

# **The Earth GEO 102**

**Department of Geosciences**

**Stony Brook University**

**Instructor of Record: Hanna Nekvasil**

## **PROGRAMMATIC GOAL:**

The primary goal of this course is to provide an overview of the geologic processes that have shaped the Earth, the interrelatedness of these processes, and the nature of the products of these processes. By the end of this course students will be prepared to understand how geologic processes have changed and will continue to change the Earth's surface over time, how processes occurring at depth relate to surface evolution, and which changes in the physical environment can be attributed to anthropomorphic activities.

## **COURSE CONTEXT:**

The focus of this course is introductory context building as it links, through a broad overview, the geological processes will be covered in detail in the required and elective courses for the Geology and Earth and Space Science majors. It has also been designed as a service course to the university community. The overview provided by this course develops scientific literacy and contributes to meeting the need for all to be able to make informed decisions about policies that impact the environment for current and future generations. Because of the diverse contexts for this course, student backgrounds and aptitudes are highly varied. Therefore, the teaching goals are (i) to provide an overview of the Earth as a system comprehensible to the science and non-science student, (ii) to facilitate growth in the ability of students to integrate concepts and predict outcomes of geological processes, and (iii) to foster the ability for the students to communicate concepts to each other. Testing is used to provide an incentive to reinforce concepts in a timely manner, while minimizing the grading penalty common to students with lesser science background and interest.

## **INSTRUCTIONAL COMPONENTS:**

### **A. Concept presentation**

This course is lecture style, using Powerpoint presentations. These presentations are posted on Blackboard ahead of time for students to download to facilitate note-taking and for later study.

### **B. Concept reinforcement**

- i. Bonus clicker quizzes on the material presented after each lecture in open format encouraging students to discuss, debate, and practice expressing their understanding orally to each other.
- ii. Monthly formal clicker quiz on subset of topics covered. More complicated two tiered reasoning required. Open discussion format.

- iii. Hour long in-class examinations. In depth reading and review of lecture notes is fostered by providing exam questions and multiple choice answer selections for study prior to the examination. This provides an incentive to study and allows students to interact with one another in the study process. Examinations are individual and closed to notes and discussion to ensure that each student has the incentive to individually learn the material.

## **C. Concept development**

*The sequence of topics covered in this course greatly differs from what is traditional for this course. Geologic process is emphasized over product, which allows for topics (e.g., mineralogy) that traditionally have been difficult for students to comprehend and retain to be presented piecemeal in the context of a process with multiple opportunities for reinforcement.*

### **I. The early hot Earth**

- i. The formation of the universe, our solar system, and the Earth and Moon
- ii. Core formation and the Earth's magnetic field
- iii. Cooling of the molten exterior
  - Crystallization of minerals*
    - Chemical bonding, stoichiometry, unit cells, igneous silicates
    - Diversification of basaltic magma due to crystallization of minerals
    - Degassing of magma and the formation of an atmosphere
  - Basaltic volcanic landforms*
    - Formation and characteristics
    - Breakdown through mass wasting, mechanical and chemical weathering
  - Transport, sorting, accumulation and modification of sediment by rivers*
  - Lithification of clastic sedimentary rocks*

### **II. The cooling solid Earth**

- i. Mantle upwelling and fracturing the crust
- ii. Brittle behavior of crust, formation of normal faults
- iii. Earthquakes
  - Movement, generation of body and surface waves*
  - Travel times and location of epicenter*
  - Exploring the Earth's interior*
- iv. Cold basalt, the asthenosphere, and reverse faults –the beginning of subduction
- v. Linking extension and subduction..ridge push and/or slab pull
- vi. Decompression partial melting of the mantle and generation of new basalt
- vii. Basalt as a recorder of changes in the magnetic field

### **III. Making continental crust**

- i. Alteration of hot basalt at the seafloor
- ii. Subduction and the formation of amphibolite
- iii. Dehydration and hydrous melting and the formation of andesite
- iv. Buoyancy of island arc andesite
- v. Continental drift
  - Accretion and the formation of mountain belts*
- vi. Metamorphic regimes in mountain belts and the production of metamorphic rocks
  - Changes in minerals as a function of pressure, temperature, and protolith*
  - Changes in rock texture*

#### **IV. Modifying the continental crust**

- i. Glaciers
  - Glacial ice*
    - Mountain glaciers vs. ice sheets
    - Internal flow of glaciers
    - Glacial advance and retreat
  - Erosional features*
  - Depositional features*
  - Rivers basins and Groundwater systems*
  - Pluvial lakes*
- ii. Coasts
  - Erosional features*
  - Sedimentary features*
  - Limestone*
- iii. Deserts

#### **COURSE LOGISTICS:**

The course content is distributed through 2 80-minute professor-given lectures per week. A graduate teaching assistant is available for help with clarification of course content.

#### **EXPECTED COURSE OUTCOMES:**

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

##### **1) Read about a recent earthquake and**

- i. identify the tectonic regime in which it was produced
- ii. indicate how the epicenter was found
- iii. explain the meaning of its magnitude
- iv. predict the nature of other associated hazards, such as tsunami and volcanic eruptions

##### **2) Read about a recent volcanic eruption**

- i. identify the tectonic regime in which it was produced
- ii. predict how explosive it could be
- iii. indicate the nature of pyroclastic deposits it would produce

iv. predict the type of lava compositions that would eventually be produced

**3) Read about global warming and**

- i. discuss natural variation in ice ages over time
- ii. list factors that contribute to climate change

**4) Look at a sedimentary rock, igneous, and metamorphic rock**

- i. discuss the processes that lead to the formation of the mineral grains in it
- ii. indicate in which tectonic environment it may have formed
- ii. recognize the interrelatedness of igneous sedimentary and metamorphic processes.

**GOALS FOR BROADER SKILLS:**

- A) To be able to pull together varied information to answer multi-tiered questions and orally defend his/her answers
- B) Look for interrelatedness of concepts
- C) Increase scientific literacy

**ASSESSMENT OF ATTAINMENT OF COURSE GOALS:**

Student attainment of course goals is assessed through in class quizzes and exams.

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**Disability Support Services (DSS) Statement**

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact Disability Support Services (631) 632-6748 or <http://studentaffairs.stonybrook.edu/dss/>. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential. Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information go to the following website: <http://www.stonybrook.edu/ehs/fire/disabilities/asp>.

**Academic Integrity Statement**

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instance of academic dishonesty to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at <http://www.stonybrook.edu/uaa/academicjudiciary/>

**Critical Incident Statement**

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, and/or inhibits students' ability to learn.

**Class Conduct**

All cell phones, iPods, and other electronic devices should be turned off during class to minimize distractions and interruptions. Class participation, including questions and discussion is encouraged. Please treat all others in a respectful manner appropriate for a university setting.

