

Instructor: Dr. Wendy Lewis

Instructor e-mail: glewis13@gmu.edu

Course Time: Thursday 1:30am – 4:10pm

Course Location: Exploratory Hall L509

Credits: 3

Office: Krasnow 254

Office Hours: Wednesday 10am-12pm

Course Overview:

Zebrafish (*Danio rerio*) are a powerful model system used in neuroscience, biology and pharmacology research. This is primarily because zebrafish embryos are optically transparent and develop externally, which means that developmental processes can be directly visualized and manipulated beginning at the one-cell stage! Zebrafish are also vertebrates, and their nervous system has more in common with humans than you might think. In this laboratory, you will use zebrafish as a model system to study vertebrate nervous system development. You will learn basic techniques for manipulating, imaging, and analyzing zebrafish embryos, while performing experiments to investigate the structure and function of the nervous system in healthy and diseased states. You will work with other students to design and carry out a novel scholarly research project.

Research and Scholarship Learning Goals

During this course you will work in small groups to design, execute, and present an original research project. Each group's project will be different and will make important contributions to our knowledge of nervous system development. Research and scholarship related learning goals and the course activities that support them are listed below.

Core: Articulate and refine a question, problem, or challenge.

- Project proposal

Discovery: Distinguish between personal beliefs and evidence.

- Project proposal
- Lab reports

Ethics: Identify relevant ethical issues and follow ethical principles.

- Lab reports
- Lectures/discussions

Method: Choose an appropriate research method for scholarly inquiry.

- Project proposal
- Investigation of live imaging, morphology, and locomotor behavior
- Free project work

Method: Gather and evaluate evidence appropriate to the inquiry.

- Investigation of live imaging, morphology, and locomotor behavior
- Immunohistochemistry
- Free project work

Method: Appropriately analyze scholarly evidence.

- Investigation of live imaging, morphology, and locomotor behavior
- Immunohistochemistry
- Free project work
- Project presentations
- Lab reports

Context: Explain how scholarly inquiry has value to society.

- Project presentations
- Lab reports
- Lectures/discussions

Context: Explain how knowledge is situated and shared in relevant scholarly contexts.

- Lectures/discussions

Creation: Take responsibility for creating and executing an original scholarly or creative project.

- Project proposal
- Project meetings
- Investigation of live imaging, morphology, and locomotor behavior
- Immunohistochemistry
- Free project work

Communication: Communicate knowledge from an original scholarly or creative project.

- Project presentations
- Project write-up

Course Specific Learning Goals:

By the end of this course, you should be able to...

- Compare and contrast the organization of the nervous system in zebrafish and humans
- Describe the advantages and disadvantages of zebrafish as a model system
- Describe common experimental techniques used in zebrafish research
- Perform basic zebrafish manipulations, including staging embryos, dechorionating, removing unfertilized embryos, and exchanging media
- Anesthetize zebrafish embryos and perform live imaging
- Analyze embryo morphology and locomotor behavior
- Explain the concept of immunohistochemistry and use this technique to analyze neurons and glia in whole-mount embryos
- Analyze data using appropriate statistics
- Explain how alcohol and other drugs affect nervous system development at the molecular, cellular, and morphological level
- Diagram and explain the development of the zebrafish nervous system
- Develop a research question, design an experiment, collect data, carry out analyses and interpret results
- Effectively present your research in written and oral format

Opportunities to Present Research

Students will have the opportunity to present their research projects within and outside of Mason. These opportunities will be discussed in class and assistance will be provided in preparing applications and abstracts. Opportunities include: The Society for Neuroscience Annual Meeting, the Mid-Atlantic Society for Developmental Biology Annual Meeting, the COS Undergraduate Research Colloquium, the OSCAR Celebration of Student Scholarship, and more.

Text and Readings

There is no required text and weekly readings will be posted on Blackboard

Supplies

- Lab notebook (cheap composition book)
- One laptop or tablet with USB port per group. If no one in your group has one, please let the instructor know

Grading and Assessments:

Lab Notebook	15%
Participation	15%
Reading Quizzes	5%
Lab Reports and Assignments	30%
Research Project (Proposal, Oral, Poster)	35%

Total Grade **100%**

Grading Scale

A 90-100%

B 80-89%

C 70-79%

D 60-69%

F 0-59%

Assignment Details:

Lab Notebook- You will maintain a lab notebook according to guidelines provided by the instructor. Someone unfamiliar with the lab procedures should be able to look at your lab notebook and replicate the procedures that you conducted during class. Details about what should be included in lab notebooks will be provided on a weekly basis.

