Lectures and labs:      Tuesdays and Thursdays: 1:30 – 4:20 pm
NR 125 for lectures
BNR 004 and BNR 040 for labs

Prerequisites: One year of general biology or zoology

Instructors: Charles Hawkins: BNR 162D. chuck.hawkins@usu.edu (mailto:chuck.hawkins@usu.edu). 797.2280.
Daniel Nelson: BNR 160. daniel.nelson@usu.edu (mailto:daniel.nelson@usu.edu). 797.3945.

Office hours: by appointment

Course Goals and Objectives

This course is designed to provide a thorough understanding of freshwater invertebrate taxonomy, ecology, and biology. This course is relevant to those interested in ecology and evolution, fisheries biology, natural resources science and management, or environmental assessment and monitoring.

Specific learning objects include:

- Understanding the evolutionary origins and phylogenetic relationships of freshwater invertebrate groups, basic theory and practice of taxonomy and systematics, adaptations and habitat requirements of freshwater invertebrates, the functional role of invertebrates in freshwater ecosystems, the factors that influence their abundance and distribution across different spatial scales, the use of freshwater invertebrates in environmental assessment, and conservation and restoration science as applied to freshwater invertebrates.
- Learn how to:
  1. use taxonomic keys to identify freshwater invertebrates,
  2. sample streams, lakes, and wetlands for freshwater invertebrates, and
  3. process invertebrate samples to known data quality standards.
- Practice conducting, interpreting, and reporting project results.
- Improve your written and oral communication skills.

Course Fee

The course fee is $55.00. The fee covers field trip costs (Motor Pool vans), collecting supplies, and photocopy expenses.
COVID-19 Classroom Protocols

To continue to provide various forms of face-to-face instruction at USU, and to limit the spread of COVID-19 during the pandemic, students are asked to follow certain classroom protocols. These protocols are based on CDC, state, and local health department guidelines and requirements are in place not only for your safety but also the safety of the entire campus community.

- **Face masks are required** in this class. Students will not be permitted to remain in class without a face mask, as per University Policy 20T.3. Students that do not adhere to the face mask policy will be referred to the Office of Vice President for Student Affairs for a possible violation of the Student Code of Conduct. There may be individual medical circumstances that prevent some students from using face masks. If you require this exemption, contact the Disability Resource Center to investigate alternative instruction.
- Follow faculty instructions regarding social distancing and entering/exiting classrooms.
- Stay home when you are sick, however mild your symptoms.
- Wash your hands with soap and water immediately before entering the classroom.

Classroom, Departmental, and University Policies

**Cell phones, laptops, and other electronic communication devices** – Active use of cell phones, laptops, and similar is prohibited in the classroom and during field trips except that you may use your laptop to take notes and when you are entering or analyzing data or need to view identification materials (e.g., keys and images). Cell phones must be stowed out of sight for the duration of every class.

**Students with disabilities** – Accommodations are collaborative efforts between students, faculty and the Disability Resource Center (DRC). Students with accommodations approved through DRC are responsible for contacting the course instructors prior to or during the first week of the semester to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DRC should contact DRC immediately at 797-2444.

**Academic freedom and professional responsibilities** – Academic freedom is the right to teach, study, discuss, investigate, discover, create, and publish freely. Academic freedom protects the rights of faculty members in teaching and of students in learning. Freedom in research is fundamental to the advancement of truth. Faculty members are entitled to full freedom in teaching, research, and creative activities, subject to the limitations imposed by professional responsibility. USU Policy 403 (http://www.usu.edu/hr/files/uploads/Policies/403.pdf) further defines academic freedom and professional responsibilities.

