

BIOL 4840- Genetic Biotechnology

Instructor:	Dr. James J. Youngblom	Term:	Spring 2017
Office:	Naraghi Hall 264	Lecture Times	Mon., Fri. 11:00-11:50
Office Phone:	667-3950	Lab Times:	Wed. 10:00-11:50
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Office Hours:	<u>Monday 12-1:30 pm, Thursday 10:00-11:30, or by appt.</u>		

University Course Catalog Description

BIOL 4840 3.0 units. Principles and applications of recombinant DNA technology. Emphasis on the tools of gene manipulation, genomic scale analysis, and bioinformatics. Weekly activity involving DNA analysis software. **Prerequisite: BIOL 3350.** (Lecture, 2 hours; activity, 2 hours)

Course Requirements

Students need knowledge of DNA structure, eukaryotic gene organization, transcription and translation, Mendelian genetic terminology, molecular properties, and chemical bonds. Basic level computer skills are required (web browsing, word, excel).

What is this course about?

The lectures on Mondays and Fridays are designed to prepare you to fill any position that requires knowledge of how scientists in the early 21st century manipulate DNA. The lectures describe the tools that are now available to learn about DNA, RNA, and proteins in any type of cell. This information will be valuable, most obviously, for students applying for graduate school in molecular biology. Since these tools and activities are so universal, the information is also valuable for students interested in health care, food science, microbiology, plant science, wildlife biology, etc. It is difficult to think of an area of biology that is not being transformed by the ability to decipher and edit DNA.

The Wednesday labs are different. All of the labs involve the use of DNA sequence analysis software. Students will become familiar with some of the most common methods for analyzing DNA sequences. In addition, students will be reinforcing what they have learned about how biology research progresses. After four weeks of practice exercises, students will spend a couple of months working on an independent research project that will create publishable information. The Wednesday activities will also reinforce some important genetic concepts for the students- what is the structure of a eukaryotic gene, how do genes evolve, and how can a single gene create variable protein products. See more about the lab activities below.

By the end of this course students will understand how to clone a gene and the value of genomic and cDNA libraries. Students will be able to explain PCR, RNAi, DNA sequencing methods, gel electrophoresis, Southern and Northern blotting, and CRISPR. Students will know how to select the appropriate molecular tools given a particular biological question. Students will appreciate the various approaches to gene mapping. Students will understand why various methods are used

for expression of gene products. Student will be able to select and utilize the appropriate DNA sequence analysis software. Students will know how to efficiently read an article from primary literature. Students will know how to assemble and appropriately prepare and present a PowerPoint presentation.

Required Text-

- 1) The Genome War by James Shreeve- Ballantine Books, 2005

Dates to Remember-

Wed. Feb. 22- Last day to drop a course	Fri. May 12- Warrior Day
Fri. Mar. 31 – Campus closed, Cesar Chavez Day	Wed. May 17- Last day of classes
Spring Break- No classes, Mar. 20- 24	Final Exam- Fri. May 19, 11:15 a.m.

Exams:

Fri. Mar. 3- **Exam #1 (60 pts)** Mon. Apr. 17- **Exam #2 (60 pts)**

Friday, May 19, 11:15 am - **Final Exam (100 pts)**

Exams/Quizzes/Reports-

Lab Reports (weeks 1-4) 20 pts. possible
 EXAM 1-Friday Mar. 3- 60 pts.
 Annotation Test- Wed. Mar. 29, 0 pts.
 Quiz #1- Wednesday Mar. 29, 10 pts (Genome Wars: Chapters 1→ 8)
 Quiz #2- Wednesday, Apr. 5, 10 pts (Genome Wars: Chapters 9→19)
 Quiz #3- Wednesday, Apr. 12 10 pts (Genome Wars: Chapters 20→ end)
 EXAM 2- Monday Apr. 17- 60 pts.
 Final Annotation reports- Wednesday, May 3, 12 p.m., 35 points
 Two Audience Presentation- Wednesday, May 10, 30 pts.
 Participation Points- 10 pts.
 Oral Presentation (Lab work) - Wednesday May 17, 15 points

FINAL EXAM- Friday May 19, 11:15- 100 pts.

