School for International Training | 1 Kipling Road, PO Box 676 | Brattleboro, VT 05302-0676 USA
Tel 888 272-7881 | Fax 802 258-3296 | studyabroad.sit.edu

Geohazards in the Himalaya

GEOL 3000 (3 Credits / 45 hours)

SIT Study Abroad Program:
Nepal: Geoscience in the Himalaya

PLEASE NOTE: This syllabus represents a recent term. Because courses develop and change over time to take advantage of unique learning opportunities, actual course content varies from term to

Course Description

This field course focuses on geohazards as a perspective through which to study the interactions between human and Earth systems in the Himalaya. Students will gain the ability to synthesize observations of Earth science and human systems to determine key relationships, hazards, and solutions. The rugged terrain of an active mountain range limits habitation and travel but also contributes to diverse and multifaceted societies within a concentrated region. The sediments and soils that come from the mountains provide rich agricultural lands; but settlements are precariously balanced on steep slopes or besides rushing rivers and are subject to geohazards such as landslides, floods, and earthquakes. Furthermore, the climate system is rapidly changing due to practices of industrialized nations, leading to additional challenges. Students will investigate how Earth systems effect and influence society and how human decisions and actions bear consequences on the environment and determine societal risk in the face of geohazards. Particular emphasis is given to study of ethical, low cost, and technologically simple solutions that dovetail with other sustainable development practices.

Learning Outcomes

By the end of the course, students will be able to:

a) Identify landforms such as river terraces, landslides, debris flows, flood plains, and moraines – in the field and via remote sensing;
b) Analyze an area for geohazards and propose mitigation or avoidance strategies;
c) Identify solutions to existing challenges and weigh relative merits of different lines of action (particularly in regard to dovetailing with sustainable development practices).
d) Conduct a field-based landslide and/or earthquake hazard analysis;
e) Compare and contrast challenges and opportunities related to topics such as hydropower, climate change, and water resource management.

Language of Instruction

This course is taught in English, but students will be introduced to Nepali vocabulary related to food, logistics, and simple small talk.

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Course Requirements

Course Schedule

***Please be aware that topics and excursions may vary to take advantage of any emerging events, to accommodate changes in our lecturers' availability, and to respect any changes that would affect student safety. Students will be notified if this occurs.**

Orientation & Introductory Activities (9 hours)

The first four days of the program are the orientation. The next two are travel to the initial field excursion site with educational stops along the way. Out of this about half is devoted to learning that supports the geohazards and human-Earth system interactions component of the program.

Geohazards of the Himalaya - Overview

Series of lectures on topics such earthquake hazards, climate change, and flooding. Exact topics will vary depending on lecturer availability.
Required Reading: Pre-program readings

Nepal Culture and History

Lecture on Nepali culture and history and field trip to cultural/religious site in Kathmandu Valley such as Bhaktapur or Patan.
Required Reading: Pre-program readings

Nepali Language

Daily class sessions to learn basics of Nepali related to travel, food, and small talk.
Required Reading: Lonely Planet Publications, *Nepali Phrasebook*, London: Lonely Planet, 2014 (older versions ok too)

Field trip stops

En route to the field excursion the program makes several stops at relevant sites such as hydropower station, river terraces, or landslide site.
Required Reading: None

Earth and Human Systems Analysis (18 hours)

This module will start at the upstream end of the Annapurna region traverse after the conclusion of *Earth Science Field Methods*. The primary emphasis will be on developing field skills and, as appropriate, augmenting with remote sensing data sets (stereo air photos, satellite imagery, etc.) After an introductory day, the group will travel back down the river valley, this time observing and analyzing geomorphic features, land use, and the ongoing intersections between the Earth and human systems. This will provide a counter point to the analysis on the upstream journey that focused on deciphering the geologic history of the region. Each team of students will carry out on small research project related to one of these themes.

Introduction

Overview lecture on geomorphic and land-use features. Introduction to air photo and satellite image analysis. Students identify research topic.
Required Reading: None

Research project

Student teams carry out small research project on theme of choice and complete a geomorphology and land-use map of the study region.
Required Reading: None

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Final presentations
Student teams give group presentation on research findings.
Required Readings: None

Geohazards Assessment and Engineering Geology (18 hours)
Landslides and flooding present the most constant geohazards in Nepal with several hundred deaths occurring every year, as well as numerous roads blocked and infrastructure damaged. After returning to the road system, students will learn to identify different types of landslides in the field and appropriate low-cost mitigation strategies. They will learn how to conduct a Structure from Motion (SfM) survey of an outcrop in order to produce a high-resolution topographic model, which they will analyze for discontinuities. After completing a kinematic analysis of the likely fracture planes, they will propose a safe road cut design for the outcrop.

