Instructor: Peter Carlson

Prerequisites: Introductory Biology (BIO 151, BIO 152 or equivalent), or Environmental Science, or have permission of the instructor.

Course Description
Drawing on a 100-day canoe expedition down the Mississippi River, this course provides an introduction to the structure and functions of streams and rivers and the interactions between aquatic systems and human communities. Students in the course will explore the physical, chemical, and biological characteristics of these critical ecosystems. Our examination of streams and rivers will be from an ecological perspective with a focus on the implications for management and policy. This course is designed for well-prepared undergraduate with an interest in environmental studies, natural resources, aquatic ecology, and watershed sciences.

Students will develop an “ecosystem approach” understanding of the structure and function of lotic systems across a wide range of circumstances, including services they provide to humans, past and present consequences of human activities and infrastructure, and the potential for restoration. By field sampling a set of eight preselected streams across environmental gradients, students will gain hands-on experience in equipment and methods for collecting abiotic and biotic data commonly used in stream research and management. Training on stream and river taxonomy will occur during labs twice a week by use of microscopes and taxonomic keys. Students will process, identify and discuss organisms collected from the sampling sites as well as samples taken opportunistically along the river. Daily observations along the river and analysis of data collected by the students are combined with assigned weekly readings and structured discussions. Additionally, daily teaching will occur on an individual basis or in small student groups along the river, e.g. discussions while traveling within the canoes, at the campsite, or during any of the frequent site visits and guest lectures.

Learning Objectives
1. Become familiar with the taxonomy and the use of keys for the microbes, plants, and animals that inhabit streams and their life history adaptations to the stream environment.
2. Become familiar with field research methods and equipment commonly used in rivers and streams.
3. Explore fluvial processes of erosion, transport, deposition and chemistry. Appreciate important food web interactions from microhabitat to watershed scales and the significance of lateral and longitudinal connectivity for energy flows.
4. Become conversant with the primary literature and underlying theory in stream ecology.
5. Explore critical ecological functions of streams and appreciate the services they provide.
6. Consider consequences of past and present human activities on the structure and function of stream and river ecosystems.
7. Examine efficacy of various restoration measures including novel concepts.
8. Apply and compare basic biotic (e.g., taxonomic and functional traits metrics) and abiotic (e.g., water chemistry) indicators of river health and analytical techniques associated with stream research.

Laboratory
Given that the course takes place while travelling the length of the Mississippi River, field lab exercises and field observation will be central to the course. Laboratory exercises are designed to complement lectures and provide hands-on application of concepts, calculations, and methods used in stream and river ecology.

Required Readings

Readings comprised from various literature resources; internet, book chapters, published articles available on the shared Google Drive.

Course Requirements
The grading philosophy in this course is to provide multiple opportunities to demonstrate your knowledge and understanding of the materials instead of putting lots of emphasis on a few tests. Operationally, this translates into multiple tests, each of which covers 5-6 lectures, laboratory exercises, 1-2 in-class exercises, and occasional opportunities for supplemental credit.

Required assignments and their percent contribution to the final grade are:
- Midterm: 25%
- Quizzes and Laboratory exercises (every 2 weeks) 20%
- Field Notes: 25%
- Final Exam: 30%

Weekly Schedule, Activities and Assignments
Description of weekly literature, labs, and week of midterm and final exams. Weekly organized discussion/lectures will be directly related to and continually build on readings assigned as well as integrated with lab work.

Pre-Departure:
LITERATURE: Introduction to aquatic ecology; Chapter 1 *Stream Ecology: Structure and Function of Running Waters*
Week 1:
LITERATURE: Introduction to the water cycle and streams, processes of fluvial hydrology and geomorphology
  – Chapters 2 and 3 *Stream Ecology: Structure and Function of Running Waters*.

LAB 1: Stream field sampling methods #1 on Big River including calculation of discharge, sampling and identification of collected macroinvertebrates, macrophytes, and other important organisms; stream habitat mapping, quantification of riparian habitat structure, etc. Daily stream and river collection, observation, discussion (i.e. life histories, habitat associations, etc.), and identification of organisms using taxonomic keys; observations and discussions of fluvial hydrology and geomorphology; observations and discussions of human activities and infrastructure and their impacts on the river. Visit to MN DNR mussel propagation and restoration research station near Hok-Si-La campground on Lake Pepin. Students are introduced to why and how mussel research and restoration takes place along the Upper Mississippi River and its tributaries. Discussions include mussel diversity and the unique life histories of individual species.

Week 2:
Nobel Peace Prize Forum, including site visits to two farms (Living Greens aeroponic farming, and the Main Street Project, Regenerative Agriculture).

Week 3:
LITERATURE: Freshwater ecosystems and biodiversity from a global perspective

LAB 2: Stream field sampling (#2) methods on Pine Creek including calculation of discharge, sampling and identification of collected macroinvertebrates, macrophytes, and other important organisms; stream habitat mapping, quantification of riparian habitat structure, etc. Stream and river collection, observation, discussion (i.e. life histories, habitat associations, etc.), and identification of organisms using taxonomic keys; observations and discussions of fluvial hydrology and geomorphology; observations and discussions of human activities and infrastructure and their impacts on the river.

Week 4:
LITERATURE: Stream classification and the River Continuum Concept

LAB 3: Stream and river collection, observation, discussion (i.e. life histories, habitat associations, etc.), and identification of organisms using taxonomic keys; observations and discussions of fluvial hydrology and geomorphology; observations and discussions of human activities and infrastructure and their impacts on the river. Stream field sampling #3 on Sandy Creek (final cold water stream in Driftless area) with students rotating to different teams to learn different techniques.

