

GENETIC ENGINEERING IN MEDICINE, AGRICULTURE, & LAW
Winter 2013

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 → 250 Olson

DISCUSSION SECTIONS: To Be Determined

REQUIRED TEXTS: *Introduction to Biotechnology, 3rd Edition* (W. J. Thieman & M. A. Palladino)
The Double Helix (J. D. Watson)
Scientific American & Other Articles (posted on SmartSite)

OFFICE HOURS: Monday: 11:00 AM – 12:00 PM → 2163 Life Science
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WEBSITE: <https://smartsite.ucdavis.edu/xsl-portal>

GOLDBERG HC70A WEBSITE: http://www.mcdb.ucla.edu/Research/Goldberg/HC70A_W13/

VIDEOCAST OF LECTURES: <http://www.oid.ucla.edu/webcasts/courses/2012-2013/2013winter/ltnrs70a-1>

TEACHING ASSISTANT:

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LECTURES: HC70A lectures are very interactive, and all-class scientific “experiments” highlight important genetic engineering concepts. All lectures are webcasted and audio podcasted, and can be accessed from the BruinCast site to help you review and learn lecture 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 – please inform Professor Harada if you are unable to attend.*

DISCUSSION SECTION: Discussion Section is taught as an Undergraduate Seminar in Socratic style, and focuses on articles that relate to the history of genetic engineering, current applications, and societal impacts. Articles introduce important concepts and teach how to read and think critically about science.

Focus your reading around four questions: (1) What is the overall conceptual issue, or question, being addressed by the article? (2) What are the technologies and approaches 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 the new technology? **You must read the articles and text background material before discussion section and come prepared to participate in a thoughtful and interactive manner. 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 after each discussion section, 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 in class on the following Tuesday unless otherwise announced.**

CLASS DINNER: A class dinner will be scheduled later in the quarter.

TRIP TO UCLA: Our class is scheduled to travel to UCLA from February 12 - 14. At UCLA on Tuesday, Feb. 12, you will be placed into groups along with the students from UCLA to take the oral exam. On Wednesday, you will attend a discussion section at UCLA, and on Thursday, you will attend a lecture by Professor Goldberg. All of your travel and hotel costs will be covered by the class. In addition, each of you will be assigned hosts from the UCLA class. We strongly encourage everyone to participate in the trip. Alternative travel schedules are possible if you have unavoidable conflicts.

DOUBLE HELIX REPORT: You will write a short report on *The Double Helix* by J. D. Watson that will count 50,000 points. Guidelines will be handed out in class. **The *Double Helix* Report is due at the beginning of class on Tuesday, January 22 (Week 3)**

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 9 and will count 150,000 points. The Exam Schedule is:

Take-Home Exam: Due Tuesday, February 12 at the beginning of class (Week 6)

All-Class Mid-Term Oral Exam: Tuesday, February 12 (Week 6)

All-Class Final Oral Exam: Thursday, March 14 (Week 10)

GRADING: You will be able to earn **ONE MILLION regular points** and a number of **BONUS POINTS** during the quarter (e.g., lab report). **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:

	Total Points	% Grade
<i>Double Helix</i> Report	50,000	5
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:

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

DATE	TOPIC
1/8	Lecture 1: <i>The Age of DNA: What is Genetic Engineering - Part One</i> Short Films: <i>Designing Life; Resurrecting the Extinct</i> Demonstration: Isolating "Your" DNA
1/10	Films: <i>Gene Engineers; Playing God</i>
DISCUSSION 1:	Genetic Engineering Then & Now: <i>Articles From the Popular Press</i>
1/15	Lecture 2: <i>The Age of DNA: What is Genetic Engineering - Part Two</i> Demonstration: Classical Genetic Engineering: Crop Origins Short Film: <i>History's Harvest: The Beginnings</i> DOUBLE HELIX REPORT QUESTIONS HANDED OUT
1/17	Film: <i>Race for the Double Helix</i>
DISCUSSION 2:	Scientific Origins of Genetic Engineering & Biotechnology: <i>Manipulation of Genes; Useful Proteins from Recombinant DNA</i>
1/22	Lecture 3: <i>What Are Genes & How Do They Work: Part One</i> Demonstration: Bacteria "Cloning" BACTERIA "CLONING" GUIDELINES HANDED OUT DOUBLE HELIX REPORT DUE
1/24	Speakers: Channapatna Prakash, PhD: <i>Engineering Crops For the Developing World</i> ; Alan McHughen, PhD: <i>Crop Genetic Engineering – What's All the Fuss About?</i>
DISCUSSION 3:	Crop Genetic Engineering: <i>Transgenic Crops; GE Crop Adoption; Sowing a Gene Revolution; Golden Rice; Plant Drug Approval; Oxford Farming Lecture</i>
1/29	Lecture 4: <i>What Are Genes & How Do They Work: Part Two</i> Short Film: <i>Kerry Mullis and PCR</i> Demonstration: Making Your Own DNA Fingerprint! BACTERIA "CLONING" REPORT DUE
1/31	Film: <i>Conviction</i> TAKE-HOME EXAM QUESTIONS HANDED OUT
DISCUSSION 4:	How to Mark Your Genes: <i>Chromosome Mapping With DNA Markers; Keeping Your Genes Private; The DNA Dilemma; Fetal DNA Sequence; Perils of Newborn Screening</i>
2/5	Lecture 5 – How Are Genes Cloned & Engineered: <i>The Hemophilia Story</i> Demonstration: DNA Gel Electrophoresis
2/7	Speaker: Harry Klann, Supervising Criminologist, DNA Unit, LAPD: <i>Catching Criminals With DNA: It's Not CSI</i>
DISCUSSION 5:	DNA & The Law: <i>When Science Takes the Witness Stand; DNA Goes to Court</i>

DATE	TOPIC
2/12	UC Davis Students Visit UCLA TAKE HOME EXAM DUE ALL-CLASS MIDTERM ORAL EXAM UCLA & UC Davis Class Reception
2/13	Dinner 5 - UC Davis Students
2/14	Lecture 6: <i>Engineering Animals For Food, Drugs, & Disease Eradication</i>
DISCUSSION 6:	Animal Genetic Engineering: <i>Transgenic Livestock As Drug Factories; The Land of Milk & Honey; FDA Approval of Atrryn; Cloning For Medicine; FDA Approval of Genetically Engineered Salmon</i>
2/19	Lecture 7: <i>Age of Genomics-Identifying Individuals Past & Present Using DNA</i> Short Film: <i>Knowledge or Certainty</i>
2/21	Speaker: Pei Yun Lee, PhD: <i>Stem Cells: Promise, Reality, and Conflict</i>
DISCUSSION 7:	Stem Cells & Genetic Engineering: <i>The Future of Stem Cells; Your Inner Healers; Diseases in a Dish; Pandora's Baby</i>
2/26	Tuskegee Students Visit UCLA Lecture 8 – Professor John Harada: <i>Human Genetic Engineering & 21st Century Gene Therapy</i>
2/27	Dinner 7 – Tuskegee Students
2/28	Speaker: Michele Evans, MD: <i>In Vitro Fertilization & Genetic Testing</i> UCLA & Tuskegee Class Reception & Dinner 8
DISCUSSION 8:	Human Genetic Engineering: <i>Gene Therapy; What Cloning Means for Gene Therapy; Hitting the Gene Off Switch; Articles From Popular Press</i>
3/5	Lecture 9: <i>Science & the Constitution: Regulating Science & GMOs</i> Short Films: <i>Inherit the Wind; Judgment Day</i>
3/7	Film: <i>Extraordinary Measures</i>
DISCUSSION 9:	Genes & Cancer: <i>The Genetic Basis of Cancer; Mapping the Cancer Genome; Gene Therapy & Cancer-Articles From Popular Press</i>
3/12	Lecture 10: <i>Science & the Constitution: Who Owns Your Genes?</i>
Discussion 10:	Patenting Genes: <i>Patenting Life; Owning the Stuff of Life; Talking Gene Patents; Myriad Gene Patent Case Articles From NY Times</i>
3/14	FINAL ALL-CLASS ORAL EXAM End of Class Reception

TEXT READING ASSIGNMENTS FOR LECTURES AND DISCUSSIONS: Note: These chapters review all information related to the topics covered in each lecture and discussion PLUS additional topics.
Concentrate on chapter sections related to lectures and discussion articles.

