Tectonic Geomorphology: Evaluating links between active deformation, climate, and geomorphology.

Course Level: Upper level undergraduate/Graduate

Suggested Prerequisites: Structural Geology, Stratigraphy, Sedimentology, Geophysics, Geomorphology, Meteorology.

The following is an outline of the learning objectives for a multi-disciplinary course in Tectonic Geomorphology taught during Spring 2005 at Texas Tech University.

The outline is followed by a two-part Pre-Curriculum Assessment that would occur during the first class meeting. In the assessment the students are asked to 1) gauge their intuitive and learned understanding of various concepts that will be covered during the semester; and 2) work in groups to develop and present an intuitive conceptual mental model of key processes/concepts that will be discussed over the semester. A list of concepts is included.

Learning Objectives

1) Critical Thinking Skills
   - need to measure student ability to assess:
     - dependent & independent variables
     - observations
     - processes
     - assumptions
     - interpretations

2) Recognizing & Developing Cross-Discipline Linkages
   - measure student ability to recognize and develop links between:
     - processes (e.g., climatic, geomorphic, structural, stratigraphic, geodynamic)
     - feedbacks (e.g., positive/negative feedbacks between climatic and geomorphic processes)
     - evaluating and integrating diverse datasets and observations

3) Graphical & Spatial Analysis
   - measure student ability to recognize/develop correlations, feedbacks, and processes through graphical and spatial analysis
     - Develop conceptual understanding of process-response systems.

4) Verbal/oral Presentation
   - measure student ability to systematically, concisely, and logically present analysis
     - see "Iterative Editing" below
     - see Presentation Rubric below

Pre-Curriculum Assessment

Part 1. Ranking of concept knowledge.
Using the following scale to rank your understanding of various concepts in Tectonic Geomorphology.

Scale
1 = **Excellent** – I can apply my understanding of this concept to a 'real-world' scenario to solve a research problem; I can explain this concept to a science news journalist *and* to a professor.
2 = **Very Good** – I can conceptualize the concept, and can recognize the variables/assumptions but would not feel comfortable applying my understanding to a research problem.
3 = **Good** – I am familiar with this concept and can recognize some of the variables that affect it.
4 = **Fair** – I have heard of this concept and am familiar with the geologic context in which it occurs but would not feel comfortable explaining it to a fellow student.
5 = I am **not familiar** with this concept.

Glacial erosion may control the absolute elevation of mountain ranges.
1 2 3 4 5

Denudation.
1 2 3 4 5

Erosion may drive rock uplift via isostasy.
1 2 3 4 5

Average elevation of a mountain range.
1 2 3 4 5

The maximum elevation of a mountain range may increase with time, while the average elevation may decrease.
1 2 3 4 5

Orographic effect
1 2 3 4 5

Stream Power.
1 2 3 4 5

Variations in precipitation across a mountain range may affect erosion rates through stream power.
1 2 3 4 5

Maximum elevation of a mountain range may be a function of latitude and proximity to oceanic water bodies.
1 2 3 4 5

Steady-state topography.
1 2 3 4 5

Growth-strata as indicators of fold kinematics.
1 2 3 4 5

Balanced, deformed state cross sections.
1 2 3 4 5

Exhumation.
1 2 3 4 5

Surface uplift.
1 2 3 4 5

Rock uplift.
1 2 3 4 5

Mineral closure temperatures.
1 2 3 4 5

Geoid.
1 2 3 4 5

Isotherms.
1 2 3 4 5

Processes of heat transfer.
1 2 3 4 5

Milankovitch Cycles
1 2 3 4 5

Scale

1 = **Excellent** – I can apply my understanding of this concept to a 'real-world' scenario to solve a research problem; I can explain this concept to a science news journalist and to a professor.

2 = **Very Good** – I can conceptualize the concept, and can recognize the variables/assumptions but would not feel comfortable applying my understanding to a research problem.

3 = **Good** – I am familiar with this concept and can recognize some of the variables that affect it.

4 = **Fair** – I have heard of this concept and am familiar with the geologic context in which it occurs but would not feel comfortable explaining it to a fellow student.

5 = I am **not familiar** with this concept.

Eustasy.
1 2 3 4 5

Flexural rigidity.
1 2 3 4 5

Relief.
1 2 3 4 5

Critical Tapered Wedge.
1 2 3 4 5

Geomagnetic timescale.
1 2 3 4 5

Magnetostratigraphy.
1 2 3 4 5

Carbonate Compensation Depth.
1 2 3 4 5

Characteristic Earthquakes.
1 2 3 4 5

Glacial Equilibrium Line.
1 2 3 4 5

Digital Elevation Models.
1 2 3 4 5

Trishear.
1 2 3 4 5

Contour Maps.
1 2 3 4 5

Isopach Maps.
1 2 3 4 5

Rates of Sediment Deposition.
1 2 3 4 5

Scale

1 = **Excellent** – I can apply my understanding of this concept to a 'real-world' scenario to solve a research problem; I can explain this concept to a science news journalist and to a professor.

2 = **Very Good** – I can conceptualize the concept, and can recognize the variables/assumptions but would not feel comfortable applying my understanding to a research problem.

3 = **Good** – I am familiar with this concept and can recognize some of the variables that affect it.

4 = **Fair** – I have heard of this concept and am familiar with the geologic context in which it occurs but would not feel comfortable explaining it to a fellow student.

5 = I am **not familiar** with this concept.

Part 2. A Class Exercise in Graphical and Visual Knowledge.

You will be assigned to a group of three students. Each group will spend 15 minutes formulating and drawing a collective mental model of one of the following concepts or processes. You will then present this to the class.

FEEDBACKS

- Graphically illustrate possible correlations between amount of precipitation, extent of glaciation, erosion rate, erosion volume, relief, distance and elevation for a mountain range such as the Andes, Cascades, or Himalaya. For example, how would a graph of precipitation versus elevation look for the Himalaya from south to north? Actual values for the axes are not necessary. Focus on visualizing what the function might look like. You may draw multiple graphs. Use colors to differentiate potential different functions.

FOLD/THRUST GEOMETRY

- Draw a picture of a fault-bend fold with a hangingwall anticline and a hangingwall flat on a footwall ramp.

THRUST SYSTEMS

- Draw a schematic cross section of a foreland fold and thrust belt produced during continent-continent collision. Annotate any features (thrust faults, foreland, hinterland, etc.) and processes (erosion, rock uplift, exhumation, etc.) that you think might occur in the section.

GEOMORPHIC RATES

- Draw a profile of a bedrock river with distinct strath (bedrock) terraces. Annotate your profile and explain how you would estimate river incision rates.

ISOSTASY

- Graphically illustrate how crustal thickness and mean elevation might change with time if erosion forces isostatic uplift.