COURSE: Spring 2024, FISH 5320/6320, Limnology, 3 credit hours

LECTURE: Tuesday and Thursdays, 11:00am-12:15pm, Swingle 301, 3 credit hours

OFFICE HOURS: Fridays, 8:00-10:00am or by appointment

REQUIRED PREREQUISITES: BIOL 1030/1037, CHEM 1040, or departmental approval (contact Tracy Cline (tjc0001@auburn.edu))

INSTRUCTOR: Dr. Alan Wilson, Swingle 321, wilson@auburn.edu, 334-246-1120

TEACHING ASSISTANTS: Ashley Hennessey avh0022@auburn.edu; Michael McDonald mbm0116@auburn.edu

ZOOM: We will use Zoom for remote course participants. You can access Zoom via Canvas =

COURSE WEBSITE: available in Canvas

FIELD OF STUDY:
Limnology is the study of the chemical, physical, geological, biological, and ecological processes that influence the structure and function of aquatic communities. It is an important field of study because of increasing global demands on freshwater natural resources which require the effective management of freshwater habitats used for drinking water, fish production, recreation, aesthetics, etc.

COURSE OBJECTIVES & STUDENT LEARNING PHILOSOPHY:
The course objectives represent a variety of tasks and skills that I expect students to have developed and mastered by the end of the course. Through participating in this course, you will (1) practice and develop your critical thinking skills (through in-class group discussions and presentations), (2) learn how to read and interpret the scientific literature, and (3) broaden your understanding of freshwater ecosystems (through lectures). My role in this course is to encourage and facilitate your learning and critical thinking about the ecology of freshwater ecosystems in a learning and fun-filled environment. I hope to provide you with a solid foundation of concepts and skills with which you can understand the complexity of freshwater ecosystems.

REQUIRED READINGS (available in canvas**)**:
1. Dodson, S. I. Introduction to Limnology. McGraw-Hill, 2004. Available at http://www.aubookstore.com/
2. Articles from the peer-reviewed literature (see below) will be used in student-led classroom discussions to supplement the textbooks. These papers will be made available to the students on the class website.

Belfiore, A., R. P. Buley, E. G. Fernandez-Figueroa, M. Gladfelter, and A. E. Wilson. 2021. Zooplankton as an alternative method for controlling phytoplankton in catfish pond aquaculture. Aquaculture Reports 21:100897.

Brooks, J. L. and S. I. Dodson. 1965. Predation, body size, and composition of plankton. Science 150:28-35.

Chaney, P. L., C. E. Boyd, and E. Polioudakis. 2012. Number, size, distribution, and hydrologic role of small impoundments in Alabama. Journal of Soil and Water Conservation 67(2):111-121

Chislock, M. F, E. Doster, R. A. Zitomer, and A. E. Wilson. 2013. Eutrophication: causes, consequences, and controls in aquatic ecosystems. Nature Education 4(4):10.

Domis, L. N. D., J. J. Elser, A. S. Gsell, V. L. M. Huszar, B. W. Ibelings, E. Jeppesen, S. Kosten, W. M. Mooij, F. Roland, U. Sommer, E. Van Donk, M. Winder, and M. Lurling. 2013. Plankton dynamics under different climatic conditions in space and time. Freshwater Biology 58:463-482.

Fee, E. J., R. E. Hecky, S. E. M. Kasian, and D. R. Cruikshank. 1996. Effects of lake size, water clarity, and climatic variability on mixing depths in Canadian Shield lakes. Limnology and Oceanography 41:912-920.

Forbes, S. A. 1887. The lake as a microcosm. Bulletin of the Peoria Scientific Association:77-87.

Kawaguchi, Y., Y. Taniguchi, and S. Nakano. 2003. Terrestrial invertebrate inputs determine the local abundance of stream fishes in a forested stream. Ecology 84(3):701-708.

Porter, K. G. 1977. The plant-animal interface in freshwater ecosystems. American Scientist 65:159-170.

Schindler, D. W. 1974. Eutrophication and recovery in experimental lakes: Implications for lake management. Science 184:897-899.

Smith, V. H. and D. W. Schindler. 2009. Eutrophication science: where do we go from here? Trends in Ecology & Evolution 24:201-207.

Titman, D. 1976. Ecological competition between algae - experimental confirmation of resource-based competition theory. Science 192:463-465.
Verburg, P., R. E. Hecky, and H. Kling. 2003. Ecological consequences of a century of warming in Lake Tanganyika. Science 301:505-507.
Welch, E.B., and Cooke, G.D., 2005. Internal phosphorus loading in shallow lakes: importance and control. Lake and Reservoir Management 21(2): 209-217
Woolway, R. I., B. M. Kraemer, J. D. Lenters, C. J. Merchant, C. M. O'Reilly, and S. Sharma. 2020. Global lake responses to climate change. Nature Reviews Earth & Environment 1:388-403.

