

Fish/Biol 340: Introduction to Genetics and Molecular Ecology

An overview of the fundamentals of molecular genetics and the application of genetic techniques to problems in ecology, evolution and natural resource management

Autumn Quarter 2023, 5 Credits

Course Description

Rationale

In the past few decades, molecular genetics has become one of the fastest growing fields in the life sciences. The application of molecular methods has spread to virtually all fields of modern biology, including ecology, conservation, breeding and natural resource management, leading to the establishment of a new discipline, Molecular Ecology. With the expansion of the application of molecular tools, it has become crucial that all biologists have a basic understanding of genetics and molecular biology, and the application of molecular tools to the detection of kin, the identification of populations, the reconstruction of phylogenetic relationships, and more recently, to the understanding of local adaptation and evolution. Rather than providing an overview of classical genetics, the aim of the course is to provide an understanding of the genetic principles underpinning these applications, thus allowing an assessment of the potential and limitations of molecular approaches to specific questions in ecology, evolution and resource management.

The course will be important to students for the following main reasons:

- **Basic understanding:** The current ubiquity of molecular genetic studies in virtually all fields of biology requires some basic understanding of the genetic principles underpinning molecular methods. Continuing developments in molecular technology, statistical analyses and computer power will further widen potential applications. Thus, even if students do not envisage using genetics in their own research, some genetic knowledge will be necessary in almost any career track.
- **Practical application:** If molecular genetic methods are to be applied effectively in ecology, evolution and general biology, they have to be carefully chosen according to the ecological and biological circumstances, assumptions of the methods and the specific aims of the study. Furthermore, an understanding of the evolutionary dynamics of molecular markers in the context of the biological question of the research is a crucial prerequisite for the interpretation of genetic data. It is thus necessary that students have a good overview of available methods, their appropriate application and potential shortcomings.
- **Communication:** Many of the current problems in the application of genetic data are founded in conceptual misunderstandings between scientists applying genetic methods and the end users of their research (fisheries managers, breeders, forest managers, conservationists). It is therefore important that students are aware of these misunderstandings and are able to understand and explain genetic research.

Aim and Objectives

To provide students with a fundamental understanding of genetic principles underlying the application of molecular genetic techniques.

Students will be able:

- To understand basic principles of molecular genetics
- To apply such principles to ecological, environmental and conservation research
- To interpret genetic data in an applied context
- To communicate and disseminate the results of their research

Basic Approach

We will achieve the above aim and objectives by the following means

- **Lecture Videos:** Most basic material will be delivered as short videos by subject. Watch those videos, and **take notes!** Most videos also contain one or two quiz questions, which will contribute to your grade. Make sure you watch these videos before class sessions, because I will not repeat them in class.
- **Class sessions:** Class sessions on Tuesday and Thursday will be in person in FSH107 and will be used to go over examples and past exam questions. Class sessions will use PollEverywhere, so make sure you are registered.
- **Textbook:** there is no required textbook for this class, but one is highly recommended (see [Readings](#) page).
- **Primary literature:** There are links to primary literature in the field on the [Readings](#) page as well as in the specific week under Modules. All these papers are fairly brief and easy. Don't worry too much about details of the methods, but consider the problem, the approach the authors took, their general results and their interpretation of the results. You should read these papers - although they won't be on the exam per se, they may be used as examples in exam questions aiming at lecture material. Furthermore, they will help you deciding on style and detail needed for your project report.
- **Laboratories:**
 - **Molecular Labs** (Wet Labs, FTR 113): The first three weeks labs will be used to introduce you to molecular methods such as DNA extraction, PCR and electrophoresis. These methods usually involve a lot of waiting, so we will use these labs also to deepen your theoretical understanding of molecular methods. Most of these labs will contribute data to your lab project.
 - **Computer Labs** (FSH 136) will be used to improve and deepen your understanding of concepts from lecture and textbook (see also the lab sections on the Modules page). We will use simulation programs to learn about genetic processes and analysis programs to analyze sample data sets. Although Windows PCs are available in the lab, please download all required software (which is free, links available on the [Links](#) page) on your own laptop. If you don't have a laptop, you can loan one from the [Student Technology Loan Program](#).

