

COURSE OUTLINE

Geology 101H (C-ID Number: GEOL 100) Honors Physical Geology (C-ID Title: Physical Geology)

Catalog Statement

GEOL 101 is an introduction to the principles of geology with emphasis on Earth processes. This course focuses on the internal structure and origin of the Earth and the processes that change and shape its surface. The honors course will be enhanced in one or more of the following ways:

1. Students do weekly quantitative problem sets in the geosciences;
2. Students prepare a research project and present it in the class;

Relevant topics include: global geochemical cycles, planetary geology from remotely sensed data, problems in plate tectonic, climate change history, and interactions of man with the Earth.

Total Lecture Units: 3.0

Total Laboratory Units: 0.0

Total Course Units: 3.0

Total Lecture Hours: 48.0

Total Laboratory Hours: 0.0

Total Laboratory Hours To Be Arranged: 0.0

Total Faculty Contact Hours: 48.0

Recommended preparation: Eligibility for ENGL 120 or ESL 151, Eligibility for MATH 110.

Note: This course may not be taken for credit by students who have completed GEOL 110

Course Entry Expectations

Prior to enrolling in the course, the student should be able to:

- analyze short essays (at least five paragraphs in length) to identify thesis, topic development and concluding sentences, as well as traditional expressions used to increase coherence;
- evaluate compositions for unity, and sufficiency of development, and coherence;
- organize and write a thesis-driven, organized essay which is at least three paragraphs in length (paragraphs should have a topic sentence and at least five additional sentences which further develop that topic sentence with explanations and examples);
- use a variety of sentence types with minimal errors in such basics of the sentence as subject-verb agreement, subordination, and complementation;
- analyze the following functions: polynomial, rational, radical, absolute value,

- exponential and logarithmic (including definitions, evaluation, and domain and range);
- graph functions, including asymptotic behavior, intercepts, vertices and transformations;
- perform operations on functions;
- find inverses of functions;
- solve equations including: linear, polynomial, radical, rational, absolute value, exponential and logarithmic;
- solve linear, absolute value, and non-linear inequalities;
- solve linear and non-linear systems of equations and inequalities;
- apply the Fundamental Theorem of Algebra and related theorems to find the roots of a polynomial;
- model and solve STEM application problems;
- graph and algebraically analyze conic sections;
- apply the binomial theorem and use formulas to find sums of finite and infinite series;
- use mathematical induction to prove formulas;
- apply the method of partial fraction decomposition.

Course Exit Standards

Upon successful completion of the required coursework, the student will be able to:

- discuss current basic understanding of earthquakes, including how they are measured, local issues concerning earthquake risk, and the relationship of seismic activity to faults and tectonic plate boundaries;
- list and briefly discuss the evidence behind the theory of plate tectonics;
- explain why melting occurs inside the Earth, its relationship to volcanoes, and geographic locations where volcanoes occur;
- explain the paradigm of uniformitarianism in the context of a scientific view of Earth's history;
- implement basic skills to interpret timing relationships between rock units;
- explain the rock cycle and describe the classification of rocks in some detail;
- describe processes that shape the Earth's surface
- discuss mineral and water resources;
- demonstrate a conceptual understanding of fundamental concepts, principles, and interactions of Earth's systems applicable to the geological sciences;
- demonstrate an understanding of how geological environments are formed, changed, and eroded through time;
- demonstrate an ability to communicate complex course concepts effectively in writing and diagrams and apply critical thinking and problem solving to make informed decisions in life.

Course Content

Total Faculty Contact Hours = 48.0

Introduction (4.5 hours)

- Solar system formation, planetary differentiation, and Earth's basic internal structure
- Basic features of continents and ocean basins
- Development of geology, the paradigm of uniformitarianism, and geology's relationship to other sciences
- Evidence, hypothesis, and theory in science
- Processes driven by internal heating
- Overview of plate tectonic cycle, hydrologic cycle, and the rock cycle

Structural Geology (1.5 hours)

- Lithostatic stress, differential stress, and strain
- Brittle and ductile rock behavior
- Identification of faults and folds and their relationship to stress

Seismology (3 hours)

- Where earthquakes occur and their relationship to faults
- Measuring earthquakes and earthquake magnitude scales
- Locating earthquake epicenters
- Relationship between focal depth, fault size, and earthquake magnitude
- Local earthquake issues and global current events

Earth's Internal Structure (3 hours)

