brunton compass. Diagrams and drawings. Use geologic cross sections and maps to interpret data.
Describe the main type of unconformities and explain why each implies crustal movement.	View video and slides. Drawings. Use cross sections.

EL DORADO UNION HIGH SCHOOL DISTRICT

Department: Science
Course Title: Geology

UNIT #12: Evolution of the Continents

GOAL: Continents are composed of relatively light “granitic” rock. They grow by accretion as a product of orogenesis.

OBJECTIVES The student will:	SUGGESTED ACTIVITIES
Outline the major steps in the evolution of a geocline and relate these events to the dynamics of plate tectonics.	Diagrams and charts. Analyze and interpret geologic maps.
Explain by using a series of diagrams, how a mountain root becomes exposed as part of a shield.	Diagrams and drawings.
Discuss the evolution of the continents.	Analyze and interpret geologic maps and diagrams of continental evolution.