- **Project Report:** As part of the laboratories, we will conduct a study on the population structure of Pacific herring in the Salish Sea (see [lab project](#)). Students will submit a 2500 word (about 8-10 double spaced pages) project report, which aims at integrating lecture material, laboratory experiments and literature and also will help to improve communication skills. The project report will be structured like a scientific paper (Introduction, Methods, Results, Discussion), and we will write sections for this report as the quarter progresses. These draft sections will be reviewed by class mates, using an online peer review system (FeedbackFruit). See the [Lab Project](#) page for more details and specific instructions.

See the 'Pages' ([Front Page](#)) link for more information about the course, lecture notes and lab handouts.

Technology

Because of remote learning, we will use a lot of technology, and here are a few pointers:

- If you are off-campus and you want to access on-campus resources, the best way is to install [Husky-OnNet](#). This software will allow you to access library and other resources, though you will still have to sign on to Canvas.
- **Communication:** Please use [EdDiscussion](#) for any questions - our response time is likely much shorter there than by e-mail. Make sure to search EdDiscussion before asking questions. Also, feel free to reply to questions - instructors will monitor traffic and approve correct answers. Students who consistently answer questions correctly will receive extra points.
- **Clickers:** As a classroom response system, we will use [PollEverywhere](#)

[Links to an external site.](#), which is free for students. You are already registered, so make sure you login with your UWNID to receive credit. Have your device handy, and respond under www.pollev.com/lorenz

- [Links to an external site.](#).
- **Peer Review:** we will use FeedbackFruit to peer review sections of the project report throughout the quarter (see [Project Report](#) for details). This tool is now integrated with Canvas, so you only have to click on the assignment (in [Modules](#)) to access it - **please do not access it directly via their website**. Importantly, make sure that the link works - if you tell me 5 min before the deadline, there is probably not much I can do.

Strategies for success

The most important thing in this class is to be an active participant, and be prepared for lectures and laboratories. Make sure you stay up to date with the lecture material, and ask if anything is unclear. Make sure to watch videos and complete quizzes before synchronous class sessions. DO NOT leave revisions until the day before the exam. Also, make sure to read lab handouts before lab, and submit your lab reports in time. Be aware that the project report (together with the drafts) counts for 35% of the class grade - you won't pass this class without submitting a final

project report. Make sure to submit your drafts and reviews on time (Wednesdays, 23:59), and most importantly, keep on revising your drafts throughout the quarter.

Time table

This is a very rough timetable by week. More specific details will be provided under [Modules](#)

Week	Date (T)	Lecture Topic	Lab
1	9/28 (Th)	Introduction, Project	DNA extraction, notebook, pipetting, Project
2	10/3	DNA, replication; PCR & sequencing	PCR, qPCR
3	10/10	Sequencing, Mendel, Relatedness	Data analysis
4	10/17	Hardy-Weinberg equilibrium	Relatedness
5	10/24	Fixation indices	Hardy-Weinberg
6	10/31	Microevolutionary forces: mutation, drift	Population Genetics Simulations
7	11/07	Microevolutionary forces: selection, migration	Papers
8	11/14	Phylogeography, Phylogeny	Phylogenetic trees
9	11/21	Thanksgiving	
10	11/28	Genomics	Population Genomics
11	12/5	Gene expression	review Session
	12/11 (M)	Final Exam	

Grading and Course Policies

Grading

Assessment will mainly be aimed at problem solving abilities rather than regurgitation of read material. All aspects of the assessment, from laboratory participation to the final exam will thus involve worked examples, many of which will have been discussed in lectures.

We do not mark on a curve, but set the grade based on equal categories between the top grade and the passing grade. This means that your grade is only affected by the top grade. You do need 50% of the final research paper grade, 50% of the exam grade, and 50% of the marks overall to pass this class.

Breakdown of percentage score

Video quizzes - 5%

Panopto videos contain fairly easy quizzes to make sure that you haven't fallen asleep.
In class assignments - 10%

In each class session there will be some clicker questions and sometimes other assignments. These will be graded, but the lowest two scores will be automatically dropped to allow you to stay home if you feel sick. If you need more dropped scores, let us know in advance.

