WINONA STATE UNIVERSITY
PROPOSAL FOR UNIVERSITY STUDIES COURSES

Department _____GEOSCIENCE___________________________________ Date ____11/01/04__________

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>420</td>
<td>Applied Hydrogeology</td>
<td>4</td>
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</tbody>
</table>

This proposal is for a(n) __XX__ Undergraduate Course

Applies to: __XX__ Major    __XX__ Minor

__XX__ Required    __XX__ Elective

University Studies (A course may be approved to satisfy only one set of outcomes.):

<table>
<thead>
<tr>
<th>Basic Skills:</th>
<th>Arts &amp; Science Core:</th>
<th>Unity and Diversity:</th>
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</thead>
<tbody>
<tr>
<td>1. College Reading and Writing</td>
<td>1. Humanities</td>
<td>1. Critical Analysis</td>
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Flagged Courses:

<table>
<thead>
<tr>
<th>1. Writing</th>
<th>____ 2. Oral Communication</th>
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<tbody>
<tr>
<td>____ XX__ b. Critical Analysis</td>
<td>____ b. Critical Analysis</td>
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Prerequisites _____ GEOS 240 and Math 155

Provide the following information (attach materials to this proposal):

Please see “Directions for the Department” on previous page for material to be submitted.

Attach a University Studies Approval Form.

Department Contact Person for this Proposal:

_Toby Dogwiler___________________________ _____x5267________tdogwiler@winona.edu_____
# WINONA STATE UNIVERSITY
## UNIVERSITY STUDIES APPROVAL FORM

Routing form for University Studies Course approval.  

<table>
<thead>
<tr>
<th>Department Recommendation</th>
<th>Approved</th>
<th>Disapproved</th>
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<tbody>
<tr>
<td>Department Chair</td>
<td>Date</td>
<td>e-mail address</td>
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<tr>
<th>Dean’s Recommendation</th>
<th>Approved</th>
<th>Disapproved*</th>
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<tbody>
<tr>
<td>Dean of College</td>
<td>Date</td>
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*In the case of a dean’s recommendation to disapprove a proposal, a written rationale for the recommendation to disapprove shall be provided to the University Studies Subcommittee.

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<tr>
<th>USS Recommendation</th>
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<tr>
<td>University Studies Director</td>
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<th>A2C2 Recommendation</th>
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<tbody>
<tr>
<td>Chair of A2C2</td>
<td>Date</td>
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<tr>
<th>Faculty Senate Recommendation</th>
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<tbody>
<tr>
<td>President of Faculty Senate</td>
<td>Date</td>
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<tr>
<th>Academic Vice President Recommendation</th>
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<tr>
<td>Academic Vice President</td>
<td>Date</td>
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<tr>
<th>Decision of President</th>
<th>Approved</th>
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<tr>
<td>President</td>
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Please forward to Registrar.

Registrar | Date entered |
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Please notify department chair via e-mail that curricular change has been recorded.
Narrative for faculty colleagues discussing how GEOS 420 will address the goals of the Critical Analysis Flag requirement in the University Studies Program

From a scientist's perspective, critical analysis skills are important because they are central to the nature of science as a discipline and form the basis for the practice of science as a career. The work of science is to observe, categorize, and explain collected data. Students must learn how to recognize and evaluate data (evidence), use those data to test the validity of hypotheses, and then evaluate those results within the context of predominant scientific paradigms.

The vast majority of scientific knowledge is communicated through relatively short (4-20 page) journal articles. Because of their brevity, journal articles must be concise, yet convey the essence of the research results and their implications in such a way that other scientist can ascertain the methodologies used and the validity of the interpretations. Thus, it is essential that scientist be able to efficiently analyze journal articles and evaluate the objectives, hypotheses, methodologies, results, and conclusions.

This is important from two standpoints. Firstly, this is how scientists obtain and categorize new information and discoveries. Secondly, through the peer review process, scientists judge the merits of new work and filter valuable contributions to the field from irreproducible, sub-standard research results. Effectively reading and processing scientific journal articles is a skill that most upper-level undergraduate science majors are lacking. Just as it is important for science majors to practice and refine scientific writing skills, they need instruction and guidance in developing scientific reading skills.

Becoming adept at analyzing data and processing scientific journal articles requires keen critical analysis skills. In GEOS 420 Applied Hydrogeology, students will achieve this proficiency by meeting the following requirements outlined for the Critical Analysis Flag in the University Studies Program. These requirements are also specifically addressed in detail in the University Studies Outcomes section of the attached sample syllabus:

A. Recognize and evaluate appropriate evidence to advance a claim
Students will individually analyze at least two journal articles over the course of the semester using a framework outlined by the instructor. In a written analysis, the student will describe the purpose and hypotheses of the research and discuss if the methods utilized by the authors were appropriate. The student will also be required to discuss the authors’ interpretation of the results and to consider if alternative explanations exist.

