SYLLABUS
EES 341 LEHIGH FIELD CAMP (6 CREDITS)
SUMMER SEMESTER 2018
30 MAY – 03 JULY

Director: Dr. Claudio Berti; Department of Earth and Environmental Sciences, 576 STEPS, Phone: 610-758-2581; clb208@lehigh.edu.

Instructors: Dr. Claudio Berti, Dr. David J. Anastasio, Dr. Frank J. Pazzaglia.

Staff: Three TAs, quartermaster, camp commissary.

Prerequisites: Introduction or gateway course to Earth and Environmental Sciences (Physical Geology, Intro to Environmental Science or equivalent), Earth Materials (Mineralogy, Petrology), Structural Geology, Sedimentology-Stratigraphy, Ecology, Hydrogeology, or equivalents. Deficiencies handled by petition.

Texts: Suggested: Geological field techniques, Coe, ISBN: 978-1-4443-3062-5 Paperback 336 pages, November 2010, Wiley-Blackwell. US $59.95.

Scope: Synoptic, capstone field experience for geology and Earth science majors. Instruction on how to make, read, and interpret geologic maps and how to envision field problems and collect environmentally diagnostic data. Using of the field, field geologic relationships, and the concepts of geological mapping and environmental data as the vehicle towards development of a professional earth and environmental scientist.

Format: Several multi-day, multi-partner field mapping projects, instructed by one or more faculty, and one or more staff. Projects contain an in the field team component, and a map drafting and writing individual component.

Skills: Geology of North America, Glacial geology of the mid-west, collection and interpretation of structural data, lithologic descriptions, note taking, basic and advances stratigraphic concepts, sequence stratigraphy and basin analysis, stratigraphic section measurements, geologic mapping and cross sections, surface and near surface hydrology, concepts of ecology and paleo-ecology, metamorphic and igneous petrology, recognition and interpretation of faults and folds in the field, electronic mapping, GPS, GIS, concepts of economic geology.

Grading: Grades are based on the quality of projects produced during three main integrated exercises, several smaller exercises, a stratigraphic measuring exercise, synthesis of map and environmental data, and exercises during the cross-country trip. The breakdown is:

Cross country trip, landscape evolution, notebook	10%
Badlands intro map	5%
Strat section and sequence stratigraphy exercise	10%
Bighorn Basin (basic mapping and simple structure)	25%
Yellowstone (volcanic rocks and active tectonics)	5%
Idaho (surficial processes)	25%
Idaho (crystalline rocks and block diagram)	10%
Camp participation, group leadership, attitude	10%

Unique characteristics of Lehigh Field Camp

Lehigh field camp offers a unique combination of challenging projects, experiential learning and self-discovery that are designed and continuously updated to provide participating students with an immersive, comprehensive and multi-faceted learning environment.

Projects are structured throughout the cross-country trip and around 3 main base camps in the Bighorns Mt. (WY), Yellowstone area (MT) and Pioneer Mt. (ID) in order to maximize the exposure to suitable locations while reducing at a minimum the time and logistics devoted to moving camp. The time allotted to each project is scaled to the range of expectations and challenges the students to perform at the best of their ability to meet demanding deadlines. The overall intensive program of Lehigh field camp requires a 30+ days of full immersion participation during which students can completely focus on the projects and learning, and in returns allow participant on their return enough time to take advantage of a full summer session or summer employment and internships.

Structured as a traveling caravan the camp takes full advantage of the vast and rich variety of landscapes and tectonic settings from the East coast of the US to the heart of the Rockies in Wyoming and Idaho, as the participants move from the deformed foreland of the Appalachian, through the glaciated terrains of the mid-west, into the rocky mountains foreland basin, thick- and thin-skin structures of the Bighorns Mt. and the Idaho fold and thrust belt and the active tectonic of the northern termination of the basin and range province. The variety of geologic settings exposes students to the three main groups of rocks: sedimentary, igneous and metamorphic and serves as a framework for a wide range of thematic that spans from continental margin scale tectonics, global environmental changes, source to sink sediment budget, energy and mineral resources, to landscape evolution in response to climatic and tectonic forcing, analysis of structural data in map and cross section, sequence stratigraphy, metamorphic petrography and core complex dynamics.

The time of the cross country trip is invested to build a common base among students that come to camp from different University and with different background. During the trip the camp has also the chance to visit several state and national parks as well as historic and cultural heritage sites which contribute to the general education and the character of voyage of discovery that distinguish Lehigh's program. The cross country trip also include a 2 day long stay in the Badlands of South Dakota were we explore stratigraphy, paleoecology and sedimentology themes as well as an introductory mapping project.

The first base camp in the Bighorn Mountain and Bighorn Basin in Wyoming focuses on sequence stratigraphy, structural geology and on regional geology of Laramide structures. Students are first introduced to sequence stratigraphy of the Frontier Fm. in a 2-day project that involves section measuring and detailed description of sedimentology characteristics to produce an interpretation of the succession of sedimentary environments in a sequence stratigraphy framework. The section measuring is performed with Jacob's staff that was designed in house and integrates a laser pointing device that speed up the measuring process.

The second 5-days project in the Bighorn Basin focuses on the structural geology of Sheep Mountain anticline. The project runs as a classic geologic mapping and structural analysis applied to a carbon sequestration problem. Students are challenged in the reconstruction of the 3D structure of the anticline through the integration of map, structural and stratigraphic data.

One last 1-day project in the area has the student challenged in the reconstruction of 3 regional scale cross section across the northern, central and southern portion of the Bighorn Mountains with the expectation of a regional reconstruction of crustal scale structures and interpretation for transfer of deformation along strike.

After Wyoming the camp moves to Montana where the students have the chance to explore the Yellowstone N.P. area and are exposed to suites of volcanic rocks and to the geodynamics, regional setting and landscape evolution as driven by of a continental hotspot.

The final location for the camp is set in the heart of the Pioneer Mt. in Idaho, where the camp takes full advantage of the location to challenge the students with a surficial process project and a metamorphic core complex project. A 4-days surficial processes project explores 3 different location along a large drainage basin from the headwater to the confluence with a major river (Big Lost River) and expose the students to themes of sediments source to sink and climate changes. Students map glacial and river deposits in both alluvial fans and river terraces and describe sediments in outcrop and soil pits. They also reconstruct the paleo-hydrology of the stream based on estimates on sediments' size in the different deposits. The final delivery has the students reconstruct the climatic variation of the last 130 ky as recorded in the stratigraphic record.

The last 2-days project focuses on metamorphic core complex through the recognition and description of igneous and metamorphic rocks, as well as ductile, brittle and brittle-ductile elements, deformation and textures. At the end of the project students are required to synthesize the evolution of the area in an oriented 3D block diagram.

The use of new technologies plays a very important role throughout all the projects and students are provided with a fleet of 20 iPads for electronic mapping. Apps are kept up to date and revised yearly to offer the latest advance in electronic mapping resources. The tablets have been just updated and will be kept on a 3-year rotation. Starting from the summer of 2017 the camp offers real time high resolution topography acquisition and processing with the use of 2 UAVs (drones). Student now benefit of new detailed maps for areas where the USGS topography is not available with the necessary detail and real-time orthomosaics and 3D models have been successfully used as a tool for integrating field observations. Future plans include students' direct data acquisition and processing with an increased fleet of UAVs together with computing and visualization capabilities.