Zebrafish Neurodevelopment Laboratory
NEUR 406: Spring 2022

MASON IMPACT
MasonImpact.gmu.edu

Instructor: Dr. Wendy Lewis
Instructor e-mail: glewis13@gmu.edu
Course Time: Thursday 1:30am – 4:10pm
Course Location: Exploratory Hall L509
Credits: 3
Instructor Office: Krasnow 254
Office Hours: Drop-in office hours are held virtually during the times below. If you are unable to attend a drop-in time, please email me to schedule an appointment.

- **Tuesday, Wednesday & Friday 1pm-2pm.** Drop into the Zoom room to meet. https://gmu.zoom.us/j/4952912681

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.

Safe Return to Campus
All students taking courses with a face-to-face component are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (https://www2.gmu.edu/safe-return-campus). Similarly, all students in face-to-face and hybrid courses must also complete the Mason COVID Health Check daily, seven days a week. Only students who receive a "green" notification are permitted to attend class. ***You will be required to your "green" notification upon entry to class. If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. DO NOT ATTEND CLASS IF YOU ARE SICK!***

Students are required to follow Mason's current policy about facemask-wearing. As of August 11, 2021, ***all community members are required to wear a facemask in all indoor settings****, including classrooms. An appropriate facemask must cover your nose and mouth at all times in our classroom. If this policy changes, you will be informed. Students who do not have a facemask will be asked to leave the classroom.*

Mason Impact + Research and Scholarship
This course is designated as a Mason Impact + Research and Scholarship course. This means you will "engage in the process of generating and sharing undergraduate research". As part of the course, you will design, execute, and present a research project relating to neurodevelopment in zebrafish. Your completed project can be submitted for a special transcript designation displaying the title of your project, and you may present your project at one of Mason's symposiums.

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. All readings/activities will be provided and posted on Blackboard.

Supplies

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

Grading and Assessments:

Lab Notebook	10%
Participation	15%
Lab Reports/Assignments/Quizzes	40%
Research Project- Group grade (Proposal, Oral, Poster)	35%
Total Grade	**100%**

Grading Scale:

A+ 98-100%	B+ 88-89%	C+ 78-79%	D 60-69%	F 0-59%
A 90-97%	B 80-87%	C 70-77%		

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. The first page of the lab notebook will be a table of contents. Every page should contain the date, a page number, and the title of the activity. 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. If you are unable to attend due to illness or not receiving a "green" health check, email the professor for alternative assignments.

Lab Reports/Assignments/Quizzes: You will complete written lab reports to assess your knowledge of classroom activities. Some reports may include statistical analysis that require you to use downloaded software or GMU's computer labs https://its.gmu.edu/service/computer-labs/. Other reports will include the objective of the experiment, the hypothesis tested, reporting of results, and conclusions regarding the results. Before attending lab each week, you will usually need to 1) read the weekly research paper, 2) read the weekly lab activity and 3) complete the online reading quiz. Reading quizzes will be taken in Blackboard.

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. Detailed information about this project will be distributed in class. The research project will include a proposal (group grade), project write up (individual grade), final oral presentation (group grade), and poster (group grade). You will submit confidential peer feedback on group members at the conclusion of the course, which will be factored into the project and participation grades.

Attendance Policy 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. Please contact the instructor if you will be unable to attend lab or have not been cleared by the Mason COVID Health Check. Absences due to emergencies or lack of Mason COVID Health Check Clearance may be excused at the instructor discretion. There will be no make-up labs available, but alternative work may be assigned. Assignments are still due even if you are absent. You may obtain data needed for the assignments from group members.

Late work will incur a penalty of 20% and may be turned in up to 2 weeks after the deadline.
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) You may not use the work of former students to help you on assignments. This is considered cheating. 4) 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 referral to the Office of Academic Integrity 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.

Student Services

- Learning Services (learningservices.gmu.edu/keeplearning/)
- University Libraries (library.gmu.edu)
- Writing Center (writingcenter.gmu.edu)
- Counseling and Psychological Services (caps.gmu.edu)
- See a longer list of Mason student support services posted on The Stearns Center website.

Add/Drop Deadlines

Deadlines for the Fall 2021 semester can be found on the Mason Academic Calendar page.

