GENETIC ENGINEERING IN MEDICINE, AGRICULTURE, & LAW

Winter 2016
Professors John Harada, Bob Goldberg, & C.S. Prakash

Science & Society 70A (UC Davis),
Honors Collegium 70A (UCLA),
Genetics and Society PLSS 0599 (Tuskegee University)

LECTURES & GUEST LECTURES: Tuesday & Thursday 3:30-6:00 → Olson 250

DISCUSSION SECTIONS: Wednesday 6:10-8:00 PM → SLB 2064

REQUIRED TEXTS: *Introduction to Biotechnology* (W. J. Thieman & M. A. Palladino)
The Annotated & Illustrated Double Helix (J. D. Watson)
Scientific American & *Other Articles* (uploaded on SmartSite)

OFFICE HOURS: Mondays: 11:00 – noon PM → Life Science 2163
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SMARTSITE: *https://smartsite.ucdavis.edu/portal*

GOLDBERG HC70A WEBSITE: *http://www.mcdb.ucla.edu/Research/Goldberg/HC70A_W16/*

TEACHING ASSISTANTS:
Leonardo Jo (ljo@ucdavis.edu) Office Hour: Thursday, 10:00 – 11:30 am
Hala Addassi (haaddassi@ucdavis.edu) By appointment

LECTURES: HC70A lectures are interactive, and in-class scientific "experiments" highlight important genetic engineering concepts. Lectures are webcasted to help you review concepts at your own pace. ***Note: Attendance in lecture is required.***

GUEST LECTURES: Guest speakers have been invited to highlight the real-life societal impacts of DNA and genetic engineering. ***Note: Attendance in guest lectures is required.***

DISCUSSION SECTION: Discussion Section is taught as an Undergraduate Seminar in Socratic style, and focuses on articles that relate to the history, applications, and societal impacts of genetic engineering. You must read the articles and text background material before discussion section and come prepared to participate in a thoughtful and interactive manner. Focus your reading around four questions: (1) What is the overall conceptual issue, or question, being addressed? (2) What are the technologies being discussed? (3) What is the significance of the technology, and how does it apply to real-life situations? (4) What ethical issues arise, if any, as a consequence of new technology? **A Discussion participation grade of *up to* 100,000 points will be assigned at the end of the quarter.** ***Note: Attendance in discussion section is required.***

QUIZZES: A **Take-Home Quiz** will be handed out each week, and will also be posted on the class website. The take-home quiz focuses on the reading material and concepts covered in both discussion and lecture for that week. Quizzes will count 25,000 points each. **Note: You may work together in groups in order to solve the quiz problems. However, each of you must learn how to solve the quiz problem, hand in your own quiz, and be prepared to answer quiz questions in Discussion or Lecture. Quizzes are due at the beginning of class the following Tuesday in Olson 250.**

DOUBLE HELIX REPORT: You will write a short report on *The Annotated & Illustrated Double Helix* by J. D. Watson that will count 40,000 points. Guidelines will be handed out in class. **The *Double Helix* Report is due at the beginning of class on Thursday, January 14 (Week 2)**

EXAMS: Exams include a **Take-Home Exam** and **Two All-Class Oral Exams**. Take-Home Exam questions will be handed out in class during Week 4 and will count 400,000 points. The mid-term oral exam will cover questions on the Take-Home Exam and Quizzes, and will count 100,000 points. Final Oral Exam questions will be handed out in class during Week 8 and will count 150,000 points. The Exam Schedule is:

Take-Home Exam: Due Thursday, February 11 at the beginning of class (Week 6)

All-Class Mid-Term Oral Exam: Thursday, February 11 (Week 6)

All-Class Final Oral Exam: Tuesday, March 8 (Week 10)

CLASS GRADING: You will be able to earn **ONE MILLION regular points** and a number of **BONUS POINTS** during the quarter. **Your grade will be based on 1,000,000 points**, although you have the potential for earning more than 1,000,000 points. Regular points will be divided as follows:

Assignment	Total Points	% Grade
Double Helix Report	40,000	4
Bacteria Cloning Report	10,000	1
Discussion Quizzes (8)	200,000	20
Discussion Participation	100,000	10
Take-Home Exam	400,000	40
Mid-Term Oral Exam	100,000	10
Final Oral Exam	150,000	15
TOTAL	**1,000,000**	**100**

The following guidelines will be used to assign grades: A (>90%), **B** (80-89%), **C** (70-79%), **D** (60-69%), **F** (<60%). Your grade will be assigned using the following formula:

$$\%\ \textbf{Total Points} = \frac{[(\text{Regular points} + \text{Bonus points})]}{[(1{,}000{,}000)]} \times [100]$$

DISCUSSION PARTICPATION CRITERIA: Each Discussion is worth 10,000 points. Points will be assigned as follows:

Grading Criteria	Total Points
Attend Discussion	2,500
Participate in Discussion	2,500
Demonstrate That You Have Read Assigned Articles	2,500
Demonstrate Thorough Understanding of Article Concepts	2,500
TOTAL	**10,000**

In addition, up to 10,000 points will be awarded for overall Discussion performance, for a total of 100,000 Discussion points that can be earned during the Quarter.

DATE	*LECTURE & DISCUSSION SCHEDULE (WEEKS 1-5)*
1/5	**Lecture 1:** *The Age of DNA: What is Genetic Engineering - Part One* **Short Films:** *Designing Life; Resurrecting the Extinct* **Demonstration**: Isolating DNA
1/7	**Films:** *Gene Engineers; Playing God* **DOUBLE HELIX REPORT QUESTIONS HANDED OUT**
DISCUSSION 1:	**Origins of Genetic Engineering-1:** *Manipulation of Genes; The Recombinant DNA Debate; A Return To Biotech's "Asilomar Moment"* **Demonstration:** DNA Gel Electrophoresis
1/12	**Lecture 2:** *The Age of DNA: What is Genetic Engineering - Part Two* **Demonstration:** Classical Genetic Engineering: Crop Origins **Short Film:** *History's Harvest: The Beginnings* **BACTERIA "CLONING" GUIDELINES HANDED OUT**
1/14	**Film:** *Race for the Double Helix* **DOUBLE HELIX REPORT DUE**
DISCUSSION 2:	**Origins of Genetic Engineering-2:** *Useful Proteins from Recombinant DNA* **Demonstration:** Bacteria "Cloning"
1/19	**Lecture 3:** *What Are Genes & How Do They Work: Part One* **BACTERIA "CLONING" REPORT DUE**
1/21	**Speakers: Channapatna Prakash, PhD**: *Engineering Crops For the Developing World;* **Alan McHughen, PhD**: *GMOs – What's All the Fuss About?* **All-Class Reception**
DISCUSSION 3:	**Crop Genetic Engineering:** *Transgenic Crops; Are Genetically Engineered Foods Evil? Oxford Farming Lecture*
1/26	**Lecture 4:** *What Are Genes & How Do They Work: Part Two* **Short Film:** *Kary Mullis and PCR* **Demonstration:** Making Your Own DNA Fingerprint!
1/28	**Film:** *Extraordinary Measures* **TAKE-HOME EXAM QUESTIONS HANDED OUT**
DISCUSSION 4:	**How to Mark Your Genes:** *Chromosome Mapping With DNA Markers; Genomics For the People; Genomics Can Improve Health Care-Right Now*
2/2	**Lecture 5 –** *How Are Genes Cloned & Engineered: The Hemophilia Story*
2/4	**Speaker: Harry Klann**, Supervising Criminologist, LAPD DNA Unit: *DNA Forensics & The Law* **All-Class Reception**
DISCUSSION 5:	**DNA & The Law:** *When Science Takes the Witness Stand; DNA Goes to Court; DNA Analysis Exposes Flaws in an Inexact Forensic Science; Problems With Touch DNA*

