

**NRES 917 & GEOL 917**  
**Environmental Isotope Hydrology**  
**Spring 2011**

Schedule: Lecture: 9:30 – 10:45 am Tuesday/Thursday. Room: Hardin Hall 202 (East Campus)

**INSTRUCTOR:**

F. Edwin Harvey  
904 Hardin Hall  
Phone: 472-8237  
E-mail: feharvey1@unl.edu

**TEXT:**

In addition to course notes to be handed out in class, the following textbooks are required or recommended.

- *Environmental Isotopes in Hydrogeology*, 1997, Clark, I. and Fritz, P., Lewis Publishers, CRC Press, Boca Raton, FL, 328 p. (Required)
- *Isotope Tracers in Catchment Hydrology*, 1998, Kendall, C. and J.J. McDonnell, Elsevier, New York, N.Y., 839 p. (Strongly Recommended)
  
- *Stable Isotopes in Ecology and Environmental Science*, 1994, Lajtha, K. and R.H. Michener, Blackwell Scientific Publications, Oxford, England, 316 p. (In Library)
- *Handbook of Environmental Isotope Geochemistry*, 1980, Fritz, P. and Fontes, J.Ch., Elsevier Scientific Publishing Company, New York, N.Y., Volume 1, 545 p. (In Library)
- *Handbook of Environmental Isotope Geochemistry*, 1980, Fritz, P. and Fontes, J.Ch., Elsevier Scientific Publishing Company, New York, N.Y., Volume 2, 557 p. (In Library)

**COURSE DESCRIPTION:**

The theory and use of stable, radiogenic and radioactive isotopes in hydrologic, ecologic and natural resource studies. Abundance and variation of the stable isotopes of oxygen, hydrogen, carbon, sulphur, chlorine, nitrogen and strontium. Application of isotopes to determine water origin, movement, geochemical history, recharge age and residence time, and to delineate contaminant sources and solute migration. Additional applications will also be covered including uses in plant-carbon cycling, ecosystem, paleoclimate, and wildlife migrations studies.

**METHOD:**

(a) Transfer of Information

Lectures will be presented twice weekly for approximately 80 minutes each (see attached syllabi). The lecture portion of the course will introduce the history of isotopes in hydrologic studies, the basic mathematical, physical and chemical theory and practical and applied

sampling and analysis techniques. Periodic assignments will be given to illustrate concepts and give students practice with interpretation of data. Students will select topics of interest and assign papers for the class to read and discuss. A field trip during the week prior to final exams will visit the Water Sciences Laboratory to examine mass spectrometers and see demonstrations of various isotope analysis methods.

(b) Evaluation of Information

The lecture portion of this course will be graded based on participation in classroom discussions and on completion of homework and reading assignments.

**GRADING:**

	Percent of grade	In general, the following grading system will apply:
Attendance/Participation	50	A+ 90-100%
Homework	25	A 93-96
Student Project/Presentation	<u>25</u>	A- 90-92
	100	B+ 87-89
		B 83-86
		B- 80-82
		C <80

Class participation is expected. Final grades will be reduced up to 5 percentage points if participation is less than satisfactory.

**Please avoid the annoyance of cell phone use and ringing in class.**

**ATTENDANCE POLICY:**

The attendance policy as listed in the schedule of classes for UNL will be adhered to. Students are responsible for the material presented in lecture or laboratory periods. It is your responsibility to acquire lecture notes, handouts or exercises for missed class periods.

**CHEATING/PLAGIARISM:**

Please review Section 4 of UNL's Student Code of Conduct for definitions and warnings against cheating and plagiarism. UNL's policy on Academic Dishonesty states that a student may receive a sanction as severe as removal from a course with a failing grade for any type of Academic Dishonesty. My policy is one of no tolerance. If you are caught cheating or plagiarizing you will be removed from the course and receive a failing grade. Remember that plagiarism goes beyond copying someone else's work "word-for-word". It includes using ideas without proper citation. It is essential, therefore, that you acknowledge the ideas of other

scientists (including your classmates) in all of your written work and reports. Failing to properly cite ideas is as critical as copying your friend's homework.

