

Winter 2005

<b>Course Number</b>	CEE 410 / 510
<b>Title</b>	Groundwater Contaminant Transport
<b>Section</b>	001
<b>CRN(s)</b>	44841 / 44842
<b>Credits</b>	4
<b>Design Credits</b>	1
<b>Prerequisite(s)</b>	
<b>Days/Time</b>	TR 1400-1550
<b>Location</b>	Room 108, Science Building 2
<b>Final Exam Day/Time</b>	Monday, March 14, 1015 - 1205

<b>Course Website</b>	<a href="http://www.ce.pdx.edu/~gwynn/transport.html">http://www.ce.pdx.edu/~gwynn/transport.html</a>
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<b>Instructor</b>	Gwynn R. Johnson
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<b>Office Hours</b>	Mondays 12:30 – 4:00 pm and by appointment
<b>Mailbox Location</b>	CEE Office, Science Building 2, Room 128

**Required Text or Other Materials:**  
Contaminant Hydrogeology, C.W. Fetter, Macmillan Publishing Company, 1993.

**Recommended References/Optional Text/Supplemental Readings & Resources:**  
 Groundwater Hydraulics and Pollutant Transport, Charbeneau, Prentice Hall, 2000.  
 Hydrology, Rafael L. Bras, Addison-Wesley Publishing, 1990.  
 Physical Hydrology, S.L. Dingman, Macmillan College Publishing, 1994.  
 Physical and Chemical Hydrogeology, P.A. Domenico and F.W. Schwartz, Wiley, 1990  
 Applied Hydrogeology, C.W. Fetter, Macmillan College Publishing, 1994.

**Catalog Course Description:**  
 This course will introduce students to the principles associated with the transport and fate of contaminants in subsurface systems. We will discuss the many factors and processes influencing contaminant transport and will emphasize the impact of these processes on contaminant fate in the environment.

### Course Objectives and Goals

**After completing this course, students should demonstrate the ability to:**

1. Have a good command of the vocabulary (nomenclature) used in the literature to describe contaminant transport through subsurface systems.
2. Mathematically describe physical and chemical processes contributing to the overall fate and transport of solutes through porous media (e.g., mechanical mixing phenomena, diffusive solute flux, and solute retardation)
3. Recognize factors contributing to nonideal solute transport through porous media while describing *ideal* solute transport.
4. Estimate the relative degree of dispersion while assessing the relative degree of nonideality exhibited in transport studies through porous media.
5. Assess the applicability of using Fick's first law to describe a solute's dispersive flux in porous media.
6. Describe the processes contributing to dispersion at various scales of interest (i.e., microscale, macroscale and megascale) for transport studies through porous media.
7. Describe sorption and desorption processes as they contribute to nonideal transport through porous media.

### Course Grading

Assignment	Points Assigned or % of Total Grade	
	CEE 410	CEE 510
HOMEWORK (approximately 5 total)	30	20
MIDTERM (To be announced)	30	30
FINAL	30	30
CLASS PROJECT (To be announced)	Not Required	10

**Please Note:** No make-up exams will be given. Your attendance during scheduled exam periods is required for you to receive a grade for that exam.

**Incompletes:** A grade of "I" is granted by the instructor *only* with prior approval and consent. Criteria are outlined in the PSU Bulletin. **Program requirements:** {for UG courses} The CEE Department requires that junior and senior engineering courses must be completed with a minimum grade of C-, and a student's cumulative PSU GPA must be 2.25 or higher to graduate from the BSCE program.

### Ethics and Professionalism

As future professional engineers you should plan to take the FE Exam (see the Oregon State Board of Examiners for Engineering and Land Surveying at [www.osbeels.org](http://www.osbeels.org)), and you should be familiar with the ASCE Code of Ethics ([www.asce.org/inside/codeofethics.cfm](http://www.asce.org/inside/codeofethics.cfm)), which includes the following:

***Engineers shall act in such a manner as to uphold and enhance the honor, integrity and dignity of the engineering profession.***

The PSU Student Conduct Code prohibits all forms of academic cheating, fraud, and dishonesty. Further details can be found in the PSU Bulletin. Allegations of academic dishonesty may be addressed by the instructor, and/or may be referred to the Office of Student Affairs for action. Acts of academic dishonesty may result a failing grade on the exam or assignment for which the dishonesty occurred, disciplinary probation, suspension or dismissal from the University. The students and the instructor will work together to establish optimal conditions for honorable academic work. Questions about academic honesty may be directed to the Office of Student Affairs (<http://www.ess.pdx.edu/osa/>).

## **Resources**

As a PSU student, you have numerous resources at your disposal. Please take advantage of them while you are here. A small sample is listed below:

- CE Website (includes program info, job listings, etc.): <http://www.cee.pdx.edu>
- Career Center: <http://www.career.pdx.edu/>
- Center for Student Health & Counseling: <http://www.shac.pdx.edu/>
- The Writing Center: <http://www.writingcenter.pdx.edu/>
- PSU Disability Resource Center: 435 Smith Memorial Union

Note: The PSU Disability Resource Center is available to help students with academic accommodations. If you are a student who has need for test-taking, note-taking or other assistance, please visit the DRC and notify the instructor at the beginning of the term.

### **Introduction to Library and Literature Research**

With the advent of the Internet it is very tempting to think that all necessary resources for a term project will be available in full text after typing in a few words at Google.com. This is not the case. You will often need to go to the library, use real library search tools and access real books and articles contained in refereed/archival journals.

Be sure to make use of the Vikat library catalog. Go to the PSU library home page at <http://www.lib.pdx.edu/>. Also available on the library home page are Full Text Electronic Journals: <http://www.lib.pdx.edu/~bvws/bytitle.html>, and a list of on-line Databases: <http://www.lib.pdx.edu/resources/databases/databases.html>. Try EI Compendex (<http://www.ei.org/ev2/ev2.home>) and Lexis-Nexis. Note that access to these databases is free for PSU students, but you must be using a computer on campus or via a dial-in service. See <http://www.lib.pdx.edu/services/distance/proxyserver.html> for instructions on how to gain off-campus access using a proxy server.

### **Campus Safety**

The University considers student safety paramount. The Campus Public Safety Office is open 24 hours a day to assist with personal safety, crime prevention and security escort services. Call 503-725-4407 for more information. For Campus emergencies call 503-725-4404.

Course Schedule – Groundwater Contaminant Transport Winter Term 2005

Course Topics Reference

Week 1.	Syllabus, Introductions and course overview Transport behavior, transport parameters. Basic solute transport equation. Advection.	Ch 1 Ch 2
Week 2.	Microscale diffusion and dispersion. Solute Transport: Structured media.	Ch 2 & 4
Week 3.	Solute Transport: Physically heterogeneous media, Variably saturated media	Ch 2
Week 4.	Solute Transport: Sorption, Retardation, Nonlinear Sorption, Kinetic Sorption	Ch 3
Week 5.	Solute Transport: Transformation Reactions, Coupled Processes, Chemical/Biological Heterogeneity	Ch 3
<b>February 8 Midterm Exam</b>		
Week 7.	Field-scale Transport of Reactive Solutes	Case Study
Week 8.	Facilitated Transport: Colloids, Cosolvents. Gas-phase Flow in Porous Media	Ch 3
Week 9.	Flow of immiscible liquids in porous media. Residual Saturation: Retention and Displacement, Partitioning and Dissolution	Ch 5
Week 10	Implications for subsurface remediation	Ch 9
<b>March 14 Cumulative Final Exam</b>		