INTRODUCTION TO BIOTECHNOLOGY, 3RD EDITON

LECTURE 1 Chapters 1 & 3

DISCUSSION 1 Chapters 2 & 3

LECTURE 2 Chapters 1 & 3

DISCUSSION 2 Chapters 2 & 3

LECTURE 3 Chapter 2

DISCUSSION 3 Chapters 6, 12, & 13

LECTURE 4 Chapter 2

DISCUSSION 4 Chapters 8 & 11

LECTURE 5 Chapters 3 & 11

DISCUSSION 5 Chapter 8

LECTURE 6 Chapter 7

DISCUSSION 6 Chapters 7, 12, & 13

LECTURE 7 Chapter 3

DISCUSSION 7 Chapters 11 & 13

LECTURE 8 Chapter 11

DISCUSSION 8 Chapter 11

LECTURE 9 Chapter 12

DISCUSSION 9 Chapter 11

LECTURE 10 Chapters 12 & 13

DISCUSSION 10 Chapter 11

DISCUSSION SECTION BIBLIOGRAPHY: Note: These articles are **required reading** for Discussion Section. They can be downloaded from SmartSite.

DISCUSSION ONE –Genetic Engineering: Then and Now

1. *Doomsday: Tinkering With Life*, Time Magazine April 18, 1977.
2. *The Miracles of Spliced Genes*, Newsweek Magazine, March 17, 1980.
3. *Shaping Life in The Lab*, Time Magazine, March 9, 1981.
4. *Immune Systems of “Bubble Baby” Restored by Gene Therapy*, UCLA News, September 14, 2012.
5. *Gene Therapy Cures Adult Leukemia*, WebMD, August 10, 2011.
6. *Gene Therapy Proves Effective For Hemophilia B*, Reuters, December 10, 2011.
7. *Want to Know My Future?*, Time Magazine, December 24, 2012.
8. *Entire DNA of Fetus Revealed through Risk-Free Testing*, Los Angeles Times, June 12, 2012.
9. *Scientist Creates Life. That’s a Good Thing, Right?*, Time Magazine, May 20, 2010

DISCUSSION TWO – Scientific Origins of Genetic Engineering & Biotechnology

1. Stanley N. Cohen, *The Manipulation of Genes*. Scientific American, July, 1975, **233 (1)**, 24-33.
2. Walter Gilbert and Lydia Villa-Komaroff, *Useful Proteins From Recombinant Bacteria*. Scientific American, April, 1980, **242 (4)**, 74-94.

DISCUSSION THREE – Crop Genetic Engineering

1. Charles S. Gasser and Robert T. Fraley, *Transgenic Crops*. Scientific American, June, 1992, **266 (6)**, 62-69.
2. USDA Economic Service Report on the Adoption of Genetically Engineered Crops, 2012
3. Terri Raney and Prabhu Pingali, *Sowing a Gene Revolution*. Scientific American, September, 2007, **297 (3)**, 104-111.
3. *Golden Rice*, Time Magazine, July 31, 2000.
4. Amy Maxmen, *Drug Making Plant Blooms*, Nature, May 10, 2012, **485**, 160.
5. Mark Lynas Oxford Farming Lecture, *“Apologies From an Anti-GMO Activist,”* January 3, 2013.

DISCUSSION FOUR – How to Mark Your Genes

1. Ray White and Jean-Marc Lalouel, *Chromosome Mapping with DNA Markers*. Scientific American, February, 1988, **258 (2)**, 40-48.
2. Mark A. Rothstein, *Keeping Your Genes Private*, Scientific American , September, 2008, **299 (3)**, 64-69.
3. *Want to Know My Future?*, Time Magazine, December 24, 2012.
4. *Entire DNA of Fetus Revealed through Risk-Free Testing*, Los Angeles Times, June 12, 2012.
5. Ariel Bleicher, *Perils of Newborn Screening*, Scientific American, July 12, 2012, **307 (1)**, 30-31.

