

# Desert Odyssey: Integrating Geology, Biology & Native American History & Culture in a Field-Intensive Program

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## Exploring Interconnections Among Landscapes, Ecosystems & Human Experience in The Desert Southwest

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### ABSTRACT:

In Spring 2015, Skagit Valley College offered *Desert Odyssey*, a 15-credit learning community integrating geology, biology and Native American history, including a 3-week field program exploring interconnections among landscapes, ecosystems and human experience in the Southwest. Students learned how geologic and biological systems influenced past and present Southwest Native American cultures.

Five weeks preceding the field program focused on (1) basic geologic tools of petrography and stratigraphy; (2) biological fundamentals including evolution and phylogeny, organismal form and function, and ecosystems; (3) Puebloan and Navajo history and culture, especially storytelling and oral history, basic language training in Diné Bizaad (Navajo); and (4) the legacy of the energy industry and the unique political and environmental situation of the Big Mountain Navajo. Students used these foundational studies to develop both group and individual research questions integrating the three disciplines.

In the field, students applied these tools as we explored diverse landscapes and spent time with Navajo families at Big Mountain where we assisted subsistence activities, including sheep herding, collecting water and firewood, butchering, and road and fence repairs. Students work was making inter-disciplinary connections among what they were seeing in the rocks, organisms, and Puebloan and Navajo culture. Their learning was facilitated by lectures from faculty and regional professionals/experts, a detailed field guide and nightly discussions.

Upon returning, students developed posters summarizing the results of their group and individual research projects which were shared with the college community. Student research projects and responses to summative assessments and a reflective "Critical Incident Questionnaire" revealed that they gained significant insights about (1) deep time and the evolution of geologic and biological systems; (2) challenges, poverty and connection to the land in modern Navajo communities; and (3) the significant way that changes in the past at both geologic and cultural time-scales effect what is happening today.

### OVERVIEW & PEDAGOGY

#### Goal of the Program:

Because the learning community model of integrative teaching has a proven track record of improving student learning (e.g. Taylor and others, 2003), Skagit Valley College requires each student to take two "integrative experience" classes. One of these must be fully collaborative. In this pilot program fully integrating three courses, our goals were to:

- Facilitate students exploration and understanding of the interconnections among Native American history and culture, desert ecology, and the geological evolution and structure of the Colorado Plateau / Four Corners region of the American Southwest.
- Support them in synthesizing perspectives from diverse disciplines into multifaceted understanding of complex issues and deep history.

### Student Activities & Assignments:

- Weekly readings, labs, guest presentations and summative exams** focused on developing the geologic, biologic & cultural tools students needed to make interdisciplinary connections.
- Guest speakers** included:
  - Tracy Voyles, "Wastelands: Legacies of Uranium Mining in Navajo Country"
  - Danny Blackgoat, Big Mountain Navajo Elder
- Students & faculty collaborated in developing **research questions** integrating three or more disciplines (e.g. ecology, zoology, geology, history, language, anthropology, astronomy).
- Research questions were the focus of student & group reading & synthesis before, during & after the **field program**.
- Student understanding of connections among geologic, biologic and cultural concepts was supported during the field program by on site examination of maps & diagrams and completion of worksheets in the **field guide**.
- Integrative themes were also explored & experienced by students at Big Mountain (Navajo Partition Lands) on the Hopi Reservation as we participated in **home stays** with Navajo families & engaged in a **service project**.
- Journal entries** chronicling student experiences & impressions were later synthesized in the "Critical Incident Questionnaire".
- Students developed individual & group **professional-quality posters & presentation** summarizing the results of their research projects which were shared with the greater college community.

#### Courses Integrated:

The learning community integrated biology, geology and ethnic studies, and constituted a full load (15 cr.) for students. **Survey of Biology** - This NON MAJORS course begins with the study of scientific method, & continues with the study of ecology of life, cells, metabolism, heredity, evolution, ecology, & the diversity of life. This course is intended to show students the relevancy of biology in everyday life.