**Academic Integrity** - The University expects that students and faculty alike maintain the highest standards of academic honesty. The Code of Policies and Procedures for Students at Utah State University (Student Conduct (https://studentconduct.usu.edu/studentcode)) addresses academic integrity and honesty. Students have a responsibility to promote academic integrity at the University by not participating in or facilitating others’ participation in any act of academic dishonesty and by reporting all violations or suspected violations of the Academic Integrity Standard to their instructors. To enhance the learning environment at Utah State University and to develop student academic integrity, each student agrees to the following Honor Pledge: "I pledge, on my honor, to conduct myself with the foremost level of academic integrity". Violations of the Academic Integrity Standard (academic violations) include, but are not limited to cheating, falsification, and plagiarism. **Plagiarism** includes knowingly "representing by paraphrase or direct quotation, the published or unpublished work of another person as one's own in any academic exercise or activity without full and clear acknowledgment. It also includes the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials." The penalties for plagiarism are severe. They include warning or reprimand, grade adjustment, probation, suspension, expulsion, withholding of transcripts, denial or revocation of degrees, and referral to psychological counseling.
There is no required text for this class, but both mandatory and optional reading materials will be provided prior to each class period. You are required to complete readings before the assigned class period, as this will greatly enhance your comprehension of lecture materials. Resources include:


¹Available online through the USU library course catalog. ²Copy available in BNR 160. ³Scanned material available on Canvas. ⁴Recommended purchase.

Canvas

We will use Canvas for sharing announcements, accessing lecture/lab outlines and identification materials, and accessing reading assignments. Your A-number and strong password allows you to access the WATS 5550 course site. The course website can be accessed by browsing to https://usu.instructure.com/. Under course list click “Sp21 BIO-5550-001”. If you have additional questions or problems, please ask us.

Course Activities and Evaluation

Evaluation of your performance will be based on four metrics:

1. how well you communicate your understanding of material presented on the evolution, biology, and ecology of freshwater invertebrates;
2. how well you summarize aspects of theory and practice in written assignments;
3. how well you develop skills in identifying freshwater invertebrates; and
4. the quality of the report you produce for the course project.

Grades will be based on how many total points, out of a hundred, that you accrue over the term.

Graded item Points
Two exams on lecture material (10 points each) 20
Two response papers (10 points each) 20
Identification skills 40
Activities and Grading Explained

**Evolution, biology, and ecology** – We will cover several aspects of the evolution, classification, and ecology of freshwater invertebrates. This material will be covered by a combination of lecture, reading, and in-class discussion. You will be evaluated on your command of this material by two in-class, “closed-book” exams.

**Response papers** – You are responsible for reading two assigned papers from the primary literature and writing 2-page response papers for each of them (11-point, Times Roman font, double spaced, 1-inch margins). The objective of these assignments is to provide you with experience interpreting and synthesizing the scientific literature on freshwater invertebrates and to provide practice honing your written communication skills. Assigned papers will relate to topics covered in lecture. I will grade based on both content and clarity of writing. In general, your papers should be organized as follows:

1. Introduce the topic of the paper including the author’s objectives/hypotheses and concisely summarize what motivated the authors to conduct the study – i.e., what knowledge gap did the authors want to fill and why was it important to do so.
2. Describe the study design and how it allowed the authors to answer their research question or test their research hypothesis. Summarize the methods they used to collect and analyze data.
3. Summarize the key findings (results).
4. Comment on the strength of the inferences the authors draw. How convinced were you that their conclusions were sound? What questions remained unanswered, if any, or what new questions emerged? Briefly describe what study you would conduct next that would build on this study if you were part of a research lab. Be sure to state what the new question/hypothesis is and what study type/design you would use.
5. Email me your paper in Word format named as: `LastName-WATS5550-ResponsePaper-1` (or 2).

**Identification skills** – We will test your ability to identify the groups of freshwater invertebrates we cover in class. Exams will focus on taxonomy (short answer questions), morphology (short answer questions), function (short answer), and your ability to identify freshwater invertebrate taxa (combination of sight identifications and use of keys to identify unknowns).