**FIFTEENTH WEEK POLICY:**

This course adheres to UNL's policy, previously referred to as "Dead Week Policy". The policy states:

*"Final examinations for full semester classes are to be given ONLY at the regularly scheduled time as published in the Official Schedule of Classes or at another time DURING FINALS WEEK mutually agreeable to all concerned.*

*"The only examinations that may be given during the last week (15<sup>th</sup> week) of classes are: laboratory practical examinations, make-up or repeat examinations, and self-paced examinations. However, the following must be applied:*

*"Projects, papers, and speeches scheduled for completion during the last week (15<sup>th</sup> week) of classes must have been assigned in writing by the end of the eighth week. This stipulation refers to the project and its scope, but not the topic. Moreover, ALL requirements, except for the final exam, must be completed no later than Wednesday of the fifteenth week. However, if the instructor has assigned a project, paper, or speech by the eighth week to replace the final, then the project, paper, or speech may be completed any time in the 15<sup>th</sup> week or finals. The exception to this is a class meeting one day a week on a Thursday or Friday for which all policies/requirements are shifted to either a Thursday or Friday, respectively."*

**Tentative Lecture Syllabus:**

<b>Dates</b>	<b>Lecture Topic</b>	<b>Specific Concepts</b>	<b>Assigned Reading</b>
Jan 11	NO CLASS – Snow Day		
Jan 13	Introduction to Environmental Isotopes in Hydrology:	Elements, Nuclides, Isotopes, Standards and Measurement Techniques, Isotope Fractionation, Craig's Meteoric Water Line, Partitioning of Isotopes in the Hydrologic Cycle	Textbook Ch. 1
Jan 18 & 20	Tracing the Hydrologic Cycle	Deuterium Excess and Source Identification, Condensation/Precipitation, Rayleigh Distillation, Evaporation, T- $\delta^{18}\text{O}$ Correlation, Local Effects on T- $\delta^{18}\text{O}$ , Ice Cores and Paleotemperature	Textbook Ch 2 & 3
Jan 25 & 27	Surface and Ground Water Studies	Recharge, Hydrograph Separation, Mixing, Groundwater-Surface water interaction, groundwater flow	Textbook Ch 4
Feb 1 & 3	Tracing the Inorganic Carbon Cycle	Carbonate Geochemistry, Carbon-13 in the Carbonate System, Evolution of Carbon in Waters	Textbook Ch 5
Feb 8 & 10	Using Stable Isotopes in Water Quality Studies	Sulfur Cycle and $^{34}\text{S}$ , Nitrogen Cycle and $^{15}\text{N}$ , Chlorine Cycle and $^{37}\text{Cl}$	Textbook Ch 6 & 9
Feb 15 & 17	Dating Modern Groundwaters	Groundwater "Age" and Stable Isotopes,	Textbook Ch 7

		Tritium/Tritium-He	
Feb 22 & 24	Dating Modern Groundwaters	$^{85}\text{Kr}$ , $^{39}\text{Ar}$ and $^{32}\text{Si}$	Textbook Ch 7
Mar 1 & 3	Dating Old Groundwaters	Radiocarbon dating, Carbonate Dissolution Correction, $^{14}\text{C}$ Complications, Carbon Dating of Organic Carbon	Textbook Ch 8
Mar 8 & 10	Dating Old Groundwaters	Radiocarbon Continued, Chlorine-36 Dating, Uranium Decay Series, $^{226}\text{Ra}$ & $^{222}\text{Rn}$	Textbook Ch 8
Mar 15 & 17	Radiogenic Strontium and Other Miscellaneous Isotopes	Strontium, Boron, Lithium, Calcium, Iron, Others	Textbook Ch 9 (p 260) and Handouts
Mar 22 & 24	<b>NO CLASS THIS WEEK</b>	Spring Break	Students guide to Daytona Beach Night Spots
Mar 29 & 31	The Practical Side of Environmental Isotopes	Applied Examples of How to Use Isotopes	Handouts
Apr 5	Guest Lecture: <i>John Gates</i> <i>UNL Earth &amp; Atmospheric Sciences</i>	Lake Evaporation	Handouts
April 7	Guest Lecture: <i>TBD</i>	TBD	
Apr 12	Guest Lecture: <i>Larkin Powell</i> <i>UNL School of Natural Resources</i>	Using Stable Isotopes to Track Animal Migration Patterns	Handouts
Apr 14	Guest Lecture: <i>Randy Stotler</i> <i>Kansas Geological Survey</i>	Standing in Your Aquifer: Stable and Radiogenic Isotope Applications in Atypical Hydrogeologic Settings	Handouts

Apr 19 & 21	Guest Lectures: <i>Diego Riveros-Iregui</i> <i>UNL School of Natural Resources</i>	Isotope eco-hydrology	Textbook Ch 5 Handouts
Apr 26 (If Needed)	Assigned Reading and Discussion	Student Papers/Lectures	Assigned Papers
Apr 28	Field Trip Water Sciences Laboratory	Mass Spectrometer Demonstration	Textbook Ch 1 & 10
May 2	<b>NO CLASS THIS WEEK</b> <i>(and no final exam either)</i>	Relax... study for the exams in your other courses	National Geographic Adventures Guide to Summer Vacation Hot Spots