Pre-lab quizzes - 5%

We will distribute a lab handout at the beginning of each week, and there will be a quiz that has to be completed by the beginning of the lab.

Laboratory reports - 15%

There will be some form of report after each lab. This reporting may have several forms, ranging from short answers to questions in the lab handout to short lab reports and discussion boards. We will also give points for in-lab participation. The exact form of the report will be explained in each lab, so make sure to take notes. Be aware that the material will also be on the exams and is the basis for your project reports. You should be able to complete these reports in the lab, but if you need more time, lab reports are due at the beginning of the next Tuesday's lecture.

Project Report - 35%

Students will write a ~2500 word report on the results of the laboratory project. This report will be prepared in sections which will be submitted to an online peer review system allowing feedback from classmates. The final report is due at the end of quarter.

Project Report Drafts, reviews and back evaluations - 20%: There will be four project report drafts, one each for introduction, methods and results. These will be submitted online and graded by four of your classmates. You will review four of your classmates drafts and provide comments. See the [Syllabus](#) and the [Project report](#) pages for more details.

Final Project Report - 15%. The final report will be submitted to Canvas and will be graded by instructors.

Mid term exam - 10%

The mid term exam serves to give a first insight into teacher and student performance and to identify problem areas. Here are

[midterm questions](#)

from past years.

Final exam - 20%

The final exam will cover the material of the entire class, including required reading material and labs (i.e. the exams are cumulative). Here are the

[final exams](#)

of previous years.

For calculating decimal grades from percentages, the following rules apply:

1. You need 95% to get a 4.0
2. You need 50% to pass the class

that means you can work out your grade from the following equation:

$$DG = 0.073*PG - 2.97$$

where DG is the decimal grade and PG is the percentage grade. Note, however, that this is only a guideline and that your grade may be one or two decimal points higher or lower.

Course Policies

Class Material

Do not share any course materials (lectures, lecture notes, recordings, assignments, quizzes, exams) posted to the class Canvas site. These materials are protected by U.S. copyright law and by [University policy](#) and may not be reproduced, distributed, displayed, posted or uploaded without written permission from the instructor. If you do so, you may be subject to academic misconduct proceedings under the [UW Student Conduct Code](#).

Absences

This class is conducted in-person. Students are expected to participate in class to fully benefit from course activities and meet the course's learning objectives. Students should only register for this class if they are able to attend in-person. To protect their fellow students, faculty, and staff, students who feel ill or exhibit possible COVID symptoms should not come to class. When absent, it is the responsibility of the student to inform the instructor in advance (or as close to the class period as possible in the case of an unexpected absence), and to request appropriate make-up work as possible. What make-up work is possible or how assignment or course grading might be modified to accommodate missed work is the prerogative of the instructor. However, to facilitate occasional absences due to illness, the lowest score will be dropped automatically from pre-lab quizzes, in-class quizzes and weekly assignments. For chronic absences, the instructor may negotiate an incomplete grade after the 8th week, or recommend the student contact their academic adviser to consider a hardship withdrawal (known as a Registrar Drop).

Make-up labs

All laboratories take considerable time to prepare. Therefore, we cannot offer make-up labs. If you cannot come to a lab, let us know at least a week in advance. If the absence is justified, we will try to accommodate you in one of the other sections or try to find other solutions. Note that lab material may be on the exam, that lab reports will be graded, and that many labs are needed to complete the project report.

Late work

We have designed this course to maximize your learning of the subject matter and advance your skills through a variety of activities. Therefore, our attendance policy is aimed at supporting our educational goals.

Assignments designed to help you prepare for class (e.g. online quizzes, discussions or homework due in class or section) will not be accepted after the due time (i.e., the night before the class by 11:59 pm).

Work scheduled to be presented or performed in class (e.g., in class worksheets, discussions and hands-on simulations) will not be accepted after the due time (i.e., 24h after the beginning of each lecture: T, Th, Sat 9:30 am)

Writing and lab assignments that are submitted late will incur a 10% deduction for every day that the work is overdue, starting from the deadline given in class. In other words, if you are given a deadline of 5:00 pm, and you hand in the assignment at 6:00 pm, you will lose 10%.

