New course: Spring 2016…ONE TIME ONLY!

GEOL 410/510: Transport Processes in Earth and Environmental Systems

Prerequisites: physics and calculus; senior or graduate standing in natural sciences or related fields

Class time: Tues/Thurs, 1–2pm, 200 Cascade Hall

Credits: 2

Instructor: David Furbish, Professor, Vanderbilt University

Office hours: There are no regularly scheduled office hours for this course. Drop in if my door is open (Cascade 325A), or send me an email to schedule a meeting (david.j.furbish@vanderbilt.edu).

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

Content: All Earth and 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 and 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 find ourselves in a position to 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 topics will include:

- Physical and thermodynamic properties of fluids and granular materials;
- Conservation of mass, energy and momentum;
- Constitutive (transport) laws and formulae;
- Advection-diffusion-reaction systems;
- Scaling — interactions among length and time scales;
- Complex systems — reducing these to their barest essence;
- Elementary numerical analysis; and
- Applications to selected Earth and environmental systems.

Level/Scope: The course is aimed at senior-level and graduate in natural 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 elements of the behavior of Earth and environmental systems. Considerable attention will be given to illustrating how to (actually) describe physical problems in mathematical terms.

Grading: The course is pass/fail. During the term, I will provide problem sets and suggest mini-research projects for those inclined to purse them...but these will not be graded. Above all, I anticipate that students will bring to class an intellectual fearlessness and an enthusiasm for pursuing a deeper understanding of how Earth and environmental stuff works.