Participation: Your grade in this course will include a participation score ranging from 0 – 5 points per class meeting. A score of 5 points will be given to a student who reports to lab on time, is prepared by having completed the readings ahead of time, is properly dressed, and actively participates in all lab activities and class discussions. A score below 5 points will be given to a student who does not fully demonstrate 100% effort in a given lab session. This could include things like arriving late, being unprepared, inappropriate phone usage during class, not having done the readings, not actively participating in lab activities and discussions, disrupting other students, failing to cooperate, leaving lab before all the work (including cleaning) is done, etc.

Reading Quizzes: Assigned readings may include lab protocols, textbook chapters, and journal articles. Typically, you will be expected to read a journal article and the lab protocol for that week before each class. These readings will be distributed via Blackboard. In order to ensure that all students are reading before class, short quizzes will be given at the beginning of most lab sessions. You will have the first 5-10 minutes of class to complete the quiz. If you are late to class and miss the quiz, you cannot make it up.

Lab Reports and Assignments: You will complete written lab reports to assess your knowledge of classroom activities. Some reports may include statistical analysis that require you to use GMU's computer labs. Other reports will include the objective of the experiment, the hypothesis tested, reporting of results, and conclusions regarding the results.

Research Project: You will work in small groups to design, conduct, and present an original research project using zebrafish embryos and the techniques covered in class. You and your group will work together on this project throughout the semester. Your group will give an oral presentation of your findings and will report results in written format in lab reports throughout the semester. Detailed information about this project will be distributed in class. The research project will include a proposal (individual assignment), final oral presentation (group assignment), and poster (group assignment).

Attendance Policy, Make-up, and Late Work

You are expected to attend class and participate in all discussions and activities. Attendance is an integral part of this course, and absences will result in significant missed information. Unexcused absences will result in a loss of participation points for the day. There will be no make-up labs or quizzes available. Late work will incur a penalty of 10% of the earned grade per day.

All policies may be modified on an individual basis at the discretion of the instructor. Excused absences may require a doctor's note or other documentation

Communication and E-mail

If you need to contact me, please do so using e-mail **from your university account only**. **Include the course name in the subject line and your name in the e-mail**. Check your e-mail and course Blackboard account daily and before each class meeting. I will use e-mail and Blackboard to communicate with you regarding changes related to the course, syllabus, and other essential information. You are responsible for all announcements posted and sent via Blackboard and e-mail, in addition to announcement make in class.

Student Conduct Policies

Be kind and respectful to your classmates, Disruptive, disrespectful, or rude behavior will lead to dismissal from class and will count as an absence for the day. You will also miss out on all the cool things we do in lab!

Cell phones in the lab: Please silence phones during class. Texting is not allowed. Cell phone use/ringing (other than for emergency) during class may result in deduction of points from the course participation grade.

Computers in the lab: Computers will only be allowed in the lab during specified times.

Laboratory Dress: You **must wear long pants and closed toed shoes** in the laboratory. If you are improperly dressed, you will not be allowed into the lab.

Food and Drink: There is absolutely **no food or drink** allowed in the lab.

Academic Integrity

Honesty and integrity are issues at the very core of this course and of science as a whole. George Mason has an honor code with clear guidelines for academic integrity. A few of the most important rules that pertain to this course are as follow: 1) All work submitted must be your own should be done individually unless explicitly stated otherwise. You will be encouraged to discuss ideas, collaborate, and brainstorm with your classmates, but actual assignments need to be completed individually. 2) When referencing the work of others (this includes published and non-published work or ideas), full credit must be given through appropriate citations. 3) If you are ever unsure about the rules for an assignment, ask for clarification. Cheating and plagiarism of any form is not tolerated. Plagiarism means using the exact words, opinions, or information from another person without giving the appropriate credit. Any offense will result in a grade of F for the course and will be dealt with in accordance with university regulations.

