

## **BIOL 487/587: Eukaryotic Molecular Genetics**

**FALL SEMESTER 2020**

### **Objectives:**

This course provides a detailed look at the fundamental molecular mechanisms that define the biology and genetics of eukaryotic organisms. Students will also learn about molecular biology techniques used to study these mechanisms. Where applicable, we will learn how mutations that affect these basic molecular mechanisms cause human disease. The course includes a bioinformatics tutorial that covers how to access information about protein structure, gene organization, RNA production and genome variations, including variants associated with disease.

**Required Text:** The Human Genome in Health and Disease (2019): Tore Samuelsson.

Assigned Articles from the Literature supplied as PDFs.

### **Prerequisites:**

Undergraduate/ BIOL 380 Biochemistry; Biol 310/Genetics 314

Graduate/MMBB541

**Time and Place:** TR 11-12:15 in Renfrew 126

**Grading:** The class will consist of four sections plus a bioinformatics assignment. Each section will be worth 100 points. This will come from a combination of assignments and a take-home exam. Graduate Students must take all four exams and do a short presentation in class. **Undergraduates may drop the lowest scoring section (except the final), and everyone must take all 4 take-home exams.**

There is one assignment that uses online databases to retrieve and analyze DNA and protein sequence and variation in human genomes. **The assignment is part of section 3 and the first draft is due November 10 for feedback and revision. The final form of the assignment is due December 11.**

**The assignment with worth 50 points. Failure to turn in a draft on November 10 will result in loss of 15 points.**

**Office hours:** Monday and Wednesday 10-11 am, via zoom. Or request another time for a zoom appointment.

### **Course Materials:**

Course Handouts will be posted prior to class on the Blackboard class site. All of you should receive an email about the course from Blackboard with instructions of how to access the class site.

The topics covered in each class may vary depending on how much we cover, but the exam dates are firm.

**Exams:**

There will be four take home exams during the year, each covering the material in a portion of the lectures. The exams will be based on the material covered during class, including the assignments. The lecture notes, your class notes and the required readings should be sufficient to study for the exams. **Notify me immediately if you will not be able to make a due date.** Grading mistakes must be claimed within 1 week from when exam is returned.

**Exam Schedule.** Exams will be available on BbLearn 1 days prior to the due date. Students will complete the exam questions and upload them in BbLearn by the due date. **These are NOT group activities and will be rigorously checked for plagiarism and similarity with other students' answers.**

Exam	Material	Date Available	Due Date
1	8/25-9/10	Monday Sept 14 11 am	Tuesday Sept 15 12:15pm
2	8/17-10/6	Wed. Oct 7 11 am	Thurs. Oct 8 12:15 pm
3	10/13-11/3	Wed Nov 5 11 am	Thurs. Nov. 5 12:15 pm
4	11/10-12/10	Thurs. Dec. 17 11 am	Fri. Dec 18 12:15

**Homework:**

**Daily assignment.** There will be an assignment posted on bblearn every lecture that has a video and/or reading associated with it. Each one will be worth 4-5 points. Students will upload completed homework on bblearn. These will be graded and will count towards the total of each section. **It is ok if you work with someone on this, but each student must turn in their own unique homework.** I suggest that they are uploaded the day of the lecture, but assignments will be accepted up until the due date for the exam associated with that section.

**Bioinformatics assignment.**

**There is a bioinformatics assignment that will provide hands-on experience with databases of protein structure, DNA and protein sequence and genetic variation. Each person will have their own protein.** Bioinformatics Homework will be available prior to class on October 13. Class on October 13, 15 or 20 will be (most likely) be Zoom meetings where I will demonstrate how to do the assignment (Oct 13) and then take follow up questions (October 15 and 20). A draft of the homework will be due on November 10.

**Learning Outcomes:**

1. **Learn and Integrate:** Students will learn about molecular biology techniques and integrate this information into how to interpret experimental results described in research articles.
2. **Think and Create:** Students will gain an appreciation of how our cells work and how mistakes in our DNA disrupt critical cellular process, including leading to genetic disease.
3. **Communicate:** Students will learn how to discuss cellular processes and molecular biology techniques and will write a summary of how mutations in a protein lead to disease (the bioinformatics assignment).
4. **Practice Citizenship:** Students will learn about and discuss ethical issues associated with knowing DNA sequences and the variety of ways this information may be used. This heightened understanding will be important as they help educate others about DNA and DNA sequencing.

