

# Molecular Evolution and Bioinformatics– Spring 2024

BIOL 4550 Section 001 – 3 Credits

Utah Valley University

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## **Instructor Information**

Dr. Carl E Hjelman (he/him)

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## **Office hours:**

Wednesday 11am-12pm and Thursday 11:30am-12:30pm or by appointment

## **Course Prerequisites:**

BIOL 3500 Genetics and minimum 6 additional credits upper division biology

## **Resources:**

### **Text:**

We will be discussing a number of papers and classic literature. These required readings will be posted in PDF format on Canvas. I can always make further reading recommendations if you ask

### **Course website:**

Canvas. Additional helpful resources are also available on <https://cehjelman.github.io>

You can access these sites from any computer linked to the internet.

**Access to Canvas will be critical as assignments, grades, updates, and other announcements will be posted there.**

### **Computation:**

While much of this class will rely on paying attention to lecture and participation in discussion and activities, some work requires use of a computer with internet access. I highly suggest that you bring your own laptop to class. **Please let me know if this is not possible.**

## **Course Information:**

### **Description**

“Nothing in biology makes sense except in the light of evolution”—Theodosius Dobzhansky

Evolutionary biology seeks to make sense of the miraculous diversity that exists within and among organisms on the planet. The concepts within this field of biology help us make sense of disease, viruses, ecology, and variation as a whole. This course will provide students with a broad conceptual foundation and capstone for life science courses they have taken or will take.

### **Course Objectives:**

- Integrate sub-disciplines of Molecular Biology into the unifying theme of Molecular Evolution.
- Recall the major scientists and ideas that contributed to the history of evolutionary thought.

- Explain the mechanisms of evolution: natural selection, migration, genetic drift, mutation, and nonrandom mating.
- Define the basic terminology and principles of the bioinformatic omics - such as genomics, transcriptomics, proteomics, etc.
- Contrast the different methodologies of DNA sequencing.
- Effectively use databases, websites, and computational methods for studying biological data in relation to the evolution of genes, proteins, and whole genomes.
- Interpret reconstructed evolutionary trees derived from sequence data.
- Apply the broader impacts of molecular evolutionary change as they relate to topics such as the tree of life, coevolution, biodiversity, evolutionary development, cultural issues, social issues, etc.
- Compose a variety of disciplinary-appropriate texts, for example: scientific essays evaluating various evolutionary topics, scientific posters, scientific manuscripts, mock grant proposals, etc.

### **Course Expectations:**

#### **Student Responsibilities**

Everyone (students and instructor) should treat others with mutual respect and patience. I encourage students to work together to solve problems, unless otherwise explicitly stated. I recognize students come from their own unique background and have had their own unique experiences. If you need any special accommodations or assistance, please do not hesitate to contact me with questions.

#### **How to do well in this course:**

How well you do will be directly related to the effort you put into it. Below are suggestions:

1. Regular attendance - You will benefit from class discussion and activities. Furthermore, the class needs your participation to establish a group dynamic that provides encouragement and support.
2. Be prepared - Please do assigned readings and assignments on time. If you are interested, I can always provide additional reading materials.
3. Listening and Speaking - We will practice being generous and respectful listeners. Know that the class will benefit from what you have to contribute. Please, no side conversations.
4. Additional Information - Keep up with the work--it's not intended to be difficult, but you can't stir up your thinking without a commitment to taking the class seriously. You will be required to do additional informal assessments and exercises. Many of these exercises will be in-class work; if you have sustained absences, you will have difficulty passing the course.
5. Making your needs known - Please let me know what your needs are throughout the term. I am happy to work with you to improve your experience in this course when possible.
6. Writing – Assignments **must be typed** unless otherwise specified. Well-written English and good spelling are expected; I will deduct points for excessive spelling and/or grammar errors on any assignment.
7. Distractions – Unless told otherwise, put away all electronic devices during class.
8. Success may take time outside of class - Mastery isn't immediate. Part of success is spending as much time studying that is necessary for you. This amount will vary from student to student. If you need tips or help, please contact me.

**Course Procedures:**

I have provided a preliminary schedule that we will follow, it includes the sequence of topics, reading materials, assignments, etc., however, keep in mind that this schedule is subject to change. You are responsible for all announcements made in class or online, and adjustments to schedule (even if you are not there). If you miss a class or come late after announcements have been made, you are responsible to find out from another student what announcements were made and what material was covered.

**Lecture Notes:**

Lecture notes or a power point presentation will typically be posted before lecture when possible. These notes will not cover everything said in lecture, but they should prove a useful addition to your notes for understanding and reviewing the concepts.

