

# *Introduction to Fish and Aquatic Invertebrate Histology*

*FAS 6256 / VEM5912*

*Spring 2025*

## **1. Course Overview**

Introduction to Fish and Aquatic Invertebrate Histology (FAS 6256) teaches basic interpretation of the normal histology (fixed tissue microanatomy and physiology) of select finfish and aquatic invertebrates (bivalves, crustaceans, horseshoe crabs, corals), and introduces common histopathologic (disease) findings.

FAS 6256, a 3-credit course taught in Spring 2023, is taught 100% online (<http://elearning.ufl.edu>) and can be taken asynchronously, but attendance at synchronous discussion sessions to review lecture materials and digital slides is highly recommended. Synchronous discussion sessions are recorded for those unable to attend.

### **Course Prerequisites**

None, but familiarity with general biology and some experience with anatomy and physiology of fish and/or aquatic invertebrates is helpful.

### **Instructor**

Course Coordinator: Dr. Roy Yanong

Contact Information

- Tropical Aquaculture Laboratory, Program in Fisheries and Aquatic Sciences (FAS), School of Forest, Fisheries, and Geomatics Sciences, IFAS, University of Florida, 1408 24<sup>th</sup> St. Southeast, Ruskin, FL 33570
- Please use the Canvas message/Inbox feature for fastest response.
- Office phone – 813-671-5230 extension 104
- E-mail – rpy@ufl.edu

Office Hours – Thursdays from 10 am-12 pm; also generally available via e-mail or course mail; office is located in Ruskin - Office/Zoom visits available by appointment

### **Teaching Assistant**

Brittney Lacy  
Email: blacy2@ufl.edu

- Please use the Canvas message/Inbox feature for fastest response.
- Office Hours – generally available via e-mail or course mail

## Required Texts/Readings

- 1) USFWS CD Rom (photomicrographs and text), *Fish Histology*, Mumford et al.; provided
- 2) *Atlas of Fathead Minnow Normal Histology*, Yonkos, Fisher, Reimschuessel, and Kane; available online at: <http://aquaticpath.php.ufl.edu/fhm/index.html>
- 3) *Histological Atlas of Florida Surgeonfish*, Tilghman, Floyd, and Klinger; provided
- 4) *Histological Techniques for Marine Bivalve Molluscs: Update*; NOAA Technical Memorandum NOS NCCOS 27; available online at: <https://repository.library.noaa.gov/view/noaa/9282>
- 5) *A histological atlas for the Palinuridae (Crustacea: Decapoda: Achelata): A guide to parasite discovery and spotting the abnormal in spiny lobsters*, Ross et al 2019; provided in course materials
- 6) *Clinical Evaluation, Common Diseases, and Veterinary Care of the Horseshoe Crab, Limulus Polyphemus*, Nolan and Smith, 2009, In *Biology and Conservation of Horseshoe Crabs*: provided in course materials
- 7) *Coral Disease and Health Workshop: Coral Histopathology II*, NOAA Technical Memorandum NOS NCCOS56; also available online for download at: <https://repository.library.noaa.gov/view/noaa/478>
- 8) Digital microscopy – the upcoming revolution in histopathology teaching, diagnostics, research and quality assurance (Krenacs et al 2010): provided in course materials

\*\*Course coordinator and individual instructors may provide additional references with each module, and other suggested references are listed further below.

## 2. Learning Outcomes

At the end of this course, each student will be able to:

- Describe proper tissue processing methods for histology of finfish, and select aquatic invertebrates and how improper processing leads to tissue artifacts
- Identify from gross and histologic specimens, major organ systems, organs, tissues, and important cell types in normal histologic specimens of finfish and select aquatic invertebrates
- Identify from histologic specimens, common pathologic (disease) findings in representative finfish and select aquatic invertebrates

- Describe how the microanatomy seen in histologic specimens of normal and diseased animals correlates with physiology and pathophysiology (function) in that tissue, organ, and organism
- Interpret tissues from other species of finfish and aquatic invertebrates using a comparative histologic approach
- Explain the relevance of histology for research and diagnostics
- Use virtual slide (Aperio) imaging technology

### 3. Course Logistics

This is a distance education, online course. Lectures, assignments, readings, and supporting materials will be made available online through the course Canvas site as per schedule. Weekly, 2-hour discussions (Wednesdays, 12:50-2:50 pm) will allow for participatory review of lectures and associated materials and digital slide evaluation. Participation in these 2-hour discussions is highly recommended, but they will be recorded for those unable to attend.

