ESCI-141H: HONORS PHYSICAL GEOLOGY

Cuyahoga Community College

Viewing: ESCI-141H : Honors Physical Geology

Board of Trustees:
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Academic Term:
Fall 2021

Subject Code
ESCI - Earth Science

Course Number:
141H

Title:
Honors Physical Geology

Catalog Description:
Honors course in Physical Geology covers materials and structures of the Earth; processes and agencies by which the Earth's crust has been and is being changed; rocks and their mineral composition; the work of gravity, water, winds, and glaciers as agents of erosion; and volcanoes and earthquakes as forces which change the surface of the Earth. Emphasis on effects geological events and resources have had on human civilization, with a strong focus on inquiry-based learning as the basis of scholarly research. To fulfill laboratory science requirements, students should also enroll in Laboratory in Physical Geology.

Credit Hour(s):
3

Lecture Hour(s):
3

Requisites

Prerequisite and Corequisite
Eligibility for ENG-101H Honors College Composition I.

Outcomes

Course Outcome(s):
Utilizing methods of scientific inquiry, apply the concepts of physical geology to gain a better understanding of the Earth.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
1. Describe the tectonic forces that produce earthquakes, volcanism, and related phenomena.
2. Describe the features of the ocean floor and how they change over time.
3. Differentiate between plate tectonics and continental drift theories.
4. Locate plate boundaries and identify the plates and the types of boundaries that separate them.
5. Explain different methods of mountain formation.
6. List valuable geologic resources and their distributions, methods of extraction, and uses.
7. Describe the atomic structure of minerals and know of their occurrences and economic uses.
8. Describe the formation, locations, and structures of igneous, sedimentary, and metamorphic rocks and the methods used to identify them.
9. Describe and recognize physical samples of minerals and rocks and interpret topographic and geologic maps
10. Explain development of major land forms and recognize and discuss the actions and interactions of gravity, water, ice, and wind on the earth's surface.
11. List the components and dates of the geologic column.
12. Differentiate between chemical and physical weathering and explain the different processes of each of these.

13. Explain the various types of mass wasting.
14. Differentiate between erosional and depositional processes and features of gravity, water, wind, and ice.

Course Outcome(s):

Apply the concepts of physical geology to scientific studies of the Earth and current events.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Differentiate between P, S, and L seismic waves and explain how they are measured and their implications.
2. List valuable geologic resources and their distributions, methods of extraction, and uses.
3. Describe the formation, locations, and structures of igneous, sedimentary, and metamorphic rocks and the methods used to identify them.
4. Explain development of major land forms and recognize and discuss the actions and interactions of gravity, water, ice, and wind on the earth's surface.
5. Recognize glacial and hydrologic systems and features.
6. Differentiate between relative and absolute dating and explain the methods used in both processes.
7. Explain the origin of the Earth in the context of the Solar Nebula Theory and deep time as confirmed by radiometric dating.

Course Outcome(s):

Apply the concepts of physical geology to current issues facing environment and society.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.
Civic Responsibility: Analyze the results of actions and inactions with the likely effects on the larger local and/or global communities.

Objective(s):

1. Differentiate between P, S, and L seismic waves and explain how they are measured and their implications.
2. List valuable geologic resources, their distributions, methods of extraction, and uses.
3. Describe the importance of human use of earth resources and the effects of earth processes on human civilization.
4. Describe the atomic structure of minerals and know of their occurrences and economic uses.
5. Explain characteristics of Earth systems, such as climate change

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Methods of Evaluation:

1. Chapter review questions
2. Article summaries
3. Exams
4. Photo essays
5. Classroom presentations
6. Research assignments
7. Term papers

Course Content Outline:

1. General introduction.
   a. Outline of course.
   b. Goals of the course.
   c. Scientific method.
   d. Concept of geologic time: catastrophism and uniformitarianism.
   e. Compositions and interactions of the parts of the ecosphere: lithosphere; atmosphere; hydrosphere; biosphere.
2. Introduction to plate tectonics.
   a. Layers of the earth: crust, mantle, and core; lithosphere and asthenosphere.
   b. Plate boundaries and their relationships to earthquakes and volcanoes: rift zones; subduction zones; and transform boundaries.
3. Comparison of rocks and minerals.