GRADING:
Course grades are based on each student's cumulative performance for the following assignments:

Activity	**Points**	**Grading scale**
Research article reports (4 x 5 pts)	20	A = 90-100%
Presentation	35	B = 80-89%
In-class article discussion prep (4 x 5 pts)	20	C = 70-79%
Paper (graduate students only*)	25	D = 60-69%
Midterm exams (2 x 50 pts)	100	F = 0-59%
Final exam	50	
Total points	225 (undergraduate students) 250 (graduate students*)	

UNDERGRADUATE PARTICIPATION & ASSIGNMENTS EXPECTATIONS:
The course grade will be based on participation in lecture, research article evaluations, several presentations, and midterm and final exams as described below:

(1) *RESEARCH ARTICLES REPORTS*: To familiarize you with the primary limnological literature, students will be expected to survey articles in *Limnology and Oceanography*, *Ecology, Canadian Journal of Fisheries and Aquatic Sciences,* or *Freshwater Science* and concisely (≤ 1 page) scientifically describe a different article four times throughout the semester. Each student will be given their own year of papers to choose from to prevent duplication of presentations. Article reports should include the article citation, description of why you chose paper, study objectives, methods, novel findings, flaws, and hyperlink to paper. Reports not fitting these criteria will be given a 0. On each due date, one or two students may be randomly chosen to briefly (≤ 5 minutes) present their paper to the class. Reports should be uploaded to canvas before class on the due date.

(2) *LECTURE PRESENTATION*: All students will be required to give a formal poster presentation on a limnological topic of their choice or one provided by the instructor. Each student will provide an associated ~1-page outline in the middle of the semester (see lecture calendar below) so that I can assist with the final presentation development. The students are expected to use the primary literature as references for this presentation. The presentation will be shared with the class on one day and shared broadly next class.

(3) *IN-CLASS ARTICLE DISCUSSION PREPARATION*: All students will be required to complete a short assignment before each article discussion day to help them prepare to be involved with discussion. During in-class article discussions, the class will split into small groups to discuss certain aspects of the papers and then share what they discussed with the broader class.

(4) *LECTURE MIDTERM EXAMS*: Two closed-book midterm exams will test your knowledge of basic facts and your understanding and synthesis of class concepts. The textbook and primary literature readings reinforce the lecture material and will be used to develop exam questions. Exam questions may include true/false, multiple choice, short answer, and essays. Students who are absent from class and miss an exam will be given a 0.

(5) *LECTURE EXAM*: The closed-book final exam will be similar to the midterm exams and will be comprehensive.

GRADUATE PARTICIPATION & ASSIGNMENTS EXPECTATIONS:
Graduate students will be expected to (1) work above and beyond the expectations set forth for undergraduates (see above), (2) think critically about course topics, (3) be class leaders in discussions and actions, (4) to alternate discussion leading of four or five seminal limnological papers throughout the semester using creative teaching techniques, and (5) write at least 5-pages of text (so not filled with figures), well-cited, single-spaced, paper supporting their final oral presentation.

CLASSROOM ATTENDANCE & BEHAVIOR:
It is recommended to attend class and engage in classroom discussions and in-class group projects. If you choose not to attend class on any day, then you accept the responsibility to learn the material on your own. If you have a question during the class period, please do not hesitate to ask. In fact, other students probably have the same question. It is important to be on time for class since the first 5 minutes of each lecture will establish the direction for that day's session. Therefore, if you come in late, certain things may not make sense and you will miss important announcements. Throughout the semester, please be courteous to all of your fellow students and to me so we can create a positive learning environment. All cell phones should be turned off before entering the classroom and should not be used during class.

FEEDBACK & EVALUATION:
This course is for you to learn important fundamental concepts and ideas on which to build your understanding of freshwater ecosystems. I will do my best to create a positive learning environment. However, learning styles differ among students, so I may do some things that are not optimal for you. If this occurs, you can let me know through email or written comments turned in at the end of the class period, during office hours, or via email. Because I need to keep the interest of all students in mind, I cannot promise that I will change the course. However, I do promise to listen and consider your suggestions. Moreover, course evaluations will be completed by students at the middle and end of the semester so that course changes can be made to enhance the learning experience for this class and future classes. Students will also be given an opportunity at the end of most lectures to ask questions about concepts not fully understood via one-minute papers. Some of these questions may be used on quizzes and/or exams. Finally, students are encouraged to use an anonymous online survey form - https://goo.gl/forms/ut92HzIhHOUtfxm62

COURSE CHANGES:
Although I expect to cover all the topics described in the syllabus, course changes will likely occur - especially based on feedback from the students. Consequently, I reserve the right to modify the course to enhance the learning experience where I deem appropriate. Course changes will be described verbally during class and/or in writing via email and/or handouts.