DISCUSSION FIVE – DNA and the Law

1. Peter J. Neufeld and Neville Colman, *When Science Takes the Witness Stand*. Scientific American, May, 1990, **262 (5)**, 46-53.
2. Caitlin Smith, Stephen Strauss, and Laura DeFrancesco, *DNA Goes to Court*, Nature Biotechnology, November, 2012, **30 (11)**, 1047-1052.

DISCUSSION SIX – Animal Genetic Engineering

1. William H. Velander, Henryk Lubon, and William N. Drohan, *Transgenic Livestock as Drug Factories*. Scientific American, January 1997, **276 (1)**, 70-74.
2. Gary Stix, *The Land of Milk & Honey*, Scientific American, November 2005, **293 (5)**, 102-104.
3. *New Antithrombin Drug, ATryn, Approved by FDA*, National Blood Clot Alliance Website.
4. Ian Wilmut, *Cloning For Medicine*, Scientific American, December 1998, **279 (6)**, 58-63.
5. *GM Salmon: FDA’s Assessment of Risks*, Los Angeles Times, December 24, 2012
6. Amy Maxmen, *Politics Holds Back Animal Engineers*, Nature, October 18, 2012, **490**, 318-319.

DISCUSSION SEVEN – Stem Cells: Studying and Genetic Engineering

1. Clive Cookson et al., *The Future of Stem Cells*. Scientific American Special Report, July, 2005, **A6-A21**.
2. Konrad Hochedlinger, *Your Inner Healers*. Scientific American, May, 2010, **302 (4)**, 47-53.
3. Stephen S. Hall, *Diseases in a Dish*, Scientific American, March, 2011, **304 (3)**, 41-45.
4. Robin Marantz Henig, *Pandora's Baby*, Scientific American, June, 2003, **266 (6)**, 63-68.
5. *High Court Rejects Stem Cell Challenge*, Los Angeles Times, January 8, 2013.

DISCUSSION EIGHT – Human Genetic Engineering

1. Inder M. Verma, *Gene Therapy*. Scientific American, November, 1990, **263 (5)**, 68-84.
2. Steve Mirsky and John Rennie, *What Cloning Means for Gene Therapy?* Scientific American, June, 1997, **276 (6)**, 122-123
3. Gary Stix, *Hitting the Genetic Off Switch*, Scientific American, October, 2004, **291 (4)**, 98-101.
4. *Immune Systems of "Bubble Baby" Restored by Gene Therapy*, UCLA News, September 14, 2012.
5. *Gene Therapy Cures Adult Leukemia*, WebMD, August 10, 2011.
6. *Gene Therapy Proves Effective For Hemophilia B*, Reuters, December 10, 2011.

DISCUSSION NINE – Genes and Cancer

1. Webster K. Cavenee and Raymond L. White, *The Genetic Basis of Cancer*. Scientific American, March 1995, **273 (3)**, 72-79.
2. Francis S. Collins and Anna D. Barker, *Mapping the Cancer Genome*, Scientific American, March, 2007, **296 (3)**, 50-57.
3. *Gene Therapy Cures Adult Leukemia*, WebMD, August 10, 2011.

DISCUSSION TEN – Patenting Genes

1. *Science: Test-Tube Life: Reg. U.S. Pat. Office*, Time Magazine, June 30, 1980.
2. Gary Stix, *Owning the Stuff of Life*, Scientific American, February, 2006, **294 (2)**, 76-83.
3. John J. Doll, *Talking Gene Patents*, Scientific American, August, 2001, **265 (2)**.
4. *Ruling Upholds Gene Patent in Cancer Test*, New York Times, July 29, 2011.
5. *Supreme Court to Look at Gene Patent Issue*, New York Times, November 30, 2012.