

Honors Collegium 70A
Genetic Engineering In Medicine, Agriculture, & Law
Dr. Bob Goldberg
Winter 2005

Sponsored by the HHMI University Professors Program

LECTURES & FILMS: Tuesday & Thursday 3:30-6:00 → Knudsen 1240B

DISCUSSION SECTIONS: Wednesday: 2-4 (Tomo), 4-6 (Mike), & 6-8 (Tiffany) → Life Sciences 2320

REQUIRED TEXTS: *Introduction to Biotechnology* (W. J. Thieman & M. A. Palladino)
The Double Helix (J. D. Watson)
Scientific American & Other Articles (downloaded from the HC70A Website using Acrobat Reader 6.0 or later)

OFFICE HOURS: Tuesday 7:30-10:30 PM & Thursday 2-3 PM → Life Sciences 2832
Phone: 825-9093; Email: bobg@ucla.edu

GOLDBERG LAB/TEACHING WEBSITE: <http://www.mcdb.ucla.edu/Research/Goldberg>

CLASS WEBSITE: <http://www.lsic.ucla.edu/classes/winter05/hnrs70a.html>

ADMINISTRATIVE ASSISTANT: Jessica Luke, Life Sciences 2835 (825-3270)/(jlake@mcdb.ucla.edu)

TEACHING ASSISTANTS: Tomo Kawashima (tomokazu@ucla.edu), Tiffany Sum (tsum@ucla.edu), & Mike Gaviño (mgavino@ucla.edu)

TEACHING ASSISTANT OFFICE HOURS: Monday 4-6 PM (Mike); Tuesday 10-12 PM (Tiffany) & 12-2 PM (Tomo); Thursday 10-12 PM (Tiffany); Friday 10-12 PM (Mike) & 4-6 PM (Tomo)

LECTURES: Lectures will be recorded digitally and streamed on the HC70A class website. You will need Quicktime 6.0 or later to view lectures.

FILM/SPEAKER DISCUSSIONS: Guest speakers and films will be used to highlight the impact of genetic engineering on society and will be on specific Thursdays throughout the quarter. Attendance is required. **Note:** If you miss more than two film/speaker discussion sessions your final grade may be lowered by one letter.

DISCUSSION SECTION: Discussion Section will be taught as an Undergraduate Seminar and will focus on scientific articles and plays/debates that simulate “real-life” genetic engineering situations. The articles/plays/debates will introduce important concepts and will teach you how to read and think about science. Focus your reading around four questions: (1) What is the question being addressed by the article? (2) What are the technologies/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 as a consequence of the new technology?

On Wednesday evening of each week, a take-home quiz will be posted on the class website that focuses on the articles read for that week’s Discussion. Quizzes are due by midnight on Friday of that week in LS 2832. Quizzes will count 25,000 points each. **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 and hand in your own quiz.** In addition to points earned on the quizzes, a Discussion participation grade of *up to* 100,000 points will be assigned at the end of the quarter by your Teaching Assistant.

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CLASS DINNERS: I will take groups of students to dinner on each Thursday throughout the quarter. These dinners will also include the guest speakers and will be a unique experience!! Check the dinner group list that will be handed out in class for the Thursday that you are scheduled to attend dinner.

DOUBLE HELIX ESSAY: You will write a brief essay on *The Double Helix* by J. D. Watson. The essay will count 100,000 points. Guidelines will be handed out in class.

The *Double Helix* Essay is due at the beginning of class on Tuesday, January 25 (Week 3)

CLASS PROJECT: The **entire class as a group** will write, produce, and perform in a videotaped "movie" concerning one aspect of Genetic Engineering discussed this quarter. The purpose of this project is to encourage class interaction, create a useful learning device, and **have some fun**. Movie guidelines will be discussed in class. Previous HC70A class projects can be viewed at: <http://www.mcdb.ucla.edu/Research/Goldberg/>.

The movie will be shown to the entire class on **Tuesday, March 15 (Week 10)** and will count 75,000 points.