Assessment	Date	Points	Percent of Final Grade
Lab Report 1-4	varies	20 pts.	5.6%
Exam 1	Mar. 3	60 pts.	16.7%
Quiz #1-3	varies	30 pts.	8.3 %
Annotation Test	Mar. 29	0 to -15 pts.	0 %
Exam 2	Apr. 17	60 pts.	16.7%

Written Annotat. Report	May 3	35 pts.	9.7%
Oral Annotation Report	May 17	15 pts.	4.2%
Two Audience Lecture	May 10	30 pts.	8.3%
Participation Points	Varies	10 pts.	2.8%
Final Exam	May 19	100 pts.	27.8%
		360 pts.	100%

Each exam will be a mixture of different types of questions (such as true/false, multiple choice, problems, short answer, and short essay). The first two exams will be based on lecture material and reading in the text. The lectures given by groups of students will be included on the final exam. The first two exams are not comprehensive. The final exam is comprehensive and will include questions about genome annotation from the laboratory exercises. A simple calculator may be used during the exams. **No leaving** the classroom during exams. The quizzes on Mar. 29, Apr. 5 and Apr. 12 will be taken entirely from the book “Genome Wars” by James Shreeve. This book is available in paperback and is found in some libraries. Read it in its entirety and you will do well on these quizzes.

Grading Scale (%)

(These numbers will not be raised; they could be lowered slightly)

<u>%</u>	<u>Grade</u>	<u>%</u>	<u>Grade</u>
94-100	A	74-76	C
90-93	A-	70-73	C-
87-89	B+	67-69	D+
84-86	B	64-66	D
80-83	B-	60-63	D-
77-79	C+	0-59	F

Make-up:

If you know you cannot be in class on the day of an exam, please see me beforehand so we can discuss the situation. I may allow you to take the exam at a later date. If something comes up unexpectedly on the day of an exam, please contact me. If you have a leave a message, leave a phone number, so we can be in touch. Do not ‘let it ride’ and plan on discussing it with me later. If I don’t hear from you promptly, you get a 0.

Other Assessments

Lab Reports 1-4- 5 pts. each. These are submitted via email and are due on the following Wednesday at 11 am. Late reports are penalized 1 pt. per day. Each person submits a report.

Annotation test (Mar. 29) - The annotation test is to confirm that students have learned the basics of gene annotation. Students failing the annotation test on Mar. 29 will take another annotation

test on Apr. 5. Students passing the annotation test will be rewarded (TBA). Students failing the annotation test twice lose 15 pts on their annotation report score.

Annotation reports (written [35 pts.] and oral [15 pts]). - The annotations reports are the final products from your gene annotation projects. The type of reports for each gene in your cosmid is well documented and will be explained as you learn how to annotate genes. Your grade will be determined by the neatness, accuracy, thoroughness, coherency, and timeliness of your reports. Each time a section of your report needs to be rewritten, there is a penalty. Reports can be submitted throughout the end of April and early May. All reports are due at 12 p.m. on May 3. Tardiness on the annotation reports will result in a penalty: 10% if it is 1 workday late, or 20% for 2-5 workdays late, 30% if 6-10 workdays late. These assignments will not be accepted if overdue by more than 10 workdays. Summarize the most interesting puzzles in your gene annotation in a short (5-7 minutes) PowerPoint presentation on May 17.

Oral presentation- You should create a PowerPoint lecture to summarize the most interesting findings of your gene annotation. You do not need to explain basic genetic terms that have already been explained in class. Rehearse your PowerPoint presentation. The presentation should be 6'-8' minutes in length. **Your score will be deducted if your presentation is too long or too short.** You are not allowed to read anything during your presentation. No reading of notes and no reading of your PowerPoint slides. Use your PowerPoint slides as a rough outline for you to follow and then know the material well enough to explain each slide without reading it or using notes. Show important screen captures from the analysis of your cosmid and explain them to the class.