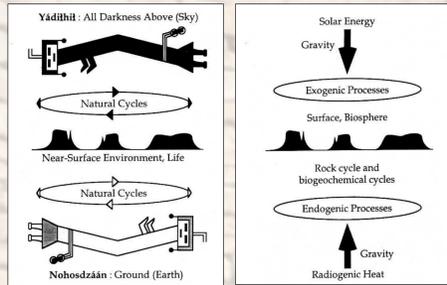
**Survey of Earth Science** - Introduction to the scientific study of the Earth & space. Intended for non-scientists. Basic physics & chemistry applied to the Earth & solar system. Emphasis on the evolution of the Pacific Northwest, including a survey of geologic, oceanographic, meteorologic, & astronomic processes that contributed to its development.

**Native American History** - History of the American Indian from earliest times to the present. Exploration of differences among the American Indians including cultural, political, historical, & social backgrounds based upon their geographic area.

#### Text & Resources Used:

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### FIELD ACTIVITIES, LEARNING OUTCOMES & ASSESSMENT:



Diné Model of Natural Systems & "Bilateral" Earth Systems Model from Serken & Morgan, 1997

**Stop 1: Introduction to Stratigraphy of the Colorado Plateau, Zion Natl. Park, UT**  
**Activity:** Observe & record distinguishing features of geologic strata in the Jurassic sequence at Zion Natl. Pk.  
**Learning Outcome:** Be able to use evidence to support assignment of a geologic unit to a particular formation/age & paleo-environment.  
**Assessment:** Completion of "Stratigraphy of Zion Natl. Pk. Worksheet"; begin "Colorado Plateau Stratigraphy Master List".



First day on the Colorado Plateau. Learning the Jurassic sequence, Zion NP, UT, May 2015

**Paleogeography & Dinosaur Ecology, Upper Kaiparowits Fm., Grand Staircase-Escalante Natl. Mon., UT**  
**Activity:** Field presentation by *Natural History Museum of Utah* researcher about the paleo-geographic setting & paleoecology of Cretaceous dinosaurs. Assist geologists in recovering fossils and in exploring a newly identified collection site.  
**Learning Outcome:** Gain understanding of the nature of geological field research and of the relationship between dinosaurs and the environment that supported them.  
**Assessment:** Complete worksheets in field guide on: (1) the strata of the Kaiparowits Basin and (2) the environments that the dinosaurs lived in.



RIGHT: Students helping carry the fossil of a giant Cretaceous turtle from the excavation site to the road, Kaiparowits Plateau, UT, May 2015



ABOVE: Co-Author Cliff Palmer shows a cast of Cretaceous dinosaur skin, Kaiparowits Plateau, UT, May 2015

**Using the Scientific Method to Determine the Origin of Upheaval Dome, Arches NP, UT**  
**Activity:** Visit Upheaval Dome, explore the strata & structure, draw sketches of what you see.  
**Learning Outcome:** Use observations & published data to access the validity of three potential explanations for the origin of Upheaval Dome. Place the event in the context of other events & episodes of Colorado Plateau evolution.  
**Assessment:** Complete Field Guide table summarizing the evidence for each hypothesis. Discuss the use of evidence in refining scientific explanations & the nature of scientific uncertainty.



Sitting on the up-turned strata of Upheaval Dome and discussing evidence for its origin as an impact crater, diatreme or salt dome, Arches NP May 2015



**Geologic Origin & Navajo Creation Story of Shiprock, NM**  
**Activity:** Visit Shiprock Mt., explore the geology of the diatreme, associated dikes & host rocks, hear the Navajo (Diné) origin story from Navajo guide.  
**Learning Outcome:** Experience the value of both scientific & spiritual ways of understanding.  
**Assessment:** Complete a time-line showing both the geologic history & steps in the Navajo origin story.

**Fossil Forest Ecosystem, Bisti/De-Na-Zin Wilderness, NM**  
**Activity:** Hike through the petrified forest & observe & record evidence for nature of the paleo-environment & the variety of species that occurred in the period recorded in the rocks.  
**Learning Outcome:** Make evidence-based comparisons of the past and present ecosystems.  
**Assessment:** Fill geologic & fossil descriptions of rock units into "Colorado Plateau Stratigraphy Master List".