#### *Technology Requirements*

There are some technical requirements/expectations that you must meet in order to be successful in this course. In general you must have a computer with reliable access to a high-speed non-wireless connection, especially for taking exams and quizzes. Most recorded lectures are streamed, not downloaded-- so reliable, fast internet is a requirement for distance students. You should have hardware capable of installing the latest version of multiple web browsers, e.g. Internet Explorer and Mozilla Firefox, Google Chrome, or Safari as some course content delivery methods work better in different browsers. Install the most current version(s). You should also have access to and familiarity with MS Office Suite, webcams, microphones, speakers, and updated versions of AntiVirus software, Java and Flash. Installation of proctoring software may be required and will be provided if so.

**Synchronous online sessions may be recorded.** By sharing your video, screen, or audio during any synchronous online class sessions, you are consenting to being recorded for the benefit of students who cannot attend live as well as for class review during the current semester. If you have special circumstances or concerns about privacy, it is your responsibility to discuss it with your instructor.

#### **General Course Overview**

The format of the class will focus to a large extent on recorded lectures, reading from book chapters or primary scientific literature on the topic for a given class, and scheduled online digital slide laboratories/chats. For each module, students will need to complete a self-test quiz. The lectures are taped lectures given by individuals from UF-IFAS-SFFGS - Fisheries and Aquatic Sciences; One Water, One Health; UF-College of Vet Med; ZooQuatic Lab; Fishhead Laboratories; Regeneron; US Fish and Wildlife Services; Roger Williams University; Teesside University, UK; and Experimental Pathology Laboratories, and discussion sessions are led by

these instructors. Students will be expected to review the reading material and the Canvas lectures, then complete the module or lecture quiz and related homework assignments. A final quiz will be available online at the end of the course.

This course is intended to introduce the basic histology of clinically normal fish, bivalves, and corals, and to demonstrate common histopathology of diseased specimens. We include striped bass, pinfish, and common carp as our fish models, but other species may be used or substituted as needed. (Our bivalve models will be determined by Drs. Baker and Smolowitz, crustacean models by Dr. Jamie Bojko, horseshoe crab model by Dr. Newton, and coral models by Drs. Berzins and Yanong.)

A teaching digital slide set will be available with online access and use will be described by way of a tutorial and a scheduled online discussion period. Additional slides and digital images will be made available as per each instructor. Weekly online discussions are scheduled to review lectures and associated materials for that week and to examine digital slides; participation in discussions will be recorded. It is important that students keep up with each module and assignment to optimize the learning experience. **For interactive discussion sessions, Canvas software will be used and students should have access to a computer with audio input and output (or have a compatible headset with a microphone) for these sessions.**

Upon completion of this course, students are expected to: be familiar with, and describe basic routine histological processing; be comfortable with use of digital slides; understand how gross anatomy correlates with microscopic anatomy, explain the relevance of histology for both research and diagnostic work; identify normal microanatomical structures and their functions for a number of different finfish and aquatic invertebrate species; understand common physiological and pathophysiological processes and how they alter microanatomy; and learn how to approach the microanatomy of other species based on similarities and differences between those studied in this course.

Delivery:

On the first day of class, log in with your gatorlink information here: <http://elearning.ufl.edu/> Click the orange LOG INTO ELEARNING button. Please check the eLearning course often for Announcements.

There is a Technical Support Discussion Board within the course monitored by technical staff. However, for time-sensitive questions or problems, you must call the UF Helpdesk. The Helpdesk can help you in real-time and will provide a service ticket, which is necessary in the event of technical difficulties during a quiz or exam.

Call the UF HELP Desk for immediate help if time-sensitive technical difficulties occur while taking a quiz or exam: <http://helpdesk.ufl.edu/> (352)-392-4357.

## Grades and Grading Scale (%)

<b>95%</b>	<b>Performance &amp; Knowledge of Subject Area</b>	
	Ability to satisfactorily integrate reading material, discussions, and homework assignments as demonstrated	
	50%	Self-test quizzes
	20%	Homework assignments equally weighted
	25%	Final Exam
<b>5%</b>	<b>Personal Profile</b>	
	5%	Regular access, enthusiasm, and attitude

A	100% to 94%
A-	93.99% to 90%
B+	89.99% to 87%
B	86.99% to 84%
B-	83.99% to 80%
C+	79.99% to 77%
C	76.99% to 74%
C-	73.99% to 70%
D+	69.99% to 67%
D	66.99% to 64%
D-	63.99% to 61%
E	60.99% to 0%

\* NOTE: Students in the CE/non-credit section will not be graded and thus may be exempt from exams and homeworks; however, homework and exams will help with the learning process, so students in the CE/non-credit section are encouraged to participate in these course activities

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>.