For each featured article analyzed by a student, they will also have to read related articles which informed and influenced their primary article. The student will present this contextual information to the class as a brief summary and then lead a 10-15 minute class discussion of the primary article (which was also read by their classmates). This very structured approach to preparing for and executing the class discussion is designed to help the student understand the work, evaluate its validity, and gain confidence in relating the information to peers.

Students will also practice this skill through the analysis and interpretation of empirical data that they collect as part of laboratory exercises or that the instructor provides as part of homework exercises or exams.

B. Apply critical analytical skills in making decisions or in advancing a theoretical position
A large emphasis will be placed on forcing students to identify and assess the hypotheses presented in the literature they read or that they develop themselves to explain data collected as part of laboratory exercises. Students will be encouraged to consider if hypotheses are testable and if the methods described do in fact offer a means of testing the hypotheses. Finally, students will be required to independently evaluate the data and judge if their conclusions about the data match those presented in the literature.

C. Evaluate alternative arguments, decision strategies, or theories within a systematic framework.
Consideration of alternative hypotheses and theories is the basis of the scientific process. A healthy skepticism is an essentially trait for scientists. As such, student will be encouraged to think of and explore alternative explanations to the interpretations presented in the literature and by the instructor. Then they will be required to evaluate their own alternative hypotheses in the same way they evaluated the original hypotheses they encountered in the literature.
A. Provide a Description of the Course

Sample Syllabus

**Applied Hydrogeology (Geoscience 420)**

Spring 2005  
Lecture: T/Th 12:30-1:50  
Laboratory: Thurs 2:00-4:50

University Studies: Critical Analysis Flag

Office Hours: TBA. *Feel free to drop by my office at other times and I will be happy to meet with you if I am not otherwise busy.*

**Catalog Description**

420 – Applied Hydrogeology—4 S.H.

Application of hydrologic principles to ground-water flow problems, aqueous geochemistry, and contaminant studies. Techniques of water-well development, aquifer tests, determination of ground-water chemistry. Use of computer models and other analytical tools. Lecture and Laboratory. Prerequisite: Geos 240 and Math 155. Offered alternate years in the spring semester.

**Instructor**

Dr. Toby Dogwiler  
Pasteur Hall 114-A  
x5267  
tdogwiler@winona.edu

**Text**


**Additional Resources**

We will rely heavily on the reading of primary literature in this course. We will review how to access the GeoRef databases through the library web site. Additionally, you should be aware of the following journals: Water Resources Research, Journal of Hydrology, Geomorphology, Hydrogeology, and Earth Surface Processes.


**Assessment**

**Exams**

<table>
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<th>Exam</th>
<th>Weight</th>
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<tr>
<td>Mid-Term Exam</td>
<td>20%</td>
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<tr>
<td>Final Exam</td>
<td>20%</td>
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**Literature Discussions**

Each student will lead two discussions of works from the primary literature. Students will choose appropriate articles in consultation with the instructor. The discussion leader will be responsible for providing a brief (5 minute) discussion to the class of other background literature that has a bearing on the featured articles. The leader will then be responsible for facilitating a discussion 10-15 minute class discussion of the article. The leader should be prepared to pose...
challenging questions to the class to help stimulate discourse. At least one day prior to the discussion, the discussion leader will turn a summary analysis of the key components of the article as described in section 1 (i-v) of the Critical Analysis Flag learning outcomes outlined below. 20%

**Laboratory Exercises**

Laboratory Exercises, Assignments, Field Trips 40%
(incl. assignments, reports, student presentations, required field trips)

Total 100%

**Policies**

- Participation in Hydro Days (mid-April) is required.
- There will be another required weekend field trip to Bloomington, Illinois in March.
- Attendance to lectures is crucial to success in this course and is mandatory.
- Attendance to laboratories is mandatory. Labs should be missed in only the direst of circumstances. Simply being sick is not sufficient excuse to miss a lab. Labs are difficult, and usually impossible, to make-up. The laboratory is worth 25% of your final grade. If you miss a lab (unexcused) you will be penalized 20% (i.e, 5% of the 25% value) of your lab grade. Nonetheless, you will still be responsible for completing any lab assignments and any portion of the exams related to the missed lab. Missing 2 or more labs will result in automatic failure of the course.
- Attendance to exams is mandatory. In order to make-up a missed exam you will have to provide me with a written excuse and supporting documentation. All missed exams must be made-up within 7 calendar days and the onus is on you to see me to schedule the exam. Otherwise, you will receive a zero (0) for that exam. Creating a make-up exam is inconvenient for me—and will result in an exam that you will likely enjoy less than the regular exam.
- All work in this course must be your own. At times we will work in groups but in the end you will complete your own “end product” to turn in for evaluation. Any cheating will be referred to the proper campus authorities and will result in a zero (0) for that assignment, test, or lab and failure of the course.
- Late homework will be penalized 15% per day, including the day it was originally due.
- If you need to contact me outside of class for any reason the burden of communication is upon you. If we are playing “phone tag” you are always “it”. I will respond to e-mails promptly through the week and on Monday morning if received over the weekend.