Students examining a petrified cedar log and imagining how different the latest Cretaceous environment was from the modern one, Bisti/De-Na-Zin Wilderness, NM May 2015

**Condor Project, Vermillion Cliffs Natl. Mon., AZ**  
**Activity:** Visit the *Vermillion Cliffs California Condor Reintroduction & Recovery Project* site. Attend a presentation by the U.S. Fish & Wildlife biologist on project purpose, goals & operations. Accompany team member to view condors in the wild.  
**Learning Outcome:** Recognize the historical & current population levels & distribution of Condors. Recognize the reasons for population decline & issues facing recovery. Understand the biology of condors & their roles in their ecosystem.  
**Assessment:** Develop a trophic diagram/map of energy transfer in the ecosystem & condors position & role in that transfer. Include how lead enters that system.



Learning about condor ecology & recovery, Navajo Bridge, AZ, May 2015

**Home Stays w/ Big Mountain Navajo (Diné)**  
**Activity:** Pre-field trip case study to learn unique political & environmental situation of Big Mountain Navajo. At Big Mountain participate in daily subsistence activities: herding sheep, collecting water & firewood, fence repair etc. Engage in service project: construction of housing for Navajo elders.  
**Learning Outcome:** Through participation, students will experience the attributes of a pre-modern, subsistence lifestyle.  
**Assessment:** Students kept a daily journal describing, narrating, & analyzing their experiences with the Big Mountain Diné. These were later synthesized in their "Critical Incident Questionnaire" responses.

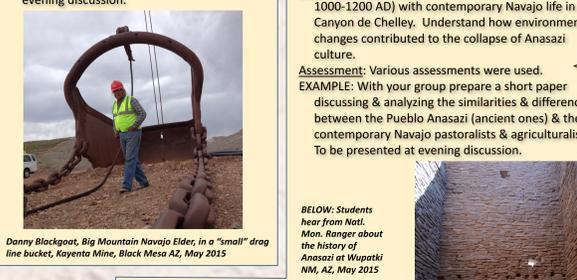


LEFT: Helping with butchering a goat. Fanny Goy, Big Mountain Navajo Elder is washing the goat stomach for later use. Big Mountain, AZ, May 2015



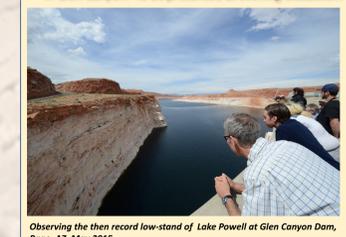
BELOW LEFT: Students help with sheep shearing. Heather (on left) did her individual project on Navajo weaving, Big Mountain, AZ, April 2015

**The Complex Navajo Relationship with Coal Mining, Kayenta Mine, Black Mesa AZ**  
**Activity:** Tour the Kayenta Mine on Black Mesa. Discuss the economics & environmental restoration of the mine with mine officials & Danny Blackgoat, Big Mountain Navajo Elder.  
**Learning Outcome:** Compare & contrast the benefits of mining to the Navajo community vs. impacts to their environment & life style.  
**Assessment:** Make journal entry reflecting on whether Kayenta Mine represents a net benefit or detriment to the Navajo People. Be prepared to present some thoughts at evening discussion.



Danny Blackgoat, Big Mountain Navajo Elder, in a "small" drag line bucket, Kayenta Mine, Black Mesa AZ, May 2015

**Ecosystems & Hydrology at Glen Canyon Reservoir, Glen Canyon Natl. Rec. Area, UT**  
**Activity:** Tour the Glen Canyon Reservoir & Dam site & see presentation on the reasons for its construction from facility operators. See a presentation by the *Glen Canyon Institute* on efforts to restore a free-flowing Colorado river through Glen Canyon & much its ecosystem to its pre-dam conditions. Then make comparisons between the current ecosystem (created by dam) & the historic (pre-dam) ecosystem.  
**Learning Outcome:** Be able to describe pre- & post-Glen Canyon dam ecosystems. Compare costs & benefits of dam construction. Describe merits & detriments of Colorado river restoration proposal.  
**Assessment:** Teams of three will write short position papers in which they make an evidence-based arguments in favor of- or against restoring a free-flowing Colorado R. in Glen Canyon. To be presented at evening discussion.