**Professor Responsibilities**

It will be my goal in this course to be prepared, organized, and provide a safe, productive environment to learn. Students can be expected to be treated fairly, and with respect. Additionally, all assignments will be graded and returned in a timely manner.

I will be available outside of class time to help any students who ask for it during student hours. If for any reason you cannot meet with me during the pre-determined times, you are welcome to contact me to discuss arranging an additional meeting time. You are always welcome to come by my office, but unless it is arranged in advance, I cannot guarantee I will be available.

The best method to reach me is through e-mail, however, please be patient and recognize that you may not always receive an immediate response. I will do my best to respond in a timely manner within reasonable hours, but e-mails sent late at night will not be responded to until the next day.

**Disclaimer - Communication and Syllabus Changes**

All items in this syllabus are subject to change or modification to correct errors or accommodate extenuating circumstances. You are responsible for messages sent by me and other UVU officials to your UVU email address. If you do not regularly use this address, please forward your UVU email to the address you regularly use. Please check the email for important class announcements and updates.

**Disclaimer – Artificial Intelligence and use of tools like ChatGPT**

Artificial intelligence (AI) is becoming an ever-prevalent tool in society and it is important to understand how this tool works. It is important to recognize this as a “tool” and not a “crutch”. AI is prone to “hallucinating” and giving incorrect or false results; it also does not allow me to gauge **your understanding** of material. I encourage use of all resources for your work but ask that you make it your own and that you do not ask AI to complete your assignments for you. If you utilize AI, be sure to indicate it in your response that you used AI and indicate how you corrected the response and made it your own. If I feel you are not adequately responding or that you are relying on AI too much, I reserve the right to remove points on responses, up to zero credit.

**Assessment:**

Your final grade will be determined by the following formula (to be determined):

<u>Area</u>	<u>% of grade</u>
Exams	30(15% each)
Reading Quizzes	15
Assignments	25
Proposal and Presentation	30
Total	100

- The class will **not** be graded on a curve
- Your final grade will be calculated on a percentage basis

<u>Cutoff</u>	<u>Grade</u>	<u>Cutoff</u>	<u>Grade</u>
93%	A	73%	C
90%	A-	70%	C-
87%	B+	67%	D+
83%	B	63%	D
80%	B-	60%	D-
77%	C+	<59.5%	E

**Assignments and Project Descriptions***Assignments (25%)*

In some of the sections, we will focus on the application of skills and utilization of tools. Handouts will accompany these activities and must be turned in on Canvas for assessment and feedback. Other sections will have short essays and papers to write up. Rubrics will accompany written assignments.

*Reading Quizzes (15%)*

We will be doing a number of readings for class. In order to encourage discussion and completion of these readings, there will be reading quizzes for each reading assignment. These will ask questions about broad concepts and some detail in order to assess completion of reading. Time will be made for in class discussion of these readings.

*Exams (30%)*

There will be two take home exams throughout the semester (see dates on schedule) and make up 30% of your final grade (15% each). These exams will be “take-home” exams and may include some basic recall of information from lectures, but will focus primarily on interpretations, critical thinking, and thoughtful discussion over open-ended questions.

*Proposal and Presentation (30%)*

While we will cover a lot of material in this course, we may not cover an organism or evolutionary topic that is of most interest to you. In order to enrich the material we learn in lectures, students will construct their own research proposal for a molecular evolution project. This project will be scaffolded throughout the semester and will conclude with a written proposal as well as a final presentation to occur in the last week of class. More details and a rubric to follow.

### **Late work:**

I will keep the window for submitting assignments open, but they will accrue a 10% grade deduction daily.

I understand that life can be chaotic and there are many things outside of your control. **If you are unable to complete an assignment for any reason by the due date, please let me know and we can work something out!** Remember to always let Dr. Hjelman know if you're going to be late!

### **Cheating and plagiarism:**

I encourage students to work together to solve problems, unless otherwise explicitly stated. This does not mean copying answers. I do not tolerate cheating of any kind, including copying from another student on exams or assignments. I will impose one of several penalties for cheating that range from a warning up to assigning a failing grade for the course. Please ask me if you are not sure about what constitutes plagiarism. See above statement about use of AI. If AI is used without modification, I consider this cheating.

### **UVU Policies and Resources**

**[Policies and Success Strategies \(Links to an external site.\)](#)**

**[Accessibility Services \(Links to an external site.\)](#)**

- Students who need accommodations because of a disability may contact the UVU Office of Accessibility Services (OAS), located on the Orem Campus in LC 312. To schedule an appointment or to speak with a counselor, call the OAS office at 801-863-8747. Deaf/Hard of Hearing individuals, email [nicole.hemmingsen@uvu.edu](mailto:nicole.hemmingsen@uvu.edu) or text 385-208-2677.