EXAMS: Exams include a **Take-Home Exam** and an **All-Class Oral Exam**. Take-Home Exam questions will be handed out in class during Week 5. The Oral Exam questions will be handed out on the last lecture day of class (March 10). The Take-Home Exam will count 350,000 points and the All-Class Oral Exam will count 150,000 points. The Exam Schedule is:

Take-Home Exam: Due Tuesday, February 22 at the beginning of class (Week 7)

All-Class Oral Exam: 3:30-6 PM, Tuesday, March 15, Knudsen 1240B (Week 10)

GRADING: You will be able to earn **ONE MILLION regular points** and a number of **BONUS POINTS** during the quarter. **Your grade for this quarter 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:

| | <u>Total Points</u> | <u>% Grade</u> |
|----------------------------|-------------------------|----------------|
| Essay | 100,000 points | 10% |
| Movie Project | 75,000 points | 7.5% |
| Discussion Quizzes | 225,000 points | 22.5% |
| Discussion Participation | 100,000 points | 10% |
| Take-Home Exam | 350,000 points | 35% |
| <u>All-Class Oral Exam</u> | <u>150,000 points</u> | <u>15%</u> |
| TOTAL | 1,000,000 points | 100% |

I DO NOT GRADE BY A CURVE in order to encourage maximum student participation and interaction. I will use the following guidelines 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:

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

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LECTURE & DISCUSSION SCHEDULE:

| <u>DATE</u> | <u>TOPIC</u> |
|----------------------|--|
| 1/6 | Case Study Discussion: <i>Choosing Your Genes - Scientific and Ethical Issues</i> Film: <i>Race for the Double Helix</i> |
| 1/11 | Lecture 1: <i>The Age of DNA -- What is Genetic Engineering?</i> Demonstrations: <i>Isolating Your DNA & Classical Genetic Engineering</i> Film: <i>Cutting & Splicing of DNA</i> |
| 1/15 | Lecture 2: <i>What Are Genes?</i> Dinner 1 |
| DISCUSSION 1: | <i>The Manipulation of Genes</i> <i>Recombinant DNA Debate</i> |
| 1/18 | Lecture 3: <i>How Do Genes Work?</i> Film: <i>Kerry Mullis & PCR</i> Demonstrations: <i>Gel Electrophoresis & Bacterial Gene "Cloning"</i> |
| 1/20 | Speaker: Dr. Richard Hamilton -- <i>The Making of a Biotech Company</i> Dinner 2 |
| DISCUSSION 2: | <i>Useful Proteins from Recombinant DNA</i> <i>Discovering Genes for New Medicines</i> <i>The Bioinformatics Gold</i> <i>The Human Genome Business Today</i> |
| 1/25 | Lecture 4: <i>How Are Genes Cloned & Engineered - The Factor VIII Story</i> DOUBLE HELIX ESSAY DUE Dinner 3 |
| 1/27 | Film: <i>Lorenzo's Oil</i> |
| DISCUSSION 3: | Debate: <i>To Genetic Engineer or Not?</i> <i>Transgenic Livestock As Drug Factories</i> <i>Cloning For Medicine</i> <i>Edible Vaccines</i> <i>Back to the Future of Cereals</i> <i>Seeds of Concern</i> <i>Green Gene Revolution</i> |
| 2/1 | Lecture 5: <i>21st Century Genetic Engineering Applications</i> Demonstration: <i>Making a DNA Fingerprint of Yourself!</i> |
| 2/3 | Film: <i>History's Harvest</i> Speaker: Dr. Alan Mc Hughen -- <i>GMOs: What's All the Fuss About?</i> Dinner 4 |
| DISCUSSION 4: | <i>Chromosome Mapping With DNA Markers</i> <i>Grading the Gene Tests</i> <i>Testing Your Future</i> <i>A Laws Fetal Flaw</i> |