LAB QUIZ on identification of common mussels and benthic macroinvertebrates
Week 5:
LITERATURE:

LAB 4: Guest lecture and discussion with Jared McGovern, Senior Education Manager on stream ecology and restoration projects run through the National Mississippi River Museum and Aquarium; wetland restoration projects at Sunfish Lake, O'Leary Lake and/or Mud Lake; discussion of river fish populations and dynamics with aquarium staff and mussel restoration projects.

Lab 5: Stream sampling # 4 at Catfish Creek in Dubuque; significant restoration project in an urban area. Study impact of stream restoration practices.

Week 6:
LITERATURE:
- Chapters 8 and 9 Stream Ecology: Structure and Function of Running Waters.

LAB 6: Guest lab with Prof. Reuben Heine (Augustana College, Rock Island) Dendrogeomorphology on river islands; core sampling and calculation of tree age and sediment deposition or erosion rates; and historical geography with Prof. Matt Fockler using USACE photos taken in surveys before construction of the locks and dams.

Week 7:
LITERATURE: Understanding diversity and diversity metrics

LAB 7: Stream sampling # 5 at Camp Creek (warm water stream). Introduction to various biotic metrics and indices including their calculation and application using data from organisms collected during stream sampling.

Study guide for Midterm distributed

Week 8:
LITERATURE:
LAB 8: Electrofishing and gill net surveys with Jim Lamer and staff from the Kibbe Research Station (Southern Illinois University); impact of invasive species; techniques for assessing health of native fish populations.

LAB 9: Stream sampling # 6 at Buffalo Creek

Week 9:
MIDTERM EXAM

LAB 10: Guest lab with Natalie Marioni of the National Great River Research and Education Center (NGRREC); potential topics include tagging and tracking of turtles; prairie restoration; discussion with water quality technicians on ongoing water quality monitoring and meta-analysis.

Week 10:
LITERATURE:

LAB 11: Stream sampling # 7 in urban area with significant impacts; River des Peres Drainage Channel in St. Louis; Stream sampling # 8 at Glaize Creek near Kimmswick, MO. Predicting, analyzing, interrupting results, and discussing data collected from streams using basic statistical methods.

Week 11:
LITERATURE: A review of stream-riparian resource transfers and the impacts of anthropogenic disturbance.

LAB 12: Stream sampling # 9 at Brazeau Creek near Cape Girardeau

LAB QUIZ on identification of common macrophytes and algae

Week 12:
LITERATURE:

LAB 13: Entering and analyzing stream monitoring data; basic forms of statistical analysis; research design for comparative study of watersheds.
Week 13:
LITERATURE:

LAB 14: Analyses and discussion of the full data set from the eight streams sampled, included are real data of catchment land use, riparian land use, annual discharge, lithology type, etc. for each of the streams sampled.

Study guide for final exam distributed

Week 14:
Review

Week 15:
FINAL EXAM

Additional Comments

Explanation of Grades
Augsburg University uses a numerical grading system using the following definitions:

<table>
<thead>
<tr>
<th>Grade</th>
<th>G.P.</th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>4.00</td>
<td>95-100% Highest standard of excellence; Goes above and beyond stated expectations; Deep integration of discussions, lections, readings and/or service learning in assignments.</td>
</tr>
<tr>
<td>A-</td>
<td>3.67</td>
<td>93-94%</td>
</tr>
<tr>
<td>B+</td>
<td>3.33</td>
<td>90-92%</td>
</tr>
<tr>
<td>B</td>
<td>3.00</td>
<td>86-89% Above basic course requirements. Some integration of class discussion, lecture, theory and/or service learning in assignments.</td>
</tr>
<tr>
<td>B-</td>
<td>2.67</td>
<td>84-85%</td>
</tr>
<tr>
<td>C+</td>
<td>2.33</td>
<td>81-83%</td>
</tr>
<tr>
<td>C</td>
<td>2.00</td>
<td>77-80% Basic standards and expectations for course met; minimum integration of class discussion, lecture, theory and/or service learning in assignments. Course grades falling below 2.0 will not be accepted toward licensure into Augsburg licensure programs.</td>
</tr>
<tr>
<td>C-</td>
<td>1.67</td>
<td>75-76% The letter grade equivalent for a ’P’ grade is a C-/ 1.67</td>
</tr>
<tr>
<td>D+</td>
<td>1.33</td>
<td>73-74%</td>
</tr>
<tr>
<td>D</td>
<td>1.00</td>
<td>71-72% Below basic standards and expectations.</td>
</tr>
<tr>
<td>D-</td>
<td>0.67</td>
<td>70%</td>
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<tr>
<td>F</td>
<td>0.00</td>
<td>69% and below</td>
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CGEE Grading Policy and Late Assignments
You must submit assignments on time. If you need an extension, you must talk to us in advance to negotiate a new deadline. If you have not been given an extension in advance and you turn in a late assignment, you will be docked half a grade. If you are more than one week late, you will be docked a full grade. No assignments will be accepted more than two weeks after the original deadline; a “0” will be given after that. Assignments due near the end of the semester will not be accepted after the last day of the semester.

Re-writing Assignments
If you receive a grade of C- or lower, you may revise a paper as long as you resubmit it within one week of the date it was returned to you. Your final grade will be an average of the two grades.

Augsburg Honesty Policy
You are expected to follow the Augsburg Honesty Policy which is printed in the program manual. We assume that you have read the honesty policy, understand it, and are following it. Except when the assignment expressly encourages group work, it is assumed that all course work will be your own. You may not copy other students’ work. The first occurrence of plagiarism will result in the failure of the assignment. A student who commits plagiarism a second time will fail the course.

Students’ Rights and Responsibilities
Students with formally diagnosed learning or physical differences have legal rights to course modifications. Those who qualify should identify themselves to the instructor as soon as possible in order to obtain extra assistance.