4. Atomic structure.
    a. Composition of the atom.
    b. Determination and significance of atomic number, atomic mass, and electron shells.
    c. Arrangement of electrons as basis for the formation of ions.
    d. Compare and contrast a cation and an anion as to change in size and change in number of electrons.
    e. Bonding: ionic bonding; covalent bonding; metallic bonding; van der Waal forces.
    f. Crystal structure.
    g. Polymorphism and solid solutions.
    h. Crustal abundances of the atoms.
5. Minerals.
    a. Chemical environment of formation.
    b. Chemical composition and atomic structure of the silicates: isolated tetrahedra; single chains; double chains; sheets; frameworks.
    c. Descriptions, chemistry, and uses of the mineral groups: silicates; carbonates; sulfates; sulfides; oxides; native elements.
    d. Role of minerals in the development of civilization.
    e. Important historical metals such as copper, iron, gold, silver.
6. The rock cycle.
    a. Magma, lava, and igneous rocks.
    b. Erosion, sediments, and sedimentary rocks.
    c. Heat, pressure, fluids, and metamorphic rocks.
    d. Prehistorical & historical usages of rocks.
7. Volcanism.
    a. Sources of heat for forming magma.
    b. Types of volcanoes, their characteristics, and their occurrences: shield; composite/stratovolcano; cinder cones; fissure eruptions.
    c. Different types of lava, their characteristics, and their occurrences: mafic; intermediate; felsic.
    d. Extrusive rock types: pillow vs. columnar structures; aa vs. pahoehoe.
    e. Correlation of volcano and lava types with plate tectonic theory.
    f. Volcano prediction.
    g. Recognition of extrusive igneous rocks using texture and composition.
    h. Influence of volcanism on human history.
8. Intrusive igneous rocks.
    a. Cooling rate and place of formation for each of the intrusive igneous rocks.
    b. Correlation of intrusive igneous rock types with plate tectonics theory.
    c. Recognition of intrusive igneous rocks by texture and composition.
    d. Intrusive igneous bodies: concordant; discordant.
    e. Processes involved with magmatic differentiation: Bowen's Reaction Series; crystal settling; assimilation; stoping.
    f. Historical development of exploitation of intrusive igneous bodies for minerals.
9. Weathering.
    a. Concept of equilibrium.
    b. Influence of climate, composition, topography, vegetation, and time.
    c. Physical weathering processes: frost action; abrasion; pressure changes - exfoliation; root pressure.
    d. Chemical weathering processes: solution; oxidation; hydration; hydrolysis.
    e. Relations between chemical and physical processes: salt crystallization; spheroidal weathering.
    f. Products of weathering.
    g. Soils: horizons; types; characteristics; factors that affect soil forming processes.
    h. Human agricultural history.
10. Sedimentary rocks.
    a. Types of sedimentary rocks: clastic; bioclastic; chemical precipitates - crystalline, oolitic, and amorphous.
    b. Processes needed to make a sedimentary rock: transportation; deposition; preservation; lithification.
    c. Textures: clastic - size and shape of particles; bioclastic; crystalline; amorphous; oolitic.
    d. Environment of formation of the different sedimentary rocks.
    e. Sedimentary structures and their historical geological significances: types of bedding; fossils; geodes; mud cracks; ripple marks.
    f. Recognition of sedimentary rocks by texture and composition.
    g. Importance of sediments & sedimentary rocks in the development of cities.
11. Metamorphic rocks.

a. Definition of metamorphism.
b. Sites of metamorphism.
c. Types of metamorphism and relationship to plate boundaries: regional; contact.
d. Metamorphic facies as distinguished by mineral types.
e. Hydrothermal processes.
f. Recognition of metamorphic rocks by texture and composition.
g. Marble in sculpture; slate for roofing, blackboards, pool tables.

