Transport Processes in Earth/Environmental Systems (GEOL 390)
Fall 2005

Credits: 3

Prerequisites: physics and calculus; senior or graduate standing in the Earth/environmental sciences or related fields

Class time: TBA

Instructor: David Furbish

Text: none; the course will involve assigned reading from various sources

Content: All Earth/environmental systems evolve because — at a fundamental level — mass, energy and momentum associated with these systems are transported over space. The purpose of this course is to provide an introductory examination of: (i) transport processes that are important in a wide variety of Earth/environmental systems; and (ii) how principles of conservation provide a unifying language that underlies both classic and emerging styles of analyzing how Earth and environmental systems "work." Accordingly, we will apply this unifying language to topics as varied as, for example, magma dynamics and volcanic eruptions, ocean waves and tsunamis, nutrient transport and trophic interactions in rivers, lakes and estuaries, sediment and soil transport, cave evolution, crystal growth and dissolution, river floods, and flow/reactions within rock fractures. In doing so, we will discover numerous, delightful commonalities among these nominally disparate topics; and we will nurture a style of thinking that is a cornerstone of "modeling" the behavior of Earth and environmental systems. Principal course modules will include:

- Continuum versus discrete-particle/cellular concepts;
- Conservation of mass, energy and momentum;
- Constitutive (transport) laws and formulae;
- Complex systems – the philosophy of reductionist versus synthesist viewpoints;
- Advection-diffusion-reaction systems;
- Scaling – interactions among length and time scales;
- Elementary numerical analysis; and
- Applications to selected Earth/environmental systems.

Level/Scope: The course is aimed at senior-level and graduate students majoring in Earth and Environmental Sciences. Students in related fields possessing an interest in, and flare for, interdisciplinary studies are welcome to participate. The course is designed to challenge students to use the math and physics they have previously studied to explore the behavior of simple Earth/environmental systems. Considerable attention will be given to illustrating how to (actually) describe physical problems in mathematical terms.

Grading: Course grades will be based on scores earned for problem sets and a research project with presentation.