### 4. Learning Content

- Students will be expected to review relevant online lectures as scheduled, prior to the week's two-hour online discussion.
- Online quizzes will follow each module or lecture
- Homework will be assigned and posted periodically (approximately every two modules)
- A final quiz will be available for completion online during the end of course exam period

- See “Evaluation of Student Learning” and “Grading Scale” below for allocated percentage of assessments/activities toward student grades

\*\*Please note that the schedule below may be amended due to lecturer availability, with appropriate notification to students ahead of time\*\*

The two-hour scheduled online discussions run from 12:50 pm to 2:50 pm on the dates indicated below (on Wednesdays), except in cases when a schedule change may be necessary due to unforeseen instructor conflicts. Primary instructor Roy Yanong will be present at most online discussion sessions, but discussion leads are indicated below:

Module 1, Week 1: Course Introduction:

- a) General Principles and Tissue Types (Roy Yanong, FAS);
  - b) Use of Digital Slides and the Aperio System (Roy Yanong, FAS)
- NO SCHEDULED ONLINE DISCUSSION/LAB- WEEK 1

Module 2, Week 2: Basic Finfish Biology, Necropsy, and Processing:

- a) Comparative Finfish Anatomy and Physiology (Roy Yanong, FAS);
- b) Finfish Necropsy (Roy Yanong, FAS);
- c) [Fixation and Processing \(Ilze Berzins, One Water, One Health\)](#)

**Two-hour scheduled online discussion, [January 22 - Roy Yanong](#)**

Module 3, Week 3: Pathology and Immunology:

- a) [Disease Overview \(Roy Yanong\)](#);
- b) Fish Immunology (Roy Yanong)

Homework Assignment 1 due

NO SCHEDULED ONLINE DISCUSSION/LAB – WEEK 3

Module 4, Week 4: Response to Injury and Neoplasia:

- c) Cellular and Tissue Responses to Injury (Roy Yanong);
- d) [Disease Indices, Pathology, and Neoplasia \(Ilze Berzins\)](#)

**Two-hour scheduled online discussion, [February 5- Roy Yanong and Ilze Berzins](#)**

Module 5, Week 5: Skin, Gills, and Pseudobranch (one lecture) (Ruth Francis-Floyd, Vet Med, FAS)

Homework Assignment 2 due

**Two-hour scheduled online discussion, [February 12- Ruth Francis-Floyd](#)**

Module 6, Week 6: Musculoskeletal System (Harley Newton, ZooQuatic Laboratory, LLC)

**Two-hour scheduled online discussion, [February 19- Harley Newton](#)**

Module 7, Week 7: Finfish Nervous System:

- a) Introduction to Fish Neurobiology (Daryl Parkyn, Fisheries Scientist (Finfish) at Falkland Islands Fisheries Department)
- b) Histological Features of the Finfish Nervous System (Susan Fogelson, Fishhead Labs)

Homework Assignment 3 due

**Two-hour scheduled online discussion, February 26-Daryl Parkyn and Susan Fogelson**

Module 8, Week 8: Hematopoietic, Circulatory, and Excretory Systems:

a) Blood, Lymph, RE System, and CV System (Jenny Dill-Okubo, Regeneron)

b) Kidney, Spleen, Hematopoiesis (Jenny Dill-Okubo)

**Two-hour scheduled online discussion, March 5- Jenny Dill-Okubo**

Module 9, Week 9: Digestive System I:

a) Gastrointestinal Tract (Taylor Lipscomb, USFWS)

**Two-hour scheduled online discussion, March 12 - Taylor Lipscomb**

[Spring Break, March 17-21]

Module 9, Week 10: Crustacea and Endocrine/Reproduction System of Fish

a) Normal Crustacean Anatomy, Physiology, and Histology (Jamie Bojko, Teesside University, UK)

b) Histopathology of Representative Crustacean Diseases (Jamie Bojko)

c) Endocrine and Reproductive System of Fish (Jeff Wolf, Experimental Pathology Laboratories)

Homework Assignment 5 due

**1.5-hour (90 min) scheduled online discussion, March 26 - (12:50 - 2:20 pm) - Jamie Bojko**

**1.5-hour (90 min) scheduled online discussion, March 26 - (2:20 - 3:50 pm) - Jeff Wolf**

Module 10, Week 11: Digestive System II and Swim Bladder:

b) Liver, Gall Bladder, Pancreas, and Swim Bladder (Ilze Berzins)

**Two-hour scheduled online discussion, April 2 - Ilze Berzins**

Module 11, Week 12: REVIEW

**Two-hour scheduled online discussion, April 9 - Roy Yanong**

Module 12, Week 13: Mollusca: Bivalves

a) Normal Bivalve Anatomy and Physiology and Histology (Shirley Baker, FAS)

b) Histopathology of Representative Bivalve Diseases (Roxanna Smolowitz, Roger Williams University)

