ESCI-161L: LAB IN GEOLOGY OF THE NATIONAL PARKS

Cuyahoga Community College

Viewing: ESCI-161L : Lab in Geology of the National Parks

Board of Trustees:
May 2025

Academic Term:
Fall 2025

Subject Code
ESCI - Earth Science

Course Number:
161L

Title:
Lab in Geology of the National Parks

Catalog Description:
An introductory laboratory course in geologic concepts with special focus on United States National Parks. Through a series of hands-on labs and literature reviews, students explore how geologic processes are responsible for the physical features in our national parks. Included in this course are the concepts of proper scientific methodologies, measurements, geological history, endogenic and exogenic processes, plate tectonics, and how the geological record can be used to reconstruct the story of select national parks. Laboratory studies include following the scientific method, including topographic maps, satellite imagery analyses, rock and mineral sample identifications, and interactive earth science web-based applications.

Credit Hour(s):
1

Lecture Hour(s):
0

Lab Hour(s):
3

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
ESCI-1610 Geology of the National Parks or concurrent enrollment.

Outcomes

Course Outcome(s):
Apply geological laboratory techniques to studies 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.
Information Literacy: Demonstrate contextual awareness of the research process through the reflective discovery of the production and value of information, the use of information in the creation of new knowledge and ethical participation in the use of information in communities of learning.
Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.
Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):
1. Analyze laboratory data using proper steps, and detailed explanation of the phenomena under study.

2. Discuss the basic principles of scientific inquiry and apply them to current research and to past discoveries of theories in physical sciences.

3. Demonstrate laboratory safety and proper laboratory techniques for each lab exercise.

4. Measure physical properties while recording observations and data.
5. Identify and describe the formation of the different types of folding and faulting.
6. Differentiate, locate, and identify erosional and depositional features of landscapes formed by wind, streams, glaciers, waves, volcanoes, and tectonic deformation.
7. Differentiate between erosional and depositional features and how they are formed.

8. Mathematical Conversions, correctly use and apply units of measurement, and convert between English and Metric.

9. Identify the composition of the earth and describe by composition and function, and sketch the cross section of the earth.

10. Describe the processes used to identify and triangulate to find the epicenter of an earthquake.

11. Distinguish between seismic waves and interpret a seismograph, obtain and apply near to real time data to earthquake patterns.

12. Identify and describe land use and landcover, and describe the processes of deforestation.

13. Explain the processes that contribute to mass wasting, and predict the most susceptible areas in the US

14. Demonstrate proficiency in reading and interpreting topographic maps to determine elevations, distances, and slopes, create topographic profiles.

15. Identify geological hazards, volcanic, water, coastal, slope, subsidence

16. Describe and identify environments of fossilization and create fossil molds using different mediums

17. Identify and classify fossils using taxonomic keys and preservation characteristics.

18. Apply principles of relative dating to determine the chronological sequence of geological events in stratigraphic sections.

19. Differentiate between types of glaciers

20. Utilize satellite imagery in order to identify and describe volcanic, fluvial, glacial and aeolian landforms.

21. Interpret geological maps, including map elements, strike and dip, fault, folds and geological units

22. Explain the stressors on the National Park systems, as well as the anthropogenic changes on the landscape.

22. Construct stratigraphic columns from field observations and rock unit descriptions

23. Interpret the type of weathering that will be prevalent in different climatological environments.

24. Apply GIS techniques to analyze spatial relationships between geological features.

25. Use grain size analysis techniques to classify sedimentary rocks and interpret depositional environments.

26. Measure and analyze geological phenomena using existing geological indices

27. Analyze water temperature and chemistry data to evaluate stream health and conditions.

28. Measure and analyze glacial features to determine ice flow directions and glacial history, including the geological history of the Great Lakes

29. Locate and define the different physiographic provinces on a map and explain the history and variety of landforms that are found.

30. Relate all geological information to specific existing National Parks, Monuments and Historic Places.

31. Discuss the importance of understanding the geosphere on the creation, adoption, and scientific understanding of National Parks and Spaces.

32. Identify, measure and describe the significances of igneous, sedimentary structures, and metamorphic rocks.

33. Perform laboratory activities in group and/or individual environments.

34. Predict landforms and geological processes based on geography, plate tectonic processes, elevation and latitude

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Course Outcome(s):

Apply geological laboratory principles to comprehend the nature, origin and future of our National Parks, Spaces and Places

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.

Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.
Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Evaluate natural hazard risks in the local area by analyzing geological maps and historical data.