12. Geologic time.
    a. Relative time and its determination - principles of: superposition; original lateral continuity; cross-cutting relationships; inclusions.
    b. Fossils and their uses in dating.
    c. Absolute time and its determination: alpha decay; beta decay; beta capture; proton decay.
    d. Theory of radiometric dating - half-life concept.
    e. Uses of and limitations of radiometric dating.
    f. Dendrochronology and varves.
    g. Geologic time: eons; eras; periods; epochs.
13. Mass wasting.
    a. Classification of types of mass wasting: rates of movement; types of material; types of movement.
    b. Controlling factors of mass wasting.
    c. Flow movements: creep; debris flow/avalanche; mudflows; earthflows; solifluction.
    d. Slip movements: slump; debris slide.
    e. Fall movements: rock fall; debris fall; subsidence.
    f. Prevention of mass wasting.
    g. Historical problems of mass wasting processes.
14. Running water.
    a. Runoff: sheet flow; streams.
    b. Types of streams and their characteristics: straight; braided; meandering.
    c. Concept of drainage basins.
    d. Factors that determine deposition vs. erosion: velocity; gradient; channel shape and roughness; discharge.
    e. Erosional processes: solution; hydraulic action; abrasion.
    f. Transportation: solution; suspension; bedload.
    g. Erosional features: stream valleys; undercut banks.
    h. Depositional features: bars; floodplains; deltas and alluvial fans.
    i. Steps in valley development: downcutting; lateral erosion; headward erosion.
    j. Rejuvenation: incised meanders; terraces.
    k. Stream piracy.
    l. Base level changes.
    m. Streams and the dawn of civilization.
15. Ground water.
    a. The hydrologic cycle.
    b. Porosity vs. permeability.
    c. Types of aquifers and their characteristics: confined/artesian; unconfined; perched.
    d. Water tables.
    e. Wells.
    f. Relation of water tables and aquifers to springs, streams, oceans.
    g. Extracting water from the ground.
    h. Effect of pumping on aquifers.
    i. Pollution of ground water.
    j. Erosional effects of ground water: cave formation; sink holes; karst topography.
    k. Depositional effects of ground water: stalactites, stalagmites, etc.; terra rosa.
    l. Geothermal energy: geysers and hot springs; advantages and disadvantages.
    m. Historical need for groundwater as a viable source of drinking water; pollution.
16. Glaciers.
    a. Theories of glacial ages.
    b. Formation of glaciers.
    c. Types of glaciers and their movement: continental; alpine; piedmont.
    d. Glacial budgets: positive; negative.
    e. Erosional features: horns; cirques; rock basin lakes; U-shaped valleys.

f. Depositional features: moraines - lateral, medial, terminal, recessional; outwash; loess; varves.
g. Effects of past glaciations: exposure of bedrock; sea level changes; isostatic depression and rebound; lakes - kettle, morainal, eroded, pluvial; erratics and till.
h. Neanderthal and Cro-Magnon peoples as influenced by glaciation.