**Laboratory Logistics**

- Please dress for the weather. At times we will get wet and muddy in the field. You may want to consider purchasing a pair of inexpensive hip waders.
- When we are in the field please adhere to my directions and requests. Think safety—both your own and for those around you. Most importantly always use your common sense and never do anything that you deem to be unsafe. If you find yourself in a situation that makes you uncomfortable stop immediately and talk to me.

**Course Outline**

1) Introduction to Hydrogeology
   a) What’s in a name?
      i) Hydrogeology, hydrology, etc.
   b) History of the discipline
      i) H. D’arcy and other pioneers

3) Groundwater
   a) The Geology of Groundwater
   b) Aquifers
      i) Recharge

University Studies Proposal
Critical Analysis Flag
University Studies Outcomes

Critical Analysis Flag

Courses that merit the Critical Analysis Flag make essential use throughout the semester of proper techniques for analyzing the structure and validity of arguments, as opposed to techniques for examining the factual validity of, or the psychological or socioeconomic bases for, the premises of an argument. Furthermore, the overall grade for the course must depend significantly on the proper use of such techniques.

The following learning outcomes are associated with the Critical Analysis Flag:

a. recognize and evaluate appropriate evidence to advance a claim;

b. apply critical analytical skills in making decisions or in advancing a theoretical position;

and

c. evaluate alternative arguments, decision strategies, or theories within a systematic framework.

In Applied Hydrogeology we will accomplish these outcomes through the following learning activities (italicized letters correlate to the application of the above outcomes):

1) Student-led discussions of primary literature (journal articles) dealing with various aspects of geomorphology. The results of almost all technical geologic research is reported in the form of short (3-25 pages) journal articles. Most undergraduates have a difficult time reading and understanding the information presented in this type of written communication. I will help you develop a strategy for breaking down a typical journal article and learning how to extract several key pieces of information:

i. The purpose of the research. What is the problem the authors set out to study and answer [a]?
ii. The hypothesis(es) of the research. A hypothesis is clearly distinguishable from the purpose or problem because it is a specific testable prediction \([b]\). Good scientific literature will include a clearly stated hypothesis and perhaps multiple hypotheses \([b,c]\). The first critical test of the validity of a scientific paper is: will determining the validity of the proposed hypothesis lend insight toward answering the general problem the authors have presented \([a,c]\).

iii. What are the methods? Whether the methodology is simple and straightforward or complex, the authors should demonstrate that the methods they utilized were appropriate for evaluating the validity of their original hypothesis \([c]\).

iv. Results. The authors should present the results unvarnished—that is, in such a way that you can analyze them for yourself without their interpretation or filtration. The key question is: are the results reasonable \([a]\)?

v. Discussion/Conclusion: Do you agree with the author’s interpretation of the results \([a]\)? Furthermore, and of critical importance, do the results provide a means to evaluate the author’s hypothesis \([a]\)? Can you think of alternate interpretations \([b,c]\)? Did the authors address those or other possibilities \([c]\).

By analyzing literature in this manner you will be able to evaluate the science presented in the paper and the significance of the results.

2) Hydrogeology is a very quantitative discipline. The most common type of scientific reasoning utilized in hydrogeology, and the geosciences in general, is empiricism. The empirical approach is a powerful way to analyze natural systems where it is difficult to control all the variables. Thus, laboratory exercises in this course will involve collecting and analyzing empirical data sets. You will be asked to evaluate these data and extrapolate what they tell us about hydrogeologic processes and compare your results and analyses to those in published investigations \([a,b,c]\).

3) Exams in this course will be subjective. Commonly, I will give you a data set and/or graphs (usually from journal articles) and you will be asked to use those data to answer a series of questions or formulate an explanation of an observed phenomena \([a,b,c]\).

**Disabilities:**
If you have a physical or cognitive disability, please come talk to me as soon as possible so that we can discuss how best to accommodate your needs.