Assignments and lab reports are due at the beginning of the class period on the due date. After that, 10% of the mark will be subtracted for each day late, and after three days we won't grade it anymore.

Exams

Missed Exams: Exams are only offered on the scheduled dates and time, and “make up” exams will not be offered. Acceptable reasons to miss an exam are listed in the [University handbook](#)

[Links to an external site.](#) Make-Up exams may be provided after the exam - these make-up exams will consist of questions different from the scheduled exam, and may therefore be more difficult. No make-up exams will be provided before the class exams, so make sure that you stay in town until the final exam.

Regrading: regrading requests must be submitted in writing together with the exam no earlier than three days and no later than a week after publishing grades. We will regrade the entire question, and so your grade may go down as well as up.

Academic Integrity

The University of Washington Student Conduct Code ([WAC 478-121](#)) defines prohibited academic and behavioral conduct and describes how the University holds students accountable. I expect that you will know and follow university policies on cheating and plagiarism.

Acts of academic misconduct include:

- **Cheating:**
 - unauthorized assistance in person and/or online for assignments, quizzes, tests or exams
 - using another student's work without permission and instructor authorization
 - allowing anyone to take a course, assignment or exam for you without instructor authorization
 - unauthorized use of material from ChatGPT or other AI systems
- **Falsification:** intentional use of falsified data, information or records
- **Plagiarism:** representing the work of others as your own without giving appropriate credit to the original author(s)
- **Unauthorized collaboration:** working with other students in the course on assignments, quizzes or exams without permission

- Engaging in behavior **prohibited by an instructor**
- **Multiple submissions** of the same work in different courses without instructor permission
- Deliberately **damaging or destroying student work** to gain advantage
- **Unauthorized recording**, and/or subsequent dissemination of instructional content

If these definitions are not clear to you, please contact us so that we can review them with you. It is important that you fully understand what is and is not permissible in this course.

Any suspected cases of academic misconduct will be handled according to university regulations, which include:

1. submission of the case material (description of the incident and supporting documents such as an exam, paper, and any communications about the incident) to the College of the Environment Dean's Office
2. suspension of the grade for the quiz, exam, homework, paper or other assignment in question
3. an X grade for the class in the case of the academic misconduct procedure continuing past the end of the quarter
4. a reduction, down to a zero, for the quiz, exam, homework, paper or other assignment in question should the academic misconduct hearing officer find you responsible

For more information, see the College of the Environment's [Academic Misconduct Policy](#) and the [Community Standards and Student Conduct](#) website.

Our specific policies in addition to these rules

- *In labs*, we encourage you to read and discuss primary literature, and collaborate over data analysis and processing. However, we would like you to present your interpretation of the data independently in the lab sessions and research paper. This interpretation includes your own graphics and tables, except where we have asked you to present team-generated work. All writing should be your own unless instructed otherwise. Instances of copying and plagiarism will result in a zero grade on the relevant assignment or research project.
- *Exams* must be taken independently, and no collaboration is permitted in any form, including in person and online collaboration. Instances of cheating during an exam will be awarded a zero on the entire exam.
- *In pre-class and post-class quizzes*, we encourage collaboration and discussion, but answers should be your own unless stated otherwise.
- *In in-class assignments*, we encourage collaboration and discussion in most cases, and may ask you to respond to questions alone or as a group. All writing and data analyses associated with in-class assignments should be your own.
- Work produced by *ChatGPT* and other AI systems may be used with the explicit and specific instructions of the teaching team, but otherwise represent plagiarism and cheating. We will occasionally use ChatGPT to improve writing, collect information and

get started, but never use any output from any of these systems as your own writing. There are several AI detection systems, and SimCheck will also incorporate an AI check.

For submissions we use SimCheck by Turnitin to detect plagiarism in assignments. SimCheck is a web-based system that allows student papers to be submitted and checked for plagiarism. SimCheck compares student papers with sources available on the Internet, select commercial article databases, and papers submitted at UW or other institutions using Turnitin. This is also a tool for you. When you submit your paper online, you will see your Turnitin "similarity score." This score tells you how much of your paper is similar to other sources. You can use SimCheck to see why the score is high - to see portions of your paper that may have been found somewhere else. If it is the reference list, don't worry; if it is part of the other parts of the paper, you should follow up on it.

