GEOLOGY 301 **GLG 301 EARTH SCIENCE *in* ARIZONA *and the* SOUTHWEST**

ASU SCHOOL OF EARTH & SPACE EXPLORATION
ARIZONA STATE UNIVERSITY

1. Course Description

Place-based application of geology and allied Earth system sciences to explore and interpret the rocks, landscapes, geologic history, climate, resources, and natural hazards of Arizona and the Southwest. Incorporates case studies of Earth system impacts on Southwest cultures past and present, and the relevance of Earth science to sustainability in the Southwest region. Weekend field trips and a final project are required.

Prerequisites: ENG 101,105 or 107; MAT 117 or higher; GLG 101, 102, 110, GPH 111, or SES 101.

Accepted for CLAS *Science and Society* credit.

2. Student Learning Outcomes

Upon successful completion of this course, students will:

A. Demonstrate knowledge of the regional geography, geology, climate, hydrology, and climate of the Southwest region.
B. Skillfully observe, describe, depict, measure, and interpret the most important types of landscapes, Earth materials, weather, and biota of the Southwest region.
C. Skillfully interpret maps, cross-sections, diagrams, and images that depict Earth system components and processes in the Southwest region.
D. Demonstrate understanding of the geologic history and evolution of the Southwest region.
E. Demonstrate understanding of the reciprocal relationship among Earth science and human societies in the Southwest region.
F. Demonstrate a critical understanding of the principles of Earth science that underly topical issues related to lifeways and sustainability in the Southwest region (such as climate change, water and energy resources, mining, agriculture, and other land use).
G. Critically read and interpret information about Earth science and the Southwest region in professional publications and popular media.
H. Skillfully formulate, communicate, and defend their own well-informed views concerning the topical issues studied in this course.

3. Listing of Assignments

These are of three types: ***Lesson Tutorials*** completed by students in class during each lesson, ***Chores*** to be completed online outside of class hours, and a ***Final Project***. There are no exams in GLG 301.

A. ***Lesson Tutorials*** are 5-15 minute interactive inquiry exercises that students complete (usually in small groups) during class sessions. These focus on *conceptual understanding* (e.g., 'make and annotate a concept sketch of the Southwest crust in cross-section'), *quantitative problem-solving* (e.g., 'given these data, calculate the approximate amount of water use in an open-pit copper mine') or *hands-on learning* (e.g., 'interpret the Jurassic paleoenvironment given the set of rock and fossil specimens placed before you'). Most Lesson Tutorials will also include whole-class discussion of the problems posed and responses made by the students. Completed ***Lesson Tutorials*** will be collected

after each class session, graded, and returned to students at the next class. The ***Lesson Tutorials*** serve several important pedagogical functions: (1) Keep students engaged; (2) Formatively assess student understanding of course content; and (3) Encourage regular class attendance.

B. ***Chores*** are assigned after each class meeting and are posted on Blackboard for completion online before the start of the next class. Chores include a reading assignment from the text(s) and sometimes additional materials that will be posted on Blackboard, followed by one to five short-answer questions that test students' understanding and synthesis of the content presented in class and the assigned readings.

C. The ***Final Project*** is required in lieu of a final exam and reflects the place-based nature of this course: a key aspect of place-based learning is that it returns tangible benefits to the place or region that is studied. Every student in GLG 301 must propose, plan, and complete a unique ***Final Project*** relevant to Earth science and the Southwest, requiring original thought, planning, and about 20 hours of work. Every ***Final Project*** must satisfy at least one of these four criteria:
   i. It improves understanding of Earth science in some part of the local community, such as a school or museum. (For example: an outreach presentation, an educational poster or display, a complete lesson plan for a K-12 class, etc.);
   ii. It improves understanding of a meaningful Southwestern place or natural phenomenon in some part of the local community, or in the greater community (For example: a guidebook for a popular hiking trail, an article in a local newspaper, Southwest-based content for another ASU or community-college course, a book review, a Wikipedia entry, etc.);
   iii. It improves understanding of the relevance of Earth science to sustainability in the Southwest region in some part of the local community (Examples: similar to those given above); or
   iv. It is an original creative work by the student that comprehensibly represents or explains some part or phenomenon of the Earth system in the Southwest region. (Some examples: a painting, an annotated collection of photographs or poetry, a short story, a textile or ceramic).

To ensure that ***Final Projects*** are appropriate, meaningful, and equitably assigned, each will be approved by means of a written agreement between the student and instructor that must be finalized by mid-semester.

4. Grading Policies and Percentages:

A. Policies:

Lesson Tutorials and ***Chores*** will be graded using assignment-specific rubrics written by the instructor to correspond to the main points of each lesson and the student learning outcomes for the course.

Final Projects will be graded using rubrics to assess student effort, student presentation of the Final Project in a special session at the end of the course, and effectiveness of the project in meeting at least one of the four criteria listed above.