17. Deserts and wind action.
    a. Location of deserts: global pressure belts; leeward of mountains; distance from oceans.
    b. Characteristics of deserts: precipitation; soil types.
    c. Transportation by wind.
    d. Erosional features: blow-outs; desert pavement.
    e. Depositional features: types of dunes; loess.
    f. Control of wind erosion and deposition: vegetation; wind breaks.
    g. Wind energy: where available; technology.
    h. Historical aspects of deserts for human habitation.
18. Waves, beaches, and coasts.
    a. Causes of waves.
    b. Characteristics of waves: wave length; wave amplitude; wave refraction.
    c. Erosional features: undercutting and mass wasting; arches and sea stacks; long shore drift.
    d. Depositional features: beaches; dunes; bars; spits.
    e. Types of coasts: drowned; emergent; formed by organisms - reefs.
    f. Historical effects of coastal processes on human existence.
19. Geologic structures.
    a. Stress: tectonic forces; compression; tension; shear.
    b. Strain: elastic; plastic - folds; brittle - faults and joints.
    c. Folds: anticlines; synclines; horizontal vs. inclined axes.
    d. Faults: normal; reverse; transform.
    e. Representation of structural features on geologic maps: strike and dip; fault lines.
    f. Types of unconformities: angular unconformities; disconformities; nonconformities.
20. Earthquakes.
    a. Causes and relationship to plate boundaries.
    b. Types of seismic waves and their characteristics: P-waves; S-waves; Surface waves.
    c. Location of epicenters: seismometers; travel-time curves.
    d. Measurement of earthquakes: Mercalli Scale; Richter Scale; Moment Magnitude.
    e. Effects of earthquakes: land displacement; tsunamis.
    f. Distribution of earthquakes and relation to plate tectonics theory.
    g. Depth of earthquakes and relation to plate tectonics theory: shallow focus; deep focus.
    h. Pattern of earthquakes and angle of subduction.
    i. Earthquake prediction.
    j. Earthquake control.
    k. Historical dangers of living in earthquake-prone areas.
21. Earth's interior.
    a. Interpretation of seismic waves.
    b. Layers of the earth and their characteristics: seismic wave classification; plate tectonics classification.
    c. Principle of isostasy.
    d. Geothermal gradient.
22. The ocean floor.
    a. Formation of oceans.
    b. Methods used to study the ocean floor.
    c. Continental shelf.
    d. Continental slopes and turbidity currents
    e. Continental rises.
    f. Abyssal plains.
    g. Seamounts, guyots, and aseismic ridges.
    h. Mid-oceanic ridges: volcanism; earthquakes; biota.
    i. Trenches: volcanism; earthquakes; ophiolites.
    j. Active vs. passive continental margins.
    k. Aseismic ridges.
    l. Reefs.
    m. Ocean floor sediments: pelagic; terrigenous.

n. Mineral deposits and their relationship to ocean features.
o. Ages on ocean floors and relationship to plate tectonics.

23. Plate tectonics.
    a. Evidence of previous continental positions.
    b. The role of continental drift in development of the theory.
    c. Role of paleomagnetism in promoting the theory.
    d. Causes of sea floor spreading and plate motions.
    e. Diverging plate boundaries.
    f. Transform faults.
    g. Converging plate boundaries.
    h. Types of convergences: ocean-ocean; ocean-continent; continent-continent.
    i. Back arc spreading.
    j. Names, locations, and relative motions of the plates.
24. Mountain belts.
    a. Characteristics of mountain belts formed at converging boundaries: faults; folds; metamorphism; batholiths.
    b. The evolution of mountain belts: accumulation stage; orogenic stage; uplift and block faulting stage.
    c. The growth of continents by exotic terranes.
25. Geologic resources.
    a. Definition of a resource.
    b. Renewable vs. nonrenewable resources.
    c. Exploration for resources and locations as related to plate tectonics.
    d. Mineral resources: metallic ores; non-metallic ores.
    e. Rock resources: igneous; sedimentary; metamorphic.
    f. Energy resources & their importance to civilization: fossil fuels; uranium; other sources of energy.
    g. Methods of obtaining resources.
    h. Environmental concerns.
    i. Conservation of resources by substitution, recycling, and more efficient use.

Resources

Plummer, C. C., D. Carlson, and L. Hammersley. *Physical Geology*. 16th ed. New York: McGraw-Hill, 2018.

Tarbuck, E. J., F. K. Lutgens, and D.G. Tasa. *Earth: An Introduction to Physical Geology*. 12th ed. Pearson , 2017.

Marshak, Stephen. *Earth: Portrait of a Planet*. 5th ed. New York: W. W. Norton & Company, 2015.

Raymond, Robert. *Out of the Fiery Furnace: The Impact of Metals on the History of Mankind*. The Pennsylvania State University Press, 1986.

Resources Other

Google Earth App will be used in multiple assignments

Instructional Services

OAN Number:

Ohio Transfer 36 TMNS and Transfer Assurance Guide OSC025 (course 1 of 2, both must be taken)

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