Instances of cheating during an exam will be awarded a zero on that exam, quiz or test. Entering responses on a PollEverywhere other than the one registered to you will result in a zero clicker score up to the day of the event, both for you and for the person whose clicker you used.

Student Academic Grievance Procedures

The College of the Environment [Student Academic Grievance Procedures](#) provide mechanisms for enrolled students to address academic problems or grievances in an equitable, respectful and timely manner. Academic grievances are defined as those involving conflicts between a student or students and their course instructors (including faculty and teaching assistants) or research mentor(s) with respect to differences arising within credit-bearing work and while the student is registered at the University of Washington. If you have or are experiencing such a conflict in this class, and have not, cannot, or do not wish to attempt resolution with me, I encourage you to explore additional options open to you by accessing the website above.

Safety

If you feel unsafe or at-risk while taking this or any course, please contact [SafeCampus](#) at 206-685-7233 any time where you can anonymously discuss safety and well-being concerns for yourself or others. SafeCampus can provide individualized support, discuss short- and long-term solutions, and connect you with additional resources when requested. For a broader range of resources and assistance, see the [Husky Health & Well-Being](#) website.

Accommodations

Religious Accommodation

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at [Religious Accommodations Policy](#) (<https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/>)

[Links to an external site.](#). Accommodations must be requested within the first two weeks of this course using the [Religious Accommodations Request form](#) (<https://registrar.washington.edu/students/religious-accommodations-request/>)

[Links to an external site.](#)

Diversity, Equity and Inclusion

The University of Washington supports an inclusive learning environment where diverse perspectives are recognized, respected, and seen as a source of strength. In this course, I will strive to create welcoming spaces where everyone feels included and engaged regardless of their social and cultural backgrounds.

Disability Access and Accommodation

It is the policy and practice of the University of Washington to create accessible learning environments consistent with federal and state law, including establishing reasonable accommodations for all students. If you have already established accommodations with Disability Resources for Students (DRS), please activate your accommodations via myDRS so that we can discuss how they will be implemented in this course.

If you have not yet established services through DRS, and you have a temporary health condition or permanent disability that requires accommodations, contact DRS directly (disability.uw.edu) to set up an Access Plan. DRS facilitates the interactive process that establishes reasonable accommodations. Conditions requiring accommodation include but are not limited to: mental health, attention-related, learning, vision, hearing, physical or health impacts.

In assessing whether you require reasonable accommodations through DRS, please note that full participation in this course requires the following types of engagement:

Course component Requirements

<i>Lectures</i>	The ability to attend lectures of 50 minutes with 60 other students. The ability to collaborate in teams; includes worksheets, short discussions of data, the ability to conduct short computer exercises.
<i>Molecular Labs</i>	The ability to spend 3 hours in a molecular genetics lab, work in teams and use lab equipment; includes repetitive motions (pipetting) and standing for extended periods of time.
<i>Computer Labs</i>	The ability to spend 3 hours in computer labs to analyze data. The ability to collaborate in teams; may include 10-15 minute data presentations and discussions
<i>Research Project</i>	The ability to collaboratively analyze and interpret data and primary literature; involves computer work, creating text, uploading assignments. The ability to comment on other student's writing, and receive critical comments from others.

Exams and Quizzes The ability to complete short answer and multiple-choice questions within a limited amount of time. Some assessments will be online, but exams will be in person.

If you anticipate or experience barriers to your learning or full participation in this course based on a physical, learning, or mental health disability, please immediately contact the instructor to discuss possible accommodation(s). A more complete description of the disability policy of the College of the Environment can be found [here](#). If you have, or think you have, a temporary or permanent disability that impacts your participation in any course, please also contact Disability Resources for Students (DRS) at: 206-543-8924 V / 206-543-8925 TDD / uwdss@uw.edu e-mail / <http://www.uw.edu/students/drs>.

Roles & Responsibilities

Student: inform the instructor no later than the first week of the quarter of any accommodation(s) you will or may potentially require.

Instructor and TA: maintain strict confidentiality of any student's disability and accommodation(s); help all students meet the learning objectives of this course.