2. Assess how local geological features influence regional water resources and quality.

3. Explain how endogenic and exogenic processes affect infrastructure development and building codes in the Northeast Ohio region.
4. Analyze how geological factors influence land use decisions and property values in your community.
5. Identify ways that weathering and erosion processes impact infrastructure maintenance, particularly in the National Parks
6. Evaluate how geological resources contribute to everyday products and materials.
7. Assess the impact of karst geology on local construction practices and sinkhole hazards.
8. Interpret how regional physiographic provinces influence local climate and weather patterns.
9. Analyze how geological factors affect soil formation and agricultural practices.
10. Evaluate the role of geological processes in determining local recreational opportunities and park development.
11. Assess how coastal processes affect shoreline development and beach management, with a special focus on Lake Erie
12. Connect local rock types to historical building materials in your community.
13. Analyze how geological factors influence alternative energy development potential in your region (geothermal, wind, water, oil)
14. Evaluate the relationship between local geology and groundwater availability for community use.
15. Connect principles of weathering and erosion to household and county maintenance
16. Identify the role of geology in shaping the designation of National Protected Spaces.

Methods of Evaluation:

1. Laboratory reports, explorations and real-time lab reviews within the manual
2. Literature reviews and Summaries
3. Laboratory Practical (exams)

Course Content Outline:

A. Introduction to Geology
   1. History of Geology as a field
   2. Definition and distribution of the physiographic provinces
   3. National Parks

a. The development of the National Parks
b. History and geopolitics
c. Art in the public eye
d. Importance of Literature

B. The Human element
   1. Americas indigenous history and the park system
   2. The indigenous history and legacy in parks

C. Overview of major divisions on the continent
   1. Major Spheres of the earth
   2. Layers of the earth by function and composition
   3. Major physiographic provinces
   4. Divisions of the US and National Parks as situated within each province
   5. Deforestation Case Studies, West coast, and Olympic mountains

D. Overview of Plate Tectonics
   1. The scientific support of the theory
   2. Evolution of the theory
   3. Types of boundaries, modelling plate tectonics

a. Divergence
 i. Extensional landscapes
ii. Great Basin stratigraphy and evolution
b. Convergence
i. National Parks on convergent boundaries
ii. Olympic, Katmai
c. Transform
 i. Joshua Tree
 ii. Channel Islands

d. Velocity and direction of plate movements
e. Tectonic uplift and Isostasy
f. Minerals and minerals of the earth
i. Identification methods
ii. Identifying Crystal form, hardness luster, fracture and specific gravity
E. Volcanism, Processes and Characteristics
1. Hot spots
a. Continental
b. Oceanic
c. Case Study: Hawaiian Volcanoes and Craters of the Moon
2. Morphologies and tectonic processes
a. Magma generation and plate boundaries
b. Igneous rocks and the rock cycle
3. Volcanism in National Parks and their settings
a. Lassen Volcanic
b. Hawaii Volcanoes
c. Volcanic Hazards
4. Igneous Rocks
a. Determining the Environment of formations
b. Igneous rock Identification
F. Endogenic and Exogenic Processes
1. Endogenic
a. Earthquakes
b. Scales of measurement
c. Reading seismograms
d. Finding Epicenters and Triangulation
2. Exogenic
a. Weathering
i. Rates of weathering
ii. Types of Weathering
b. Erosion
3. Sedimentary Rocks
a. Classifications
i. Sediment size scale
ii. Biogenic, clastic and chemical
b. Identification
c. Areas of deposition
d. Sedimentary Structures, contacts and formations
4. Fossils and Fossilization
a. Processes and Environments
b. Fossil Identification
i. Molds, Casts, Body Fossils
ii. Taxonomy
iii. Permineralization
c. Principles of faunal succession
d. John Day National Monument
5. Metamorphic Rocks
a. Classifications and properties
b. Identification
i. Protoliths
ii. Metamorphic Grades
iii. Index Minerals

c. Geothermal Gradients and mapping
G. Topographic Maps
1. Map Distances
2. Interpreting Topographic Maps
3. Creating Vertical Topographic Profiles
H. Oceans and Coasts
1. Geological characteristics
a. Passive Shorelines
b. Active Shorelines
c. Erosional and Depositional Characteristics
i. Longshore drift
ii. Seasonal Profiles
d. Coastal Vulnerability indices
e. Human Interference and Coastlines
f. Unique limestone bedrock and water flow
g. Impact of sea-level changes, Eustasy
2. Estuaries and Deltas
3. Ocean Circulation
a. Thermohaline/Density driven currents
b. Modelling Currents c. Surface Currents
4. Featured National Parks, Passive and Active margins
a. Gulf Shores
b. Everglades
c. Olympic National Park
I. Fluvial Processes
1. Drainage Basins and Modelling
2. Identifying Fluvial Landforms and stream gradients
3. Stream Patterns and underlying geology
4. Featured National Parks
a. Great Smoky Mountains National Park
b. Shenandoah National Park
5. Mass Wasting Events
a. Types of Mass Wasting Events
b. Hazards and mitigation of mass wasting
c. Geological materials and their characteristics
i. Angle of repose
ii. porosity and permeability of materials
J. Relative and Numerical Dating
1. Principles of Relative Dating
2. Geologic record, time scale
a. Uniformitarianism
b. Catastrophism
c. Unconformities
3. Numerical dating
a. Decay rates in various rocks
b. Analytical methods used in numerical dating
c. Strengths and weaknesses of both types of dating
4. Telling time at the Grand Canyon, examples
K. Structural Geology and Geologic Maps
1. Interpreting a Geological Map
2. Understanding Geological Units
3. Outcrop Patterns