Student Presentations (30 points)!

Groups of 4 students will be assigned a rare genetic disease and a type of cure to research (see below). Imagine you are starting a biotech company based on the development of this cure for this disease. For the company to be successful you need to recruit two groups of people- investors (venture capitalists) and scientists (molecular geneticists). On May 10 give a two-part presentation to the class. One part is designed to convince people with money to invest in your company. The other part (obviously more detailed) is to recruit scientists to join your company. Each portion should be 5-7 minutes. Dress appropriately.

<u>Type of cure</u>	<u>Disease</u>
Enzyme Replacement Therapy	Mucopolysaccharidosis Type I
Gene Therapy	Leber Congenital Amaurosis
Increase Expression of neighboring gene	Spinal Muscular Atrophy
Increase Expression through binding of a transcription factor	X-linked Hypohidrotic Ectodermal Dysplasia
Exon Skipping	Duchenne Muscular Dystrophy
Chaperone assisted folding	Fabry Disease

Your classmates will help in grading your presentation- 2/3 of your class presentation score is determined by your classmates. Those scores are the same for each person on your team. Your instructor will determine the other 1/3 of your score. Individual students may be graded differently.

Your student colleagues will complete this form after your presentation:

CATEGORY					Total/Comments
Organization/preparation of the presentation.	Excellent. All four were ready to go and well rehearsed. (4 pts.)	Good. Most of the group members were professional and knew their material. (3 pts.)	Could be better. The group did not seem particularly organized. (2 pts.)	Everybody needs to be better prepared next time. (1 pt.)	
The genetic disease was well described- what gene is effected and what does it do?	Excellent. I understand the biology of the disease now. (6 pts.)	Good- I understand the disease better than before. (4.5 pts.)	Inconsistent. Some aspects of the disease were not well described (3 pts.)	Needs work here. I was unable to follow. (1.5 pts.)	
The need for a cure was clarified. What are the current treatment options? What are the effects if someone is not treated?	Current treatments options thoroughly explained. (6 pts.)	It was a good attempt but incomplete. (4.5 pts.)	I needed more info. to appreciate the need. (3 pts.)	There was little information provided. (1.5 pts.)	
The potential market was well described. Who and how many people will want this drug.	Excellent- The description was thorough and well described. (4 pts.)	Good. The attempt was uneven. I know who wants this drug but not how many. (3 pts.)	There was a little information provided but more is needed. (2 pt.)	Needs works. There was no information provided. (1 pt.)	
How this genetic disease will be cured was properly explained. What techniques will your company need to master?	Excellent- The science behind the cures was clearly explained. (6 pts.)	Good. This helped clarify would this disease would be cured. (4.5 pts.)	OK but a little short and lacking in thoroughness. (3 pts.)	The description was lacking. I needed a much longer, clearer summary. (1.5 pts.)	
PowerPoint	Good color, graphics, clear figures. A lot of work went into putting the lecture into PowerPoint. (4 pts.)	Good color, graphics, most of the figures easy to read. A fair amount of work went into this assemble. (3 pts.)	OK but not up to standards for college seniors. Review how to make better PowerPoint presentations. (2 pts.)	Unattractive PowerPoint. Much more work needed in this area. (1 pt.)	
					Final TOTAL =

The labs:

BIOL 4840 provides CSU Stanislaus undergraduates the opportunity to contribute to original research involving a large-scale DNA sequencing projects from Washington University St. Louis Genome Sequencing Center. Students will analyze portions of chromosome 4 of *Drosophila ficusphila* and compare the data to chromosomes of *D. melanogaster* to determine genome *D. ficusphila* organization. The lab tools will be various types of DNA sequence analysis software. If you successfully complete the annotation of your *Drosophila* clone, give your instructor

reliable contact information. You will be contacted to see if you want to be a co-author when Washington University is ready to publish a paper on the comparative genomics of various species of *Drosophila*.