Introduction to Geoengineering and Landslide Hazards
Several lectures to introduce the topic. One-day group field excursion to learn basic field methods.
Required Reading: Landslide Field Trip Guide

Field work
Student teams will collect field observations related to landslide hazards and mitigation. Students will conduct an SfM survey to produce high-resolution topographic model of an outcrop.
Required Reading: SfM Methods Manual

Write-up
Students will use data collected in the field to analyze landslide hazard and recommend mitigation steps.
Required Reading: Kinematic Analysis and Road Cut Design readings

Evaluation and Grading Criteria

Description of Assignments
More detailed instructions and grading criteria will be given out at the start of each assignment. The paragraphs below provide general information.

Participation & collaboration: Students must attend ALL program components. Any unexcused absence will result in a minimum of 5% reduction in final course grade. Physically leaving the program will be grounds for dismissal (see Handbook *Conditions of Participation*). However, the participation and collaboration grade rests on much more than merely being present. A-level participation requires attributes such as: coming with all needed materials; daily input to group discussions that includes analysis and/or creativity; active listening and productive responses to comments by others. When students are working in small groups, each person is expected to contribute equally with both physical and mental tasks.

Field notebook and small assignments: High quality field analysis depends on detailed and comprehensive field notes. Invariably students will develop additional questions when it comes time to do a full project write-up and detailed notes will be essential to answer or dismiss these questions. Students will be coached on what these notes require and then evaluated on consistency, accuracy, and completion. Different types of fieldwork may require different sets of observations. In preparation for the larger projects, students may be given smaller practice assignments that should be recorded in field notebooks.

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Earth and human systems analysis: Students will map and analyze intersections between Earth systems and human society. The project will start with an air photo and satellite analysis of landforms (river terraces, landslides, etc.) and human land use. Teams of students will then choose specific topics in the sphere of Earth-human system interactions for detailed field study. They will identify examples of conflicts (i.e. hazards), benefits, and solutions strategies. This perspective of seeing Earth systems through the lens of ongoing human interactions will provide a valuable contrast to the approach taken on the upstream trip, which focused on determining the geologic past. Possible subtopics include: landslides, river control measure, building materials, climate change, road building, hydropower development, water quality, and agricultural placement. Each team will produce geomorphology and land use map and give a presentation. High quality maps will correctly identify observed landforms and detail the field and remote sensing observations used to make determinations. Presentations will contain critical evaluations of: 1) challenges faced by Himalaya societies in living in such a geologically dynamic regions; 2) benefits brought by the dynamic Earth system; 3) examples of existing solutions to potential problems from hazards; and 4) ideas for other solutions or mitigation strategies. Excellent presentations will be concise but clearly communicate the differences and commonalities of the different contributing students.

Geohazards Assessment and Engineering Geology: After the project returns to the road system, the students will conduct a study related to landslides and risk along one or more regions of the road system between Annapurna region and Kathmandu. Students will learn to take field observations of attributes such as rock bedding orientation, rock strength, soil characteristics, water saturation, fault proximity, and slope steepness. They will also learn practical mitigation techniques for Nepal and the realities of risk due to society preparation (or lack thereof). They will also conduct an SfM study of rock discontinuities and design appropriate road cuts that would limit failure and rock falls that reach the road.

Assessment:

Participation & Collaboration	10%
Field notebook & small assignments	10%
Earth and human system analysis	40%
Geohazards Assessment & Engineering Geology	40%

Grading Scale

94-100%	A
90-93%	A-
87-89%	B+
84-86%	B
80-83%	B-
77-79%	C+
74-76%	C
70-73%	C-
67-69%	D+
64-66%	D
below 64	F

Expectations and Policies

In order to best facilitate your learning, my expectations are as follows:

Engage your brain and ask questions

Be ready to contribute actively every day. Success in this program will require active participation.

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Show up prepared
Be on time, have your readings completed, and points in mind for discussion or clarification.

Think critically
This course is designed to help you develop your critical thinking abilities; these life skills will help you analyze, infer, evaluate, and make reasoned judgments related to many facets of life.

All assignments must be completed on the due date/time
Written assignments received after the specified time will be considered late and as such, docked 10% per day. Any written assignments not received by 5 days after the due date will receive a zero. Presentations must be completed at the specified time. Exceptions will only be for serious medical reasons and extensions MUST be arranged before the due date/time.

Comply with academic integrity policies (no plagiarism or cheating, nothing unethical).

Respect differences of opinion (classmates', lecturers, local constituents engaged with on the visits)
You are not expected to agree with everything you hear, but you are expected to listen across difference and consider other perspectives with respect.

Please refer to the SIT Study Abroad handbook for policies on academic integrity, ethics, warning and probation, diversity and disability, sexual harassment and the academic appeals process. Also, refer to the specific information available in the Student Handbook.

Disability Services: For information about and support from Disability Services (DS) to facilitate an accessible educational experience, please contact disabilityservices@sit.edu. Additional information regarding SIT Disability Services can be found on the DS website at:
http://studyabroad.sit.edu/disabilityservices.

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