## **ADVISORY**

**Academic Dishonesty:** Acts of cheating or plagiarism in BIOL 487/587 will result in an automatic zero for that exam or assignment. A zero on any one exam or assignment will result in an F as a final course grade. Please be aware that ALL parties involved in an act of cheating or plagiarism will be penalized. Cheating refers to the acquisition of answers to test questions or assigned materials in a dishonest fashion. Plagiarism is defined as 1) the use of another person's writing as your own and/or 2) the use of writing from published sources without citation. **Plagiarism includes copying or paraphrasing another's writing with slight changes in wording.**

One of the biggest challenges for students trying to summarize scientific papers is avoiding plagiarism. For guidelines on what is and what is not plagiarism and examples of each, please see the following website. A PDF of this content is also posted on the class website. Every year students in my class receive zeros on some assignments due to plagiarism.

<http://ori.hhs.gov/avoiding-plagiarism-self-plagiarism-and-other-questionable-writing-practices-guide-ethical-writing>

**Students with disabilities needing accommodations to fully participate in this class should contact Center for Disability Access and Resources (CDAR). All accommodations must be approved through CDAR prior to being implemented. To learn more about the accommodation process, visit CDAR's website at [www.uidaho.edu/cdar](http://www.uidaho.edu/cdar) or call 208-885-6307.**

## **Course structure and Main Topics**

- Part 1 DNA mutations: types, consequences and how we study them  
Chapters 1; 3-5; 9, 13
- Part 2 Transcription, Epigenetics and Cancer as a genetic disease  
Chapter 8, 10 (part of 5)
- Part 3 mRNA processing and regulation of translation. Bioinformatics.  
Chapter 8 (part of 6), 11, 12
- Part 4 Impact of DNA mutations on protein function; therapies to fix genetic diseases  
Chapter 2, 6, 7, 14, 15

The objective of the bioinformatics assignment is for students to get experience with online tools to analyze one specific protein/gene. It will cover basics of protein structure, and homology, gene structure, knowledge about alternative splicing, gene regulation and human variation, including mutations that are associated with human disease. Every student will have a different gene.

## Syllabus for BIOL 487/587 Eukaryotic Molecular Genetics

Instructor: Jill Johnson , Ph.D.

### Course Outline

Tuesday	Thursday
Aug 25 Intro, Chapter 3. Basics.	Aug. 27: Genome context, repeated sequences and CODIS, Ch. 4 (except p. 36-42)
Sept 1: Chapter 5 Variants in the human genome.	Sept 3: Methods:. Ch.4 p. 36-42, online materials)
Sept 8: Linking disease to gene: example of paper using a variety of techniques	Sept 10 Splicing and recombination errors. Ch. 9
Sept 15: <b>Exam 1 due</b>	<b>Sept 17: Transcription</b> basics and methods to study transcription and DNA-protein interactions.
Sept 22: Intro to epigenetics	Sept 24: Chromatin remodeling and DNaseI hypersensitivity
Sept 29 More epigenetics, intro to cancer as a genetic disease	Oct 1: Cancer genomes and issues with faulty DNA replication and repair
Oct 6: Telomerase: Cancer drug development: Gleevec, Her2, checkpoint inhibitors (part of Ch. 5)	<b>Oct 8: Exam 2 due</b>
<b>Oct 13:</b> Computer lab	<b>Oct 15:</b> Computer lab
<b>Oct 20:</b> Computer lab	<b>Oct 22.</b> Bioinformatics applications, example, ch 12
<b>Oct 27:</b> RNA modifications, stability and localization	<b>Oct 29:</b> Non-coding regulatory RNA
<b>Nov 3:</b> More about microRNAs, modified mRNA and disease Using the genetic code and errors in translation	<b>Nov 5: Exam 3.</b>
<b>Nov 10:</b> Protein folding diseases. CFTR and PAH mutations. <b>Draft of computer lab due.</b>	<b>Nov 12:</b> Prion disease and Alzheimers' disease
Nov 17: Targeting mutant proteins.	<b>Nov 19:</b> Targeting RNA: SMA and DMD, Triplet repeat diseases, Ch 7. and other
<b>Nov 24: Thanksgiving Break</b>	<b>Nov 26: Thanksgiving Break</b>
<b>Dec 8:</b> ISRIB and sticky mice.	<b>Dec 10:</b> Graduate student presentations
<b>FINAL EXAM: Friday December 18 10:15-12:15</b>	

**Grading:** Four course sections (including final)(100 points each), 1 bioinformatics assignment worth 50 points that is due near the end of the course. The final is not comprehensive, but information used in earlier sections of the course will be helpful for the fourth exam (knowledge of molecular biology techniques, etc). Undergraduates may drop score of one section (except the final).