**[Campus Resources \(Links to an external site.\)](#)**

### **Technology Support Services**

For 24/7 technical support contact [Instructure's Canvas Support Live Chat \(Links to an external site.\)](#) (385) 204-4930 (Available 24/7)

### **Student Care Statement**

Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live, and believes this may affect their performance in the course, is urged to visit <https://www.uvu.edu/studentcare/> for access to a variety of resources. You may also email [care@uvu.edu](mailto:care@uvu.edu) for assistance.

All of us have a need to maintain mental health and benefit from the assistance of professionals to do so. UVU offers mental health services at very low cost (some are free). While there may be a wait list for individual counseling, group counseling may be available in some circumstances. Student Health Services is located in SC 221, telephone 801-863-8876 <https://www.uvu.edu/studenthealth/psych/>. The following community resources are available 24/7- the National Suicide Prevention Lifeline 1-800-273-8255 and the Safe UT Crisis Chat & Tip Line <https://safeut.med.utah.edu/>. You may also access the Crisis Text Line 741-741 or call 9-1-1. If an emergency is happening on campus, call campus police 801-863-5555.

**Tentative Course Schedule**

Here is a (tentative) schedule for topics. It is your responsibility to make up any work that you might miss if absent. All readings and assignments can be found on Canvas.

Wk	Dates	Topics	Readings	Due Dates
1	Jan. 9 Jan. 11	Intro & Syllabus Scientific Thought and Intro to Evolution		<i>Syllabus Quiz-Due Jan 12</i>
2	Jan. 16 Jan. 18	<b>Video on History of Evolution (no in-person class)</b> Mendel and the Modern Synthesis	For Class – Mendelism, Darwinism, and Evolutionism—Dobzhansky	<i>Reading Quiz due Jan 18</i>
3	Jan. 23 Jan. 25	Introduction to Pop. Gen. and Hardy-Weinberg Mechanisms: Mutation and Non-Random Mating	For Class – Crow and Dove 1988 & Crow 1999	<b>Reading Quiz—Jan 23</b>  <b>Modern Synthesis Scientist Essay Due Jan 26.</b>
4	Jan. 30 Feb. 1	Mechanisms: Selection Mechanisms: Selection		<i>Final Project Topic Selection due Feb 1.</i>
5	Feb. 6 Feb. 8	Selection on H-W Mechanisms: Genetic Drift and Gene Flow	For Class – Dobzhansky and Spassky 1962	<i>Reading Quiz due Feb. 8</i>
6	Feb. 13 Feb. 15	H-W Work Day H-W Work Day		<i>Darwin day Feb 12!</i>  <i>H-W Assignment due Feb 15</i>
7	Feb. 20 Feb. 22	Neutral Theory vs. Selection Neutral Theory vs. Selection	For Class – Kern & Hahn 2018 – Jensen et al. 2018 – Kreitman 1996	<i>Reading Quiz—Feb 20</i>  <i>Exam 1 Due Feb. 23</i>
8	Feb. 27 Feb. 29	Genome Structure, Duplications, and Gene Families Sequencing and Next Gen Methods	For Class – Demuth and Hahn 2009	<i>Reading Quiz—Feb. 27</i>  <i>Take a stance on the neutral theory essay—Mar 1</i>
9	Mar. 5 Mar. 7	Finding Sequencing Data Genome Sequencing Debate		<i>Sequencing Debate-March 7</i>

				<b>Annotated Bib. And Outline—Mar.8</b>
-	Mar. 11-15	<b>SPRING BREAK—NO CLASS</b>		
10	Mar. 19	Genotyping and GWAS		<b>Meet with Dr. Hjelman by March 22</b>
	Mar. 21	Molecular Pop. Gen		
11	Mar. 26	Molecular Pop. Gen	For Class – Schlebusch and Jakobsson 2018	<b>Reading quiz—March 26</b>
	Mar. 28	Phylogenetics and Tree Thinking		<b>Should you have to get approval for DNA kits-essay Due Mar. 29</b>
12	Apr. 2	Substitution Models and Alignments		<b>Submit Draft of Proposal—April 2</b>
	Apr. 4	Making your own phylogenies		<b>Submit Peer Review by April 5</b>
13	Apr. 9	Work on Project		<b>Exam 2 due Apr. 12</b>
	Apr. 11	Work on Project		
14	Apr. 16	Work on Project		
	Apr. 18	Presentations		
15	Apr. 23	Presentations		<b>Final Proposal due Apr. 26</b>

**Final Written Proposal: Due Apr 26 by 5pm**

**Final group evaluation: Due Apr 26 by 11:59pm**