Observing the then record low-stand of Lake Powell at Glen Canyon Dam, Page, AZ, May 2015



RIGHT: Spider Woman Rock, in Canyon De Chelly National Monument, AZ, is the home of Spider Woman, Creator of the Universe in Navajo belief, May 2015



BELOW: Students hear from Navajo Mon. Ranger about the history of Anasazi at Wupatki NM, AZ, May 2015

### STUDENT LEARNING & REFLECTIONS:

Results of the "Critical Incident Questionnaire":

*What was the most significant thing you learned during the field course?*  
 "This was a life changing class that offered perspectives on this world that no book or classroom could achieve."

*"I think one of the most important reasons to engage in this type of field study is to expose other students to the Navajo people; our service projects with them were helpful and meaningful; more students need to help others outside their immediate communities."*

*"The most important lesson was learning both geology and Native American history in a real world environment: hard to duplicate in the classroom. There is no substitute for hands-on learning. This type of cements the critical concepts in the mind."*

*"I think the most important thing I learned was from the Navajo elders. They live their lives so humbly, so non-materialistically."*

*"I felt like this was really a geology/Native American history class... and we did a lot of hiking... so in the future make it a geology/history/PE class."*

*"Definitely our travels throughout the Navajo Reservation surprised me the most, seeing everything from urban markets, to the countryside of Big Mountain, even the strip mining at the Kayenta Coal Mine... It was nice of the elders on Big Mountain to welcome us into their homes and show us glimpses into their world, their legacy, their experiences as native people living on the land."*

*"I learned that there is a huge difference in time between the geologic events and processes that formed the Southwest landscape that we explored and the habitation of that landscape by Basketmaker, Puebloan, and ultimately Navajo peoples. There are many connections that can be recognized in how the Earth and the people interacted."*

*"The most important thing was our time on Big Mountain with Fanny & Danny [Navajo elders], Osa, and Owen."*

*"The Navajo Nation was by far the most eye-opening experience... The stay with Danny Blackgoat [Navajo elder] was incredible... The service projects for the Navajo were some of the most personal and touching highlights."*

### DESERT ODYSSEY GROUP PROJECTS:

- The Navajo Story: Multi-Cultural Connections & Scientific Support
- What Caused the Anasazi Collapse?
- Navajo Life & Energy Use on the Colorado Plateau
- The Legacy of Uranium & the Navajo

### DESERT ODYSSEY INDIVIDUAL PROJECTS:

- Northwest & Southwest Landscapes: Photographic Comparisons
- Tsé: The Geologic Vocabulary Game
- Navajo Livestock: A Threatened Livelihood
- Three Days on Big Mountain: Hózhó in Daily Life
- Anasazi & Navajo Star Connections
- Desert Odyssey First Impression - Student Experience
- Impacts of Invasive Tamarisk (*Tamarix gallica*) on Desert Ecosystems & Water Tables in Southwestern Utah & Northern Arizona
- A Comparison of Indigenous Groups on the Colorado Plateau
- Evidence for Mesoamerican Influence on Anasazi Culture
- Dinosaur Ecology & Evidence for Diversification in the Upper Cretaceous Kaiparowits & Wahweep Fms. Grand Staircase-Escalante National Monument UT
- Navajo Textiles & Weaving: Techniques & Role in Their Culture
- Looking Into Navajo Poverty
- Helping the Navajo: How Can We Reduce the Impacts of Poverty, Mining Waste & Sub-Standard Housing?

### PEDOGOGIC CONCLUSIONS & LESSONS LEARNED: (in order of importance)

- Give students more ownership of the field program. Specifically:
  - work with each student to develop expertise on some topic, issue, area
  - have each student develop & present the field guide for one field locale
- Schedule fewer field stops & spend more time at each; Schedule more complete days off
- Work to achieve better integration of the three subjects; More time with all instructors in the classroom; Refine integration of assignments
- Spend more time preparing students for the culture shock of visiting one of the poorest communities in the United States
- Work with students on effective group behavior and group dynamics before the trip; discuss how effectively group the is functioning during the trip
- Work with the college and the SVC Foundation to provide more scholarships to support
- Provide more guidance on group & individual projects; give feedback on drafts
- Be more explicit about the physical / hiking requirements for participation
- Scaffold the physical activities during the field program so that students can become accustomed to the heat and altitude

### ACKNOWLEDGEMENTS:

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