B. ***Percentages:*** GLG 301 will be graded on a 1000-point scale:

30 ***Lesson Tutorials*** (one per class) at 10 points each = 300 points total
30 ***Chores*** (one following each class) at 10 points each = 300 points total
Final Project agreement completed and approved = up to 100 points
Final Project roadcheck to ensure good progress = up to 100 points
Presentation of Final Project = up to 100 points
Quality and Effectiveness of Final Project = up to 100 points

C. ***Grading Scale:***

1000 points	**A+**
934-999 points	**A**
900-933 points	**A-**
866-899 points	**B+**
834-865 points	**B**
800-833 points	**B-**
766-799 points	**C+**
600-765 points	**C**
500-599 points	**D**
< 500 points	**E**

5. Required Readings

A. Required Texts

Ffolliott, P. F., & Davis, O. K. (Eds.) (2008) *Natural Environments of Arizona.* Tucson: University of Arizona Press. ISBN 978-0-8165-2697-0.

Baldridge, W. S. (2004) *Geology of the American Southwest.* New York: Cambridge University Press. ISBN 0-521-01666-5.

Wiewandt, T., & Wilks, M. (2004) *The Southwest Inside Out.* Tucson: Wild Horizons Publishing. ISBN 1-879728-04-4.

6. Course Itinerary:

The course will meet twice per week for 75 minutes each class = total of 30 lessons.

Week 1:	**A sense of the Southwest**
Questions	*Where and what is "the Southwest (Sw)"? What are its basic characteristics? How do Earth scientists view it? Why does it matter to Earth science? What are its topography and subsurface structure? What processes form its landscapes?*
Concepts	The physical and the cultural Sw regions and how they are interrelated; Sw region is part of the global Earth system; Why Sw is exceptional for studying Earth science; How Sw geology influences its climate, water, ecology, and human societies; How we image the subsurface; Recent findings (EarthScope); Structure beneath the landscape; External and internal processes of change
Readings	Ffolliott & Davis Chapter 1 Baldridge Introduction Wiewandt & Wilks Chapter 1

	Additional readings on Earth system science and Southwest physiography
Weeks 2-3:	**Building blocks of desert and mountain**
Questions	*What rocks are Sw landscapes built of? How do we identify and interpret them? What do they record about the history of Earth and life? What makes some Sw rocks so beautiful, so useful, so valuable?*
Concepts	Rock-forming processes and rock cycle; Interpreting common rocks, minerals, and fossils found in the Sw; The rock record in the Sw; Different ways that rocks and minerals have been used by Sw societies, past and present
Readings	Ffolliott & Davis Chapter 4 Wiewandt & Wilks Chapter 8 Additional readings on Earth materials, rock cycle, and minerals
Weeks 4-5:	**How the Southwest is built, shaped, and sometimes shaken**
Questions	*How did the Sw originate? What evidence is there? What is responsible for the geologic and topographic complexity of the Sw? What role does plate tectonics play? How do mountains, basins, and faults form in the crust? What causes earthquakes?*
Concepts	Plate tectonic processes that built the Sw; Folding, faulting, and mountain-building; Histories of major Sw mountain ranges; Earthquakes and seismology; Earthquake hazards in the Sw
Readings	Ffolliott & Davis Chapter 4 Baldridge Chapters 1-3 Wiewandt & Wilks Chapter 1 Additional readings on plate tectonics, earthquakes, and Southwestern tectonics
Week 6:	**It's a deep heat**
Questions	*How do volcanoes form? What caused volcanism in the Sw? How has volcanism affected Sw landscapes and climates in the past How has it affected human societies in the Sw? What Sw volcanoes may erupt again? What hazards and benefits are related to Sw volcanoes?*
Concepts	How rocks melt; Volcanic types and processes; Volcanic landforms of the Sw; Volcanic history of the Sw; Volcanic hazards and their significance in the Sw; Sunset Crater and its influence on Native American peoples; Geothermal energy in the Sw
Readings	Baldridge Chapters 7-8 Wiewandt & Wilks Chapter 2 Additional readings on Southwest volcanoes and volcanic hazards
Week 7:	**How the Southwest is sculpted**
Questions	*How do weathering and erosion sculpt Sw landscapes? What are the most important agents of erosion in Sw deserts and mountains? What products and hazards result from these processes? What role do humans play in sculpting the Sw?*
Concepts	Surface processes and geomorphology; Water, wind, ice, and gravity as erosional agents; Mass movement; Erosional landforms of the Sw; Impact processes; Landslide hazards in the Sw; Humans as Earth's major geomorphic force
Readings	Ffolliott & Davis Chapters 2 and 4 Baldridge Chapters 6 and 8 Wiewandt & Wilks Chapters 3-4 Additional readings on plate tectonics, earthquakes, and Southwestern tectonics
Final Project Proposal due	
Week 8:	**The Southwest has a deep history**
Questions	*How do layered rocks form? What histories are recorded in layers and structures? How do we determine the ages of rocks? What is the geologic history of the Sw region?*
Concepts	Sedimentary environments and processes; Evidence for evolution; Fossilization; Principles of stratigraphy; Overview of Sw geologic history; Fossils in Sw rocks;