Homework Assignment 4

**Two-hour scheduled online discussion, April 16 - Shirley Baker/Jenny Dill-Okubo**

Module 12, Week 14: Coral and Horseshoe Crabs

a) Coral Anatomy, Histology, and Representative Diseases (Ilze Berzins)

b) Histology of Horseshoe Crabs (Harley Newton)

**Two-hour scheduled online discussion, April 23 - Ilze Berzins and Harley Newton**

Final Exam - Available April 28 - May 1 (timed - 3 hours)

## Additional References

### Suggested References

1. *Biology of the Hard Clam*, Kraeuter and Castagna
2. *Systemic Pathology of Fish*, Ferguson

### Additional References

1. *Wheater's Functional Histology, 4<sup>th</sup> Edition*, Young and Heath, Churchill/Livingstone, 2000
2. *Color Atlas of Veterinary Histology*, Bacha and Wood, Lea and Febiger, 1990
3. *Histology and Cell Biology: An Introduction to Pathology*, Kierszenbaum;
4. *Fish Medicine*, Stoskopf (Fish Histology chapter)
5. *Fish Disease, Diagnosis and Treatment, 2<sup>nd</sup> edition*, Noga
6. *Fish Diseases and Medicine*, Smith
7. *Fish Pathology*, Roberts
8. *Molecular Biology of the Cell*, Alberts, et al.
9. *Atlas of Tilapia Histology*, Morrison et al, World Aquaculture Society

## Policies and Requirements

This course plan and syllabus are subject to change in response to student and instructor needs. Any changes will be clearly communicated in advance through Canvas.

### **Grades and Grade Points**

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>.

### **Attendance and Make-Up Work**

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>.

### **Accommodations for Students with Disabilities**

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center. See the "Get Started With the DRC" webpage on the Disability Resource Center site <https://disability.ufl.edu/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### **In-Class Recording**



Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal education use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and deliver by an instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentation such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or guest lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless, of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third-party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### **Privacy Statement**

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who unmute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

### **Online Course Evaluation Process**

Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. Students are expected to provide professional and respectful feedback on the quality of

instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at: <https://gatorevals.aa.ufl.edu/students/>.

Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via

<https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at: <https://gatorevals.aa.ufl.edu/public-results/>.

### **UF Honor Code**

UF students are bound by The Honor Pledge which states “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Conduct Code specifies a number of behaviors that are in violation of this code and the possible sanctions. See the UF Conduct Code website for more information. If you have any questions or concerns, please consult with the instructor or TAs in this class.

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: <https://policy.ufl.edu/regulation/4-040/>

### **Whole Gator App**

The Whole Gator and website and app connects UF students with resources dedicated to supporting overall health and well-being. In addition to many of the resources below it also has strategies to practice self-care. <https://one.ufl.edu/whole-gator/topics>

### **Health and Wellness**

- U Matter, We Care: If you or someone you know is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu), 352-392-1575, or visit U Matter, We Care website to refer or report a concern and a team member will reach out to the student in distress.
- Counseling and Wellness Center: Visit the Counseling and Wellness Center website or call 352-392-1575 for information on crisis services as well as non-crisis services.
- Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit the Student Health Care Center website.
- University Police Department: Visit UF Police Department website or call 352-392-1111 (or 9-1-1 for emergencies).

- UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; Visit the UF Health Emergency Room and Trauma Center website.
- GatorWell Health Promotion Services: For prevention services focused on optimal wellbeing, including Wellness Coaching for Academic Success, visit the GatorWell website or call 352-273- 4450.
- Student Success Initiative, <http://studentsuccess.ufl.edu>

### **Academic Resources**

- E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at [helpdesk@ufl.edu](mailto:helpdesk@ufl.edu).
- Career Connections Center: Reitz Union Suite 1300, 352-392- 1601. Career assistance and counseling services.
- Library Support: Various ways to receive assistance with respect to using the libraries or finding resources. Call 866-281-6309 or email [ask@ufl.libanswers.com](mailto:ask@ufl.libanswers.com) for more information.
- Teaching Center: 1317 Turlington Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring.
- Writing Studio: Daytime (9:30am-3:30pm): 2215 Turlington Hall, 352-846-1138 | Evening (5:00pm-7:00pm): 1545 W University Avenue (Library West, Rm. 339). Help brainstorming, formatting, and writing papers.
- Academic Complaints: Office of the Ombuds; Visit the Complaint Portal webpage for more information.
- Enrollment Management Complaints (Registrar, Financial Aid, Admissions): View the Student Complaint Procedure webpage for more information.

### **Student Complaints:**

- Residential Course: <https://www.ombuds.ufl.edu/complaint-portal/>
- Online Course: <https://pfs.tnt.aa.ufl.edu/state-authorization-status/#student-complaint>