Course Calendar
NEUR 406-001, Spring 2022

Date	Topic	Lab Activities	Pre-Lab Activities and Assignments Due *Due 1 hour before class unless noted* *All assignments submitted to Blackboard unless noted*
Week 1 Jan 27	Introduction to Zebrafish	• Introduction to zebrafish • Laboratory safety and zoonosis • Introduce projects • Field trip to Krasnow?	
Week 2 Feb 3	Staging and Development	• Temperature experiment • Staging exercise • Dechorionate and label anatomy • Discuss project design and assignments	Pre-Lab Activities • Read Kimmel at al., 1995 pages 253-260 • Read Lab Guide: Staging and Development • **Take Pre-Lab Quiz** Assignments Due • **Zebrafish CITI training** (submit completion reports to Blackboard)
Week 3 Feb 10	Live Imaging	• Microscopes, anesthesia, and live imaging • Discuss project ideas with group and professor	Pre-Lab Activities • Read Rieger et al., 2011 • Read Lab Guide: Live Imaging • **Take Pre-Lab Quiz** • Brainstorm project ideas with group Assignments Due • **Staging Lab Report**
Week 4 Feb 17	Morphology Scoring	• Score morphology of embryos • Assign literature review	Pre-Lab Activities • Read Panzica-Kelly et al. 2010 • Read Lab Guide: Morphology Scoring • **Take Pre-Lab Quiz** • Choose project chemical/treatment before class Assignments Due • **Live Imaging Lab Report Due**

Week 5 Feb 24	Data Analysis and Graphing **Virtual Lab**	• Watch Lecture: From Raw Data to Figures • Complete SPSS Tutorial • Complete Image J Tutorial • Take Virtual Lab Quiz	Pre-Lab Activities • Download SPSS and ImageJ- make sure you can open programs Assignments Due • **Literature Review Due by 12:30pm on 2/24** • **Virtual Lab Quiz Due by 11:59pm on 2/24**
Week 6 Mar 3	Locomotor Development	• Analyze spontaneous tail coiling and touch-evoked responses • Assign Project Proposals	Pre-Lab Activities • Read Downes and Granato, 2006 • Read Lab Guide: Locomotor Analysis • **Take Pre-Lab Quiz** Assignments Due • **Morphology and Data Analysis Lab Report Due**
Week 7 Mar 10	Solutions and Dilutions	• Pipetting, solutions, dilutions, experimental setup • Discuss project proposals with professor	Pre-Lab Activities • **Sign up for Krasnow Lab Tour for Week 9** Assignments Due • **Project Proposals Due (group assignment)**
Week 8 Mar 17	**Spring Break** **No Class!**	• **No Class**	
Week 9 Mar 24	**Lab Tour and Project set up in Krasnow Lab (237) (sign up for time)**	• Tour Krasnow lab during assigned time • Make project solutions	Pre-Lab Activities • Project Solutions Worksheet Assignments Due • **Locomotor Lab Report Due** • **Bring Project Solutions Worksheet to Lab Tour**
Week 10 Mar 31	Project Work I	• Project Data Collection (Live Imaging, Morphology, Locomotor Analysis)	Pre-Lab Activities • **Set up project in Krasnow Lab**
Week 11 Apr 7	**No Class**	• **No Class**	
Week 12 Apr 14	Project Work II	• Project Data Collection (Live Imaging,	Pre-Lab Activities **Set up project in Krasnow Lab**

		Morphology, Locomotor Analysis)	
Week 13 Apr 21	Immunohistochemistry (IHC)	• Day 1 IHC on project embryos	• **Project Work Lab Report (individual) and SPSS file (group) Due**
Week 14 Apr 28	Immunohistochemistry (IHC) Imaging Project Work III	• Imaging and analysis of IHC • Finish/repeat any project experiments as needed • Poster feedback • Work on Presentations	Pre-Lab Activities • Finish Day 2 and 3 of IHC in Krasnow lab Assignments Due • **Poster draft due** • **Immunohistochemistry Lab Report Due**
Week 15 May 5	Project Presentations and Research Celebration	• Oral presentations of projects	Due Thursday 5/5 before class • **PowerPoint slides due to Blackboard before class (group)** Due Friday 5/6 by 11:59pm • **All data files (SPSS and images) (group)** • **Final Poster (group)** • **Self and peer evaluation (individual)** Due Monday 5/9 by 9am • **Lab Notebook Due**
Submit Project Slides to Mason Impact after you are done! https://provost.gmu.edu/initiatives/mason-impact/mason-impact-students			

NOTE: This schedule is subject to change at any time! **Check the Blackboard calendar and announcements every week for updates. You are responsible for all announcements and syllabus modifications made in class each week whether you are present or not.**

Project work is in blue.