- During the 1st, 2nd, 3rd, and 4th Wednesdays of the semester, the class will work together to explore several DNA analysis software tools. During this time, students will learn how to analyze genomic data. Homework from these labs is due at the start of the next lab.
- At the Mar. 1 lab meeting of the semester, each student will be assigned a file of DNA from *Drosophila ficusphila* (35-50 kb).
- All students will complete a brief annotation test that will determine lab partnerships.
- Independent work will happen in class and outside of class.
- On May 17 each (pair of) student(s) will give a 6-8' minute PowerPoint presentation, summarizing their most interesting annotation problem.**

Class information:

The website <http://www.csustan.edu/Blackboard/> will have a link for this class. On Blackboard, I will post materials pertaining to this class. The lectures for this class will be presented in PowerPoint. The PowerPoint lectures will also be available on-line at <http://www.csustan.edu/Blackboard/>. Lab handouts are also available on Blackboard.

Notes:

Each Wednesday you work on a computer. Laptops are provided if needed. All of the DNA tools we will use are web-based. If you want to work on your own laptop, you can as long as you can connect to the internet in Naraghi Hall. The first four weeks are structured and will include a lab handout that is due the following week. The first hour (or so) of class will be your instructor introducing some important concepts. Both the lab exercises and demonstration materials will be available electronically on the class Blackboard site.

The lectures will relate to the tools of biotechnology. These tools will be introduced more or less chronologically starting with the usage of restriction enzymes for gene cloning in the 1970s and concluding with next generation sequencing and other tools of the last few years.

Email

I will use email to send you course announcements. The emails are sent to your csustan email account. Email is the good way for you to communicate with me outside of class time. I check my email many times per day on weekdays and periodically on weekends.

Student Conduct- The Wednesday activities will run the full two hours. Attendance is required. Do not enroll in this class if you have conflicts or other commitments on Wednesday afternoons. Be on time for class. During the first minutes of many Wednesday lab periods we will discuss the day's activities. Do not leave the classroom in the middle of a lecture. Do not use cell phones, ipods, or other electronic devices during class. Computers are only allowed in class as a tool for note taking or class exercises.

Cheating/Academic Dishonesty- Students caught cheating are prosecuted as described in the university catalog. A report is filed with the Dean of Student Affairs. Class homework assignments are not group projects. Copying from someone's paper and presenting it as your own is a form of academic dishonesty. All electronic devices (including phones) & headphones must be kept in purses or backpacks during the exams and quizzes. No exceptions. You can use a real calculator and not the calculator function on a cell phone or PDA.

Taping Policy- Audiotaping of classes is permitted only with prior permission of the instructor; videotaping is not permitted under any circumstances. Authorized tapes are for the personal use of the student, and may not be distributed to others without the permission of the instructor.

Guest Policy- Guests are generally not permitted in this class. For an exception to this policy you must request prior permission.

How to do well in this class-

1. **COME TO CLASS** and ask questions. Take good notes, Review and rewrite your notes.
2. Search for material related to each lecture.
3. Review the PowerPoint lectures.
4. Start studying for exams early. Avoid cramming the night before exams. The three exams account for 63% of your grade.
5. Spend extra time on topics that are new to you- use the internet for extra help (there is unlimited amounts of information related to course topics online).
6. If material is unclear, see me during my office hours. If something is really unclear, ask for a special review session.
7. Start early and work diligently on your lab projects. Keep good lab notes.
8. Keep an eye on all due dates. Start preparing your final lab report early and carefully proof read. Include a table of contents.
9. Make interesting PowerPoint presentations. Rehearse them so they can be presented smoothly.
10. When the lectures involve discussions of recent articles, read them before class. You will get a lot more out of the lecture if you have review the material beforehand.