CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

GEOLOGY 105 –PHYSICAL GEOLOGY: EARTH SYSTEMS LABORATORY

3 hours laboratory, 1 unit

Catalog Description

This course is designed to explore the Earth's physical environment, complementing either the physical geography lecture course (GEOG 120) or the Earth Science lecture course (GEOL 104) through practical applications of materials covered in these courses. This laboratory course enhances the observational and analytical skills that are vital to understanding Earth's major physical and chemical systems including atmospheric, hydrospheric, lithospheric and biospheric processes and the Earth's place within the Solar System. Exercises will utilize the methods of scientific inquiry to explore the Geographic Grid, Earth-Sun relationships; weather and climate; the rock cycle; plate tectonics, including faulting, earthquakes, hot spot volcanism and plate boundary dynamics; erosional and depositional environments; landform genesis, identification and geomorphic change; soil and vegetation distributions and habitat analysis. Students gain experience with map interpretation/analysis, unit conversions and dimensional analysis, field work using GPS, compass, clinometer, and other specialized equipment. Special attention is given to the unique local setting of San Diego County especially as exhibited in the Cuyamaca College Nature Preserve where field experiences are incorporated into laboratory exercises on a regular basis. Also listed as GEOG 121. Not open to students with credit in GEOG 121.

Prerequisite

"C" grade or higher or "Pass" in GEOG 120 or GEOL 104 or equivalent or concurrent enrollment in either course

Entrance Skills

Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:

1) Visualize and comprehend Earth-Sun relations and resulting physical phenomena on Earth's surface such as seasonal progression, sun angle changes, time keeping and use of the geographic grid.
2) Analyze and interpret basic map data including an introduction to topographic maps.
3) Recognize atmosphere-hydrosphere interactions and interpret related processes including global, regional and local temperature and pressure patterns, adiabatic heating and cooling, and cloud and precipitation genesis.
4) Analyze climatic data and recognize the relationship between climate, vegetation and soil.
5) Recognize and delineate cycles and patterns within the biosphere.
6) Visualize and interpret geologic and geomorphic processes that shape the Earth's surface.

Course Content

This course contains a series of integrated observations, experiments, assignments, exercises, and lab write-ups focusing on overview and use of the methods of scientific inquiry and quantitative reasoning; Earth's size, shape, and movements-in-space; the importance of solar energy and the Global Energy Budget to environmental patterns and processes at Earth's surface; overview of Earth's subsystems including tectonic, petrologic, geomorphic, hydrospheric, oceanographic, atmospheric, and biospheric (biotic) processes that shape Earth's surface environments; actual distribution of solar radiation, weather patterns, ocean currents, climates, ecosystems, physiographic features (landforms), plate boundaries, and tectonic work including resultant geologic structures, volcanism, and rock cycling; and practical experience using a variety of tools and concepts common to the study of physical geography and the broader Earth sciences. More specifically:

1) The Earth Sciences
    a. What is Earth Science
    b. The Methods of Scientific Inquiry and Hypothesis Testing
    c. Mass and Energy Laws
    d. Systems Approach (Formation of the Universe; Solar System; Earth as a system; Earth subsystems)
    e. Units, Unit Conversions, Dimensional Analysis, Graphing, and Scientific Notation
2) The Geographic Grid
    a. Earth's Size and Shape; Great Circles; Globes vs. Maps
    b. Angular Measure, the Unit Circle, and application of Trig Functions
    c. Parallels and Meridians; Latitude/Longitude System
    d. Environmental Patterns and Real-Word Variation: Scales-of-Analysis Geospatial Tools and Techniques
    e. Isoline Mapping (contours, isotherms, isobars, etc.)
    f. USGS 7½ Minute Series Topographic Maps
    g. Compass and Clinometer (bearings, orienteering, strike and dip)
    h. GPS: Datums, Grid Systems, Waypoints (e.g., canvassing for groundwater wells/establishing MP's)
3) Astronomy and Movements of the Earth in Space
    a. The Solar System: Gravitational Force and Density Segregation
    b. Electromagnetic Radiation: Stefan-Boltzmann, Wien's Law, and the Spectrum
    c. Earth-Sun Relationships and Insolation Receipt
        1. Rotation: Diurnal Variation
        2. Revolution: Solar Declination, the Analemma, Zenith vs. Sun Angle, and the Seasons
    d. Rotating Frames-of-Reference: Time-Keeping and Coriolis Effect
4) Earth's Internal Forces and Tectonic Stresses
    a. Endogenous Energy
    b. Plate Tectonics
        1. Geologic Structures: Folds, Fractures, and Faults
        2. Mountain Building
        3. Earthquakes
        4. Volcanoes
5) Earth Materials
    a. Minerals: Classification and Identification
    b. The Rock Cycle: Igneous, Sedimentary, and Metamorphic Rocks
    c. Rock Weathering and Soils
6) Earth History
    a. The Geologic Time Scale
    b. Relative vs. Absolute Dating
    c. Fossils and Fossilization
    d. Paleogeography: Spatial Patterns through Time
7) Earth's External Processes (Geomorphic/Atmospheric Processes shaping Surface Environments)
    a. Surface Water, Watersheds, Aquifers, and Groundwater
    b. Glaciers, Glaciation, and Global Sea Level Change
    c. Deserts: Orographics vs. Subtropical Dynamic Highs
    d. Landforms and Gradational Systems
        1. Gradational Agents
        2. Gradational Processes: Erosional vs. Depositional Landforms
        3. Exogenous Energy
    e. Global Distribution of Earth's Major Physiographic Features
8) Atmospheric "State" Variables
    a. Temperature and Temperature Distribution

        1. Kinetic Theory: Heat vs. Temperature
        2. Cycles of Insolation and Temperature
        3. Albedo vs. Absorption
        4. Response to Absorption: Specific Heat (land vs. water) and Continentality
    b. Pressure and Pressure Distribution
        1. Thermal vs. Dynamic
        2. Winds: Global vs. Synoptic vs. Mesoscale
    c. Atmospheric Moisture and Phase Changes
        1. Measures of Humidity (Specific vs. Relative vs. Saturation-Specific)
        2. Sensible vs. Latent Heat
        3. Cloud Development and Classification

9) Weather Systems
    a. Weather Patterns and Synoptic-scale Weather Maps
    b. Cyclonic Storms vs. Anticyclones
    c. Severe Weather, Fire Weather, and Mesoscale Meteorology
10) Climate System
    a. Controls on Climate and Change
    b. Global Distribution of Earth's Major Climates
    c. Topography and Microclimates
11) Physical Oceanography
    a. Oceanic Circulation
        1. Gyres: Warm vs. Cold Currents
        2. Ocean/Atmosphere Interactions (e.g., El Nino/Southern Oscillation Events)
    b. Coastlines: Littoral Cells and Sand Budgets
12) Biogeography, Ecosystems, and Natural Selection (Biotic Processes shaping Surface Environments)
    a. Climate and Earth's Biome Distribution
    b. Microclimate and Habitat Variation
    c. Taxonomy and Convergent Evolution
    d. Habitat Analysis
13) Laboratory Activities: (representative examples)
    a. The methods of scientific inquiry.
    b. Units, unit conversions, scientific notation, and dimensional analysis.
    c. The geographic grid, including Earth size and shape.
    d. Compasses and clinometers; strike and dip.
    e. Astronomy and Earth-Sun Relationships: rotation, revolution and solar energy.
    f. Zenith and Sun angle; insolation variation; determining time and Latitude/Longitude across Earth's surface.
    g. Daily and Annual cycles of insolation and temperature.
    h. Variation in thermal properties: principle of continentality, albedo effect.
    i. Pressure distribution, winds, weather maps and map interpretation.
    j. Atmospheric moisture and clouds; measures of humidity; use of psychrometric tables.
    k. Oceanic gyres; warm vs. cold currents; linkage to the atmospheric system.
    l. Use of handheld GPS (global positioning system) receivers for canvassing.