	Radioactive decay as a natural clock; Relative and absolute geologic dating methods; Deep time; Evolution is only controversial politically, not scientifically
Readings	Ffolliott & Davis Chapter 4 Baldridge Chapters 4-5 Wiewandt & Wilks Chapter 8 Additional readings on geologic time and Southwestern fossils
Week 9:	**Treasures of the sierras and power from the past**
Questions	*What makes a rock worth mining? What processes made the diverse mineral resources of the Sw? How are they mined and used? What are fossil fuels and how do they form? From where does the Sw get most of its energy? What are the economic and environmental outcomes of mining metal and energy resources in the Sw*
Concepts	Economic minerals; Ore-forming processes; History of copper and other metal ore deposits in the Sw; Exploration, mining, and reclamation; Mining in the Sw economy; Origin of fossil fuels in the Western Interior; Fossil and nuclear energy sources; Environmental impacts of coal, oil, uranium, and metal mining
Readings	Readings on mineral resources, mining, and mine reclamation, focused on the Sw
Week 10:	**Soils: the good, the bad, and the ugly**
Questions	*What is the nature and origin of soil? How do soils evolve and how are they characterized? What are typical Sw soils? Which best sustain ecosystems and agriculture? What are the causes and processes of soil erosion in the Sw? How can Sw soils be preserved and sustained?*
Concepts	Soil-forming processes; Characterization of soils, emphasizing common Sw types; Evolution of soil profiles; Soil use; Soil erosion and desertification; Soil conservation; Environmental problems caused by desert dust
Readings	Ffolliott & Davis Chapter 5 Wiewandt & Wilks Chapter 7 Additional readings on soil erosion and desert dust
Final Project Roadcheck due	
Weeks 11-12:	**Water is life in the desert**
Questions	*Where does water occur in the Sw region? How does water interact with climate and landscape? What are the principal groundwater systems in the Sw? What are the principal river systems in the Sw? How have Sw societies changed these systems in order to obtain water supplies? What are the environmental impacts of these changes?*
Concepts	Basic groundwater and surface water hydrogeology; Climate and water; Sw groundwater basins; The Colorado, Gila, and Río Grande systems; Engineering and history of water management in the Sw; Colorado and Salt River dams, reservoirs, and the CAP canal; The water-energy nexus in the Sw; Status and future of Sw water resources
Readings	Ffolliott & Davis Chapter 5 Wiewandt & Wilks Chapters 5-6 Additional readings on Southwestern water resources and water use
Week 13:	**It's a dry heat now…what about later?**
Questions	*What creates a desert? What weather patterns are typical of the Sw region? What global patterns influence our climate? How is global climate change affecting the Sw? What might our climate be like in the future?*
Concepts	Types and causes of desert climates; The deserts of the Sw; Wind and rainfall patterns across the Sw; The North American Monsoon; Dust storms; Effects of El Niño and La Niña; Prehistoric, historic, and recent droughts; Predicted effects of climate change on water resources, ecology, and dust and wildfire hazards in the Sw
Readings	Ffolliott & Davis Chapter 3 Baldridge Chapters 1-3

	Wiewandt & Wilks Chapter 1 Additional readings on plate tectonics, earthquakes, and Southwestern tectonics
Week 14:	**Survival and sustainability in the Southwest**
Questions	*How well did past human societies adapt to living in the Sw? How well are our current societies doing? Which practices are sustainable and which are not? What must Sw societies do to be sustainable into the foreseeable future?*
Concepts	Impacts of topography, climate, water, and land use on Indigenous lifeways; Comparison with mainstream Sw lifeways; Expected limits to resources and growth in the Sw; Alternative sources and uses of water and energy; Earth system influences on Sw-friendly architecture, agriculture, and transportation
Readings	Ffolliott & Davis Chapter 9 Baldridge Chapter 8 Additional readings on Southwest ethnography and ethnogeology (instructor's own research) and desert lifeways
Week 15:	**Presentation of Final Projects**

7. Academic Dishonesty Statement

"Academic dishonesty, including inappropriate collaboration, will not be tolerated in this course. There are severe sanctions for cheating, plagiarizing and any other form of dishonesty. Students are responsible for knowing the rules governing the use of another's work or materials and for acknowledging and documenting the source appropriately." (From the *ASU Student Handbook*).

For more information refer to the ASU Student Academic Integrity Policy at http://provost.asu.edu/academicintegrity.

8. Disability Policy Statement

An effort will be made to render this course fully accessible to all students. Qualified students with disabilities who will require disability accommodations in this class are encouraged to make their requests to me at the beginning of the semester either during office hours or by appointment. **Note:** Prior to receiving disability accommodations, verification of eligibility from the **Disability Resource Center** (**DRC**) is required. Their office is located on the first floor of the Matthews Center Building. DRC staff can also be reached at: 480-965-1234 (V), 480-965-9000 (TTY). For additional information, visit: www.asu.edu/studentaffairs/ed/drc. Their hours are 8:00 AM to 5:00 PM, Monday through Friday. Disability information is confidential.