Disability Accommodations

If you have a documented learning disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with Office of Disability Services (SUB I, Rm. 4205; 993-2474; <http://ods.gmu.edu>) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Mason Diversity Statement*

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

** This is an abbreviated statement, full statement is available at <http://ctfe.gmu.edu/professional-development/mason-diversity-statement/>*

Privacy and E-mail Use

Students must use their MasonLive email account to receive important University information, including communications related to this class. I will not respond to messages sent from or send messages to a non-Mason email address.

Add/Drop Deadlines

- Last day to add: September 3
- Last day to drop (no tuition penalty): September 9
- Final drop deadline (50% tuition liability): September 17
- Self-Withdrawal period (100% tuition liability, W on transcript): September 18 – September 30
- Selective-Withdrawal period (100% tuition liability, W on transcript): October 1– October 29

Schedule Overview

*Research and scholarship related activities are highlighted in blue

Date	Topic	Activities	Readings/Assignments Due
Aug 29	Introduction to Zebrafish	<ul style="list-style-type: none"> • Intro to zebrafish • Laboratory safety and zoonosis • Introduce projects • Field trip to Krasnow 	
Sept 5	Staging and Development	<ul style="list-style-type: none"> • Temperature experiment • Staging exercise • Dechorionate and label anatomy (24-38 hpf) 	Quiz on Reading: <ul style="list-style-type: none"> • Kimmel at al., 1995 pages 253-260 • Lab Guide: Staging and Development <p>Zebrafish CITI training due</p>
Sept 12	Live Imaging	<ul style="list-style-type: none"> • Microscopes, anesthesia, mounting, and live imaging • Talk about project chemicals 	Quiz on Reading: <ul style="list-style-type: none"> • Rieger et al., 2011 • Lab Guide: Live Imaging <p>Staging Lab Report Due</p>
Sept 19	Morphology Scoring	<ul style="list-style-type: none"> • Experimental design • Assign project proposals • Project meetings • Score morphology of embryos 	Quiz on Reading: <ul style="list-style-type: none"> • Panzica-Kelly et al. 2010 • Lab Guide: Morphology Scoring (Lab and Guide files) <p>Live Imaging Lab Report Due Project meetings today (have chosen chemical)</p>
Sept 26	Data Analysis and Graphing	<ul style="list-style-type: none"> • Raw data to figures: SPSS and Image J Tutorial 	No reading quiz <p>Bring laptop to class</p> <p>Project Proposals Due</p>
Oct 3	Locomotor Development and Analysis	<ul style="list-style-type: none"> • Analyze spontaneous tail coiling and touch-evoked responses • Assign Project Solutions worksheet 	Quiz on Reading: <ul style="list-style-type: none"> • Downes and Granato, 2006 • Lab Guide: Locomotor Analysis <p>Morphology and Data Analysis Lab Report Due</p>
Oct 10	Project Preparation	<ul style="list-style-type: none"> • Make solutions • Practice pipetting and experimental setup 	<p>Project Solutions Worksheet Due (bring to class)</p>

Oct 17	Project Work I	<ul style="list-style-type: none"> • Live Imaging, Morphology and Locomotor Analysis 	Locomotor Lab Report Due
Oct 24	Project Work II	<ul style="list-style-type: none"> • Live Imaging, Morphology and Locomotor Analysis 	
Oct 31	Project Work III	<ul style="list-style-type: none"> • Live Imaging, Morphology and Locomotor Analysis 	
Nov 7	Immunohistochemistry I	<ul style="list-style-type: none"> • Day 1 IHC on treated embryos 	Project Work Lab Report (individual) and SPSS file (group) Due
Nov 14	Immunohistochemistry II	<ul style="list-style-type: none"> • Day 2 IHC on treated embryos 	Poster draft due
Nov 21	Immunohistochemistry III Project Work IV	<ul style="list-style-type: none"> • Imaging and analysis of IHC • Continue remaining project work 	Immunohistochemistry Lab Report Due
Nov 28	No Class! Thanksgiving!		
Dec 5	Project Presentations and Research Celebration Location TBD	<ul style="list-style-type: none"> • Oral presentations of projects 	PowerPoint slides AND Poster due to Blackboard before class Submit Project Title to https://uge.gmu.edu/students-submit-a-project/ Self and Peer Evaluation Due by Friday 12/6 at 11:59pm