DATE	*LECTURE & DISCUSSION SCHEDULE (WEEKS 6-10)*
2/9	**Lecture 6 (From UC Davis): 21st Century Genetic Engineering Revolution**
2/11	**ALL-CLASS MIDTERM ORAL EXAM** **TAKE HOME EXAM DUE**
DISCUSSION 6:	**Animal Genetic Engineering:** *Transgenic Livestock As Drug Factories; FDA Approval of Genetically Engineered Salmon; CRISPR The Disrupter; Open Season Seen in Gene Editing of Animals; Jennifer Doudna, a Pioneer Who Helped Simplify Genome Editing; Meet One of the World's Most Groundbreaking Scientists-He's 34*
2/16	**Lecture 7:** *Age of Genomics-Identifying Individuals Past & Present Using DNA* **Short Film:** *Knowledge or Certainty*
2/18	**Speaker: Pei Yun Lee, PhD:** *Stem Cells: Promise, Reality, and Conflict* **All-Class Reception**
DISCUSSION 7:	**Stem Cells & Genetic Engineering:** *The Future of Stem Cells; Your Inner Healers; Diseases in a Dish; Pandora's Baby*
2/23	**Lecture 8 – Professor John Harada (From UC Davis):** *Human Genetic Engineering* **FINAL ORAL EXAM QUESTIONS HANDED OUT**
2/25	**Speaker: Michele Evans, MD:** *In Vitro Fertilization & Genetic Testing* **All-Class Reception**
DISCUSSION 8:	**Human Genetic Engineering:** *Gene Therapy; Gene Therapy's Second Act; Is the Gene-Editing Revolution Finally Here?; Gene Editing Offers Hope For Treating Muscular Dystrophy; DNA Editing of Human Embryos Alarms Scientists; No Time to Waste – the Ethical Challenges Created by CRISPER*
3/1	**Lecture 9:** *Science & The Law: Regulating Science & GMOs* **Short Films:** *Inherit the Wind***;** *Judgment Day*
3/3	**Lecture 10:** *Science & The Law: Who Owns Your Genes?*
DISCUSSION 9:	**Patenting Genes:** *Owning the Stuff of Life; Supreme Court Myriad Patent Ruling; CRISPR Patent Fight Now a Winner-Take-All Match; Scientists' Hopes to Win Nobel Prize for Gene-Editing Technique at Risk Over Patent Dispute*
3/8	**FINAL ALL-CLASS ORAL EXAM** End of Class Reception

TEXT READING ASSIGNMENTS:

Note: No textbook is perfect and follows the lecture sequence of every class – including *HC70A*! Your textbook contains most, but not all, of the conceptual information covered in *HC70A* lectures and discussion sections – but not in the same order. Because genetic engineering is changing at warp speed, several concepts presented in *HC70A* will be new, and were discovered only within the past few months. I will give you supplementary reading material to cover these concepts. ***The assigned textbook reading reviews and complements information related to the topics covered in each lecture and discussion. Study the information presented in these reading assignments, as it will help you understand the major concepts presented in HC70A and solve problems on the exams and quizzes.***

Introduction to Biotechnology, **3rd Edition (2013)**

Lecture 1	Chapters 1 & 3 (pgs. 58-69)
Discussion 1	Chapter 3 (pgs. 58-69)
Lecture 2	Chapters 1 & 3 (pgs. 58-69)
Discussion 2	Chapters 2, 3 (pgs. 69-84), & 5 (pgs. 133-135)
Lecture 3	Chapter 2
Discussion 3	Chapters 6, 12, & 13 (pgs. 326-328)
Lecture 4	Chapter 2
Discussion 4	Chapter 11 (pgs. 263-272; pg. 278)
Lecture 5	Chapters 3 & 11 (pgs. 263-272; pg. 278)
Discussion 5	Chapter 8
Lecture 6	Chapters 5 & 7 plus Supplementary Reading
Discussion 6	Chapters 7, 12, & 13
Lecture 7	Chapters 1 (pgs. 15-16), 3 (pgs. 88-99), &11 (pgs. 270-271)
Discussion 7	Chapters 11 (pgs. 292-305) & 13 (pgs. 330-333)
Lecture 8	Chapter 11 (pgs. 280-287)
Discussion 8	Chapter 11 (pgs. 280-287)
Lecture 9	Chapter 12
Discussion 9	Chapter 12
Lecture 10	Chapter 12