- Compositional vs. mechanical layer models
- Idea of indirect (circumstantial) vs. direct evidence in the understanding of Earth's interior
- The asthenosphere, lithospheric plates, and isostasy
- Rock evidence for near surface composition
- Compositional proxies for Earth's interior
- Seismological methods for modeling Earth's interior
- The idea of the geodynamo creating the geomagnetic field

Plate tectonics (1.5 hours)

- Drawing/describing plate boundaries in detail
- Formation of the ocean floor
- Ophiolite sequences
- The evidence for plate tectonic theory
- The history of the development of plate tectonic theory

Minerals (1.5 hours)

- Atomic theory
- Crystal structure and definition of a mineral
- Types of minerals
- Mineral properties

Igneous Rocks (3 hours)

- Intrusive vs. extrusive igneous rocks
- Rock names and characteristics
- Intrusive igneous rock structures
- Melting processes inside Earth
- Processes that influence magma composition and their relationship to plate tectonics
- Composition-dependent properties of magmas and their relationship to geographic location

Volcanology (4.5 hours)

- Basic volcano types
- Where volcanoes occur and why they occur in those locations
- Eruptive styles and relationship to volcano type
- Why there are different eruptive styles
- Current global and local issues about volcanoes as well as notable historical eruptions

Mountain Belts and Cratons (1.5 hours)

- Tectonic uplift, erosion, and isostatic uplift
- Geographic locations
- Interpretation of mountain belts and the rocks they contain in light of plate tectonics

Metamorphic Rocks (1.5 hours)

- Types of metamorphism and how metamorphism occurs
- Index minerals and metamorphic grade
- Identifying metamorphic rocks and a few basic types of metamorphic rocks, including foliated and non-foliated examples
- Where metamorphic rocks are found

Weathering and Erosion (1.5 hours)

- Physical vs. chemical weathering processes
- Agents of transport
- Soil development and soil types

Sedimentary Rocks (3 hours)

- Classification
- Characteristics
- Depositional environment
- Economic resources

Geologic Time (6 hours)

- Relative age dating and its implementation
- Absolute age dating processes
- The geologic time scale
- Basic overview of the big events in Earth's history that determine the boundaries on the geologic time scale

Energy, Mineral, and Water Resources (4.5 hours)

- The formation and development of fossil fuels
- Other energy resources, renewable and nonrenewable
- Overview of types of mineral deposits
- Groundwater's use and pollution that occurs
- Environmental issues associated with resource use

Surface Areas (at least one of the following) (3 hours)

- Deserts and surface processes
- Coasts and coastal processes
- Glaciers and glacial environments

Global Climate Change (3 hours)

- Carbon cycle
- Milankovitch cycle and other parameters affecting global climate
- Methods for determining temperature and climatic conditions in the past
- Deep history, Pleistocene history, and recent history of climatic changes on Earth

Planetary Geology (1.5 hours)

Comparison of Earth with Venus, Mars, the moon, Mercury, and other large objects in the solar system

Relationship of surface age to crater density

Notable findings from planetary missions

Methods of Instruction

The following methods of instruction may be used in the course:

- lectures and in-class demonstrations;
- analysis of graphs, figures and data sets;
- instructor or student-led group discussion and peer-to-peer learning;
- media of appropriate content;
- computer-assisted learning and the internet;
- hands-on experiences of appropriate design;
- student presentation of research topics;
- field trips.

Out of Class Assignments

The following out of class assignments may be used in the course:

- creation and analysis of graphs, figures, and data sets;
- online assignments;
- field trip reports;
- creation and analysis of graphs, figures, and data sets the geosciences using skills expected of students who have completed MATH 100;
- individual or group projects that create reports or other media (e.g., write a research paper or outline of a presentation using multiple sources or student-generated research related to a student selected topic in the field of earth sciences).

Methods of Evaluation

The following methods of evaluation may be used in the course:

- instructor evaluation of attendance, participation in class, and participation in group work of any kind;
- evaluation of student work by peers;
- homework assignments;
- creation and analysis of graphs, figures, and data sets;
- quizzes;
- tests, with at least one midterm exam and one final exam—exams including essay style or short answer questions are strongly encouraged;
- instructor evaluation of student-created reports or other media.

Textbook(s)

Tarback, Edward J., Frederick K. Lutgens and Dennis G. Tasa, *Earth: An Introduction to Physical Geology*. 11th ed. Upper Saddle River: Pearson Prentice Hall, 2014. Print. 12th Grade Reading Level. ISBN 9780321813930.

Student Learning Outcomes

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- discuss uniformitarianism in the context of a scientific view of Earth's history.
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