**Project and report** – You will participate in a class project designed to improve your understanding of freshwater invertebrate ecology, how invertebrate data are used in environmental assessment, and the factors that affect data quality. The project will compare the invertebrate assemblages at two locations on the Logan River – a ‘reference’ site and a degraded site that is in the process of being restored. You will be responsible for taking quantitative samples, processing the samples in the lab, and using the data to draw inferences regarding differences between the sites. You will also be responsible for writing a ~ 10-page report (11 point Times Roman font, double spaced) that describes the project and the conclusions you drew from the data you collected. The report must be written in the standard format of a scientific journal article (Abstract, Introduction, Methods, Results, Discussion, Literature Cited) and must incorporate relevant literature. Your grade will be based on both scientific content as well as the clarity of your writing. Provide a Word file named as follows: `YourLastName-WATS5550-ProjectReport`.

**Field Experiences**

The field experience consists of 3 field trips, weather and COVID-19 permitting. Two trips will be held during class time, and your active participation is required. We will return to campus by 4:15 on that day. These trips will focus on collecting quantitative samples in support of the class project. The third trip will be a day-long Saturday excursion.
that will highlight sampling of pond and wetland habitats and the ecology and natural history of their invertebrate inhabitants.

To effectively participate in, and enjoy, the field excursions, you will need to be prepared for **wading in winter conditions**. We can provide some waders or hip-boots, but strongly encourage you to bring your own gear if you have it. Despite our best efforts, some of our equipment leaks! All necessary collecting equipment will be provided. When sampling, we ask that you put safety first and be conscious of the conditions in which you wade. Do not put yourself or your classmates in danger.

**Laboratory Experiences**

The laboratory experiences are designed to both provide practice in identifying freshwater invertebrates and a realistic experience in sample processing. Each laboratory experience will start with a lecture that introduces a taxonomic group and will conclude with time working on identifying both reference specimens and individuals you have collected. Over the course of the semester, we will provide you with taxonomic keys and other handouts that you should keep in a three-ring binder that we will provide.

A significant portion of the laboratory will also be spent processing the samples you collect. This exercise is designed to introduce you to sample processing procedures and make you aware of the importance of data quality when estimating the presence and abundance of the organisms you sample. You will be expected to follow standard laboratory sample processing protocols that we provide you that will include subsampling, sorting, identification, and data compilation.

**Schedule**

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<td>Overview of the course / Pretest / Introduction to taxonomy</td>
<td>Introduction to the lab portion of the course</td>
<td>Habits and sampling / Taxonomy and keys / Aquatic insect orders</td>
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<td>19/21</td>
<td>Field trip to Logan River (Rendezvous Park)</td>
<td>Field trip to Logan River (Rendezvous Park)</td>
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<td>Jan</td>
<td>Field trip to Logan River (Wood Camp)</td>
<td>Field trip to Logan River (Wood Camp)</td>
<td>TC 1</td>
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<td>Field trip to Logan River (Wood Camp)</td>
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<td>Date</td>
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<td>Feb 9/11</td>
<td>Writing your papers</td>
<td>Odonata</td>
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<td>Feb 16/18</td>
<td>Phylogeny and evolution</td>
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<td>Trichoptera</td>
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<td>Megaloptera &amp; Collembola</td>
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<td>Mar 9/11</td>
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<td>ID midterm</td>
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<td>Hemiptera and Coleoptera</td>
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<td>Mar 23/25</td>
<td>Biodiversity patterns</td>
<td>Mollusca and benthic Crustacea</td>
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<td>Mar 30/1</td>
<td>Biodiversity patterns</td>
<td>Annelids, Mites</td>
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<td>3 Apr (Sat)</td>
<td>Field Trip</td>
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<td>Apr 6/8</td>
<td>Biological assessment</td>
<td>Pretend it is Friday!</td>
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<td>Paper 2 due 6 Apr</td>
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<td>Apr 13/15</td>
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<td>Lecture exam 2</td>
<td>Catch up</td>
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**Links:**
- [MCB 7, Biological Assessments](https://qcnr.usu.edu/wmc/bioassessments/)

Paper 1 assignment 23 Feb
Paper 1 due 2 Mar
ID midterm 11 Mar
Lecture exam 1 16 Mar
Paper 2 assignment 30 Mar
Paper 2 due 6 Apr
Lecture exam 2 20 Apr
Apr 27
Project report due
Final lab exam review

May 4
Lab Final
1:30-3:20

Lab Final
1:30-3:20