ACADEMIC HONESTY:
The Auburn University Student Academic Honesty Code (available at https://sites.auburn.edu/admin/universitypolicies/Policies/AcademicHonestyCode.pdf) clearly defines the university's honesty code. I expect all students to conduct themselves in my class with this Code in mind. I have a zero-tolerance policy for cheating. Cheating is not fair to you and to your colleagues. If you are not sure which activities constitute cheating, please ask me. Some examples of cheating include, but are not limited to the following activities: attempting to pass others' work as your own (i.e., plagiarism), using crib sheets, or providing exam answers to other students. Students who cheat will receive a 0 on the assignment in question and will most likely fail the course.

USE OF ARTIFICIAL INTELLIGENCE:
The use of artificial intelligence (AI), such as ChatGPT, is not allowed for any aspect of this course unless the student gets prior permission for its use which would require a strong, clear, and compelling justification.

ACCOMMODATIONS FOR DISABILITIES:
If you have a disability and/or a special need that requires accommodations, please inform me immediately so that I can develop a plan to work with you and arrange an appointment with a campus disabilities counselor.

LECTURE SCHEDULE (available in Canvas)

Date	**Lecture topic**	**Readings (pages)**
11-Jan	Course introduction and overview	none
16-Jan	What is limnology?, History	Dodson 1 (3-23); Forbes 1887
18-Jan	Lake bathymetry and morphometry	Dodson 11 (265-290); Fee et al. 1996
23-Jan	Origin of lakes; Lake types	Chaney et al. 2012
25-Jan	Water as an environment, Viscosity and Reynold's numbers	Dodson 2 (29-38, 50-51)
30-Jan	Lake mixing, waves, currents, light, heat	Dodson 2 (40-56)
01-Feb	Seasonal mixing patterns, Oxygen cycle	Dodson 2 (43-45, 237-239)
06-Feb	Seasonal mixing patterns, Oxygen cycle continued ***ARTICLE REPORT #1***	Dodson 2 (43-45, 237-239)
08-Feb	Article discussion: Verburg et al. 2003 and Woolway et al. 2020 ****IN-CLASS ARTICLE DISCUSSION DOC DUE****	Verburg et al. 2003; Woolway et al. 2020
13-Feb	Nutrient cycles; stoichiometry (MATT GLADFELTER GUEST LECTURE) ALAN OUT OF TOWN	Dodson 10 (231-251); Schindler 1974
15-Feb	Single-celled and colonial organisms	Dodson 3 (65-80)
20-Feb	Article discussion: Welch & Cooke 2005 and Schindler 1974 ****IN-CLASS ARTICLE DISCUSSION DOC DUE**** ALAN OUT OF TOWN	Welch & Cooke 2005; Schindler 1974
22-Feb	Aquatic invertebrates, exam review (ASHLEY HENNESSEY GUEST LECTURE) ALAN OUT OF TOWN	Dodson 4 (85-124)
27-Feb	****MIDTERM EXAM #1****	none
29-Feb	Aquatic invertebrates continued, ***PROJECT OUTLINE DUE*, *MIDTERM COURSE EVAL***	Dodson 4 (85-124)
05-Mar	**SPRING BREAK – NO CLASS OR LAB**	none
07-Mar	**SPRING BREAK – NO CLASS**	none
12-Mar	Aquatic vertebrates	Dodson 5 (85-138)
14-Mar	Plankton population dynamics	Dodson 6 (143-157); Porter 1977; Domis et al. 2013
19-Mar	Community ecology: competition (MICHAEL MCDONALD GUEST LECTURE) ***ARTICLE REPORT #2***	Dodson 7 (161-168)
21-Mar	Article discussion: Titman 1976 & Scheffer et al. 2003 ****IN-CLASS ARTICLE DISCUSSION DOC DUE****	Titman 1976; Scheffer et al. 2003
26-Mar	Community ecology: predation	Dodson 7 (168-182)
28-Mar	Seasonal succession, trophic cascades, biomanipulation	Dodson 8 (189-205);
02-Apr	Bottom-up regulation and energy flow ***ARTICLE REPORT #3***	Dodson 9 (209-219)
04-Apr	Bottom-up regulation and energy flow continued	Dodson 9 (209-219); Kawaguchi et al. 2003
09-Apr	Article discussion: Belfiore et al. 2021 & Brooks and Dodson 1965 ****IN-CLASS ARTICLE DISCUSSION DOC DUE****	Brooks and Dodson 1965; Belfiore et al. 2021
11-Apr	****MIDTERM EXAM #2****	none
16-Apr	Eutrophication, exam review	Dodson 10, 11 (201-202,244-245); Chislock et al. 2013
18-Apr	Eutrophication continued, ***ARTICLE REPORT #4***	Smith and Schindler 2009
23-Apr	Poster presentation to class (update before printing for everyone)	none
25-Apr	Poster presentation for everyone, ***GRAD STUDENT FINAL PAPER DUE***	none
03-May	Final exam – 10:30am-12:30pm	All readings