Course Objectives

Students will be able to:

1) Apply in a practical manner the concepts and principles of physical geography, and of the Earth sciences in general, to the following systems:
    a. Hydrologic System (including the Hydrologic Cycle)
    b. Plate Tectonic System (including the Rock Cycle)
    c. Solar System
    d. Geologic Time-Scale
    e. Atmospheric System (including both Weather and Climate)
    f. Biospheric System

g. Gradational System.

2) Explain Earth-Sun relationships, how this causes seasonal change, and the importance of this to controlling environmental processes and patterns on Earth's surface.
3) Explain how Earth's rate-of-rotation is used in practical terms to determine longitude and solve time zone issues. Apply plate tectonics to understand the stresses ("force couples"), the structures produced (especially faults and folds, and thus mountains and basins), and the volcanics involved at different plate boundary types Identify minerals and rocks, and describe their basic properties.
4) Identify how processes that shape Earth can change over geologic time. Identify how human activity can affect such processes (e.g., gradational processes relative to destabilizing a beach system).
5) Effectively use maps to understand patterns in the spatial distribution of physical features and processes within the hydrosphere, atmosphere, biosphere, and lithosphere.
6) Read a real weather map, relate it to the actual sky condition as simultaneously observed outside, and then predict any near-term changes that are likely.
7) Explain the role of natural selection in determining the distribution of biotic processes that has resulted in variation across plant families and across the Earth's varied ecosystems.
8) Collect, analyze, and interpret field data that demonstrates the interrelationships between climate, vegetation, and soil.
9) Recognize and identify, in a specific landscape, the mass and energy flows and the environmental processes and patterns occurring across the Earth's surface; ability to analyze real-world variation in these environmental processes and patterns.
10) Apply, in a practical manner, the principles of the Methods of Scientific Inquiry. Communicate complex course concepts effectively in writing, diagrams, maps, and graphs.

Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

1) Quizzes, exams given periodically to assess comprehension of fundamental knowledge
2) Demonstration of ability to collect, analyze and present laboratory or field data in the form of graphs, charts, diagrams written reports and lab write-ups
3) Participation in class exercises and discussions
4) Final exam (written)

Special Materials Required of Student

1) Ruler, protractor, pencil compass, colored pencils, calculator
2) USGS topographic maps
3) Batteries for GPS units
4) Scientific calculator

Minimum Instructional Facilities

1) Laboratory (table work sites) with running water, writing board, Smart cart, overhead projector
2) Wall maps illustrating global/regional scale spatial distributions of physical phenomena at Earth's surface (e.g., physiography, geology, ocean basins, plate motions, etc.)
3) Physiographic globe(s)
4) Rock, mineral, vegetation and soil samples
5) Soil analysis kits
6) Weather instruments (max-min thermometer, barometer, hygrometer, sling psychrometer, etc.)
7) Stereo paired aerial photographs and stereoscopes
8) Tape measures, meter sticks, rock hammers, compasses, hand lenses and other field equipment
9) GPS units with navigational software
10) Laptop computers with GIS software

Method of Instruction
1) Brief integrated classroom lecture, discussion, demonstration
2) Independent/small group work on laboratory exercises completed under supervision during lab session
3) Instructional slides and audio/video presentations and other ancillary material to supplement lab manual
4) Auxiliary use of study groups, peer tutoring and/or instructional office hours
5) Local field exercises which integrate observations, measurements and data collection, related problem solving and analysis and presentation and interpretation of results in written or oral formats

Out-of-Class Assignments
1) Background reading assignments
2) Completion of pre-lab exercises
3) Completion of lab write-ups/reports
4) Individual or small group projects

Texts and References
1) Required (representative examples):
    a. Earth Systems Lab Manual
2) Supplemental: Supplementary texts are at the discretion of the instructor, such as those used in the GEOG 120 or GEOL 104 lecture sections, including:
    a. Christopherson, R.W. *Elemental Geosystems*, 8th edition. Pearson, 2015.
    b. Lutgens, F.K. and E.J. Tarbuck. *Foundations of Earth Science*, 8th edition. Pearson, 2017.

Student Learning Outcomes
Upon successful completion of this course, students will be able to:
1) Apply the process of scientific inquiry to draw conclusions about the Earth system and explore human influence on it.