4. Faults, Folds and Map Symbols

L. Wind Processes and Landforms

1. Particle Transport and Velocities of transport
2. Erosional Features
3. Depositional landforms
4. Identifying Dune Morphology and migration

M. Karst Processes, Aquifers and Associated Landforms

1. Overview of Aquifers

a. Geological Materials and aquifers

b. Porosity and Permeability, and testing flow

c. Hydraulic Head

2. Describing and identifying Karst landscapes

3. Subterranean features

a. Mapping caves

b. Using geophysics to understand subsurface stratigraphy

c. Processes of dissolution of carbonate materials

d. Acid rain, deposition, and effects of deposition on Rocks

4. Karst in Ohio and Great Lakes Region

a. Subsidence

b. Sinkhole and cavern locations and hazards

N. Glacial Processes and Landforms

1. Identifying Glacier Formations and types
2. Glacial Balance, determining and measuring change
3. Erosional Landforms and Depositional Landforms
4. Interpreting Glaciers on Maps
5. Case Study: Glacier National Park and Ice loss

O. Field work, Field Trips

1. Identification of sedimentary features and local strata history interpretation
2. History of the local strata based on sedimentary structures
3. Stream Monitoring

a. Determination of water temperatures

b. Calculating stream gradients, and flow

P. Conclusions

1. Interrelationships between physiographic provinces

2. Importance of National Parks in geological education and conservation

The Course Schedule is subject to change due to pedagogical needs, instructor discretion, parts of term, and unexpected events.

Resources for the Instructor

Foster, David A., David Hacker and Ann G Harris. *Geology of National Parks*. 8th ed. Kendall/Hunt Publishing, 2022.

Harris, David V., and Eugene P. Kliver. *The Geology of US Parklands.* 5th ed. New York: John Wiley and Sons, 1999.

Lillie, Robert J. *Parks and Plates: The Geology of Our National Parks, Monuments, and Seashores.* New York : W.W. Norton, 2005.

CCC-Western Campus. *ESCI-161L Lab Manual.* {ts '2002-08-15 00:00:00'}.

David Osleger. *Geology and Landscapes of America's National Parks*. 1st. Oxford University Press, 2021. 9780199301201

Robert Lillie. *The Story Behind The Scenery: Plate Tectonics and the Landscape of our National Parks*. Wells Creek Publishers, Oregon, 2020.

Michelle Davis. *Laboratory in Geology of the National Parks: A Physiographic Perspective*. 1st. VanGriner Publishing, Cincinnati Ohio, 2025. upcoming.

Additional Resources for the Instructor

1. https://fire.airnow.gov/
2. Incorporated Research Institutions for Seismography (IRIS) (https://www.iris.edu/hq/)
3. USGS Earthquakes and Hazards (https://www.usgs.gov/programs/earthquake-hazards/earthquakes/)
4. USGS Induced Earthquakes (https://www.usgs.gov/programs/earthquake-hazards/science/induced-earthquakes/)
5. US Marine Protected Areas, NOAA (https://marineprotectedareas.noaa.gov/)
6. NSF, USGS, NASA, Earthscope, Plate Velocity Viewer (https://www.unavco.org/software/visualization/GPS-Velocity-Viewer/GPS-Velocity-Viewer.html)
7. Sequent, Visible Geology (https://www.visiblegeology.com/)
8. Murdack, Barbara. (https://www.farmanddairy.com/news/glaciers-carved-out-ohios-unique-and-specialized-habitats/689304.html) Glaciers carved out Ohio's unique and specialized habitats, 10/21
9. Structural Geology for a Sustainable World, Geoscientist, Geological Society of London (https://geoscientist.online/sections/features/structural-geology-for-a-sustainable-world/)
10. Official Sea Level Rise Strategy, Miami, FL (https://www.miamidade.gov/global/economy/resilience/sea-level-rise-strategy.page)
11. Zuvanich, Adam, (https://www.houstonpublicmedia.org/articles/climate-change/2023/04/12/449026/gulf-coast-sea-level-rising-at-unprecedented-rate-recent-studies-find/) **Gulf Coast sea level rising at 'unprecedented' rate, recent studies find, 4/12/23**
12. Volcano Discovery, https://www.volcanodiscovery (https://www.volcanodiscovery.com/). (https://www.volcanodiscovery.com/)com/
13. USGS Earthquakes, https://earthquake.usgs.gov/earthquakes/map/
14. Copernicus Emergency Management, home, https://emergency.copernicus.eu/
15. DART Deep Ocean Assessment and Reporting of Tsunamis, https://nctr.pmel.noaa.gov/Dart/
16. Soil Salinization White Paper, California Department of Food and Agriculture (https://www.cdfa.ca.gov/agvision/docs/soil_salinization.pdf)

Instructional Services

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