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LECTURE SCHEDULE CONTINUED:

| <u>DATE</u> | <u>TOPIC</u> |
|----------------------|---|
| 2/8 | Lecture 6: <i>Science & the Constitution: How Is Science Regulated?</i> TAKE-HOME EXAM QUESTIONS HANDED OUT |
| 2/10 | Film: <i>Planted DNA Evidence</i> Speaker: Officer Harry Klann: <i>Using DNA to Catch Criminals</i> Dinner 5 |
| DISCUSSION 5: | Play: <i>Trial of the Century</i> <i>When Science Takes the Witness Stand</i> <i>The DNA Detectives</i> |
| ----- | |
| 2/15 | Lecture 7: <i>Science & the Constitution: Who Owns Our Genes?</i> |
| 2/17 | Film: <i>Genetically Correct: Ensuring Perfect Babies</i> Speaker: Dr. Michele Evans: <i>In Vitro Fertilization and Genetic Testing</i> Dinner 6 |
| DISCUSSION 6: | <i>Embryonic Stem Cells for Medicine</i> <i>The Stem Cell Challenge</i> <i>The First Human Cloned Embryo</i> <i>Pandora's Baby</i> <i>Cloning Noah's Ark</i> |
| ----- | |
| 2/22 | Lecture 8: <i>The Human Genome Project: Detecting and Using Your Genes</i> TAKE HOME EXAM DUE |
| 2/24 | Film: <i>Perfect Baby</i> Speaker: Dr. Greg Stock: <i>Ethical Issues in Human Genetics & Cloning</i> Dinner 7 |
| DISCUSSION 7: | <i>Gene Therapy</i> <i>Overcoming Obstacles to Gene Therapy</i> <i>What Cloning Means for Gene Therapy</i> <i>Gene Doping</i> |
| ----- | |
| 3/1 | Lecture 9: <i>Identifying Human Origins: Are There Races - Past and Present?</i> |
| 3/3 | Film: <i>Outbreak</i> Dinner 8 |
| DISCUSSION 8: | <i>The Genetic Basis of Cancer</i> <i>Tumor Busting</i> <i>The Magic of Microarrays</i> <i>New Hope for Cancer</i> |
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LECTURE SCHEDULE CONTINUED:

| DATE | TOPIC |
|----------------------|--|
| 3/8 | Lecture 10: <i>Genetics, Cloning, & the Law -- 21st Century Issues</i> |
| 3/10 | Lecture 11: <i>Genetic Engineering -- What Will the Future Bring?</i> Film: <i>Knowledge or Certainty?</i> Dinner 9 |
| DISCUSSION 9: | <i>Attacking Anthrax</i> <i>Capturing the Killer Flu Virus</i> <i>Technology Against Terror</i> |
| 3/15 | FINAL ALL-CLASS ORAL EXAM & CLASS PROJECT DUE |

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TEXT READING ASSIGNMENTS FOR LECTURES AND DISCUSSIONS:

INTRODUCTION TO BIOTECHNOLOGY

| | |
|--------------|---------------------------|
| LECTURE 1 | Chapter 1 |
| DISCUSSION 1 | Chapters 2 & 3 |
| LECTURE 2 | Chapter 2 |
| DISCUSSION 2 | Chapters 2, 3, & 4 |
| LECTURE 3 | Chapter 2 |
| DISCUSSION 3 | Chapters 6, 7, 12, & 13 |
| LECTURE 4 | Chapter 3 |
| DISCUSSION 4 | Chapters 8 & 11 |
| LECTURE 5 | Chapters 5, 6, 7, 9, & 10 |
| DISCUSSION 5 | Chapter 8 |
| LECTURE 6 | Chapter 12 |
| DISCUSSION 6 | Chapters 11 & 13 |
| LECTURE 7 | Chapter 12 |
| DISCUSSION 7 | Chapters 11 & 13 |
| LECTURE 8 | Chapters 8 & 11 |
| DISCUSSION 8 | None |
| LECTURE 9 | None |
| DISCUSSION 9 | Chapter 5 |
| LECTURE 10 | None |

SUPPLEMENTAL READING: Reading that complements your textbook will be handed out in class and posted on the class website. This material represents selected chapters on DNA, Gene Activity, Recombinant DNA, Genetic Engineering, Human Genetics, Biotechnology, and Medical/Agricultural Applications of Genetic Engineering from introductory biology textbooks. *These chapters should be read and studied for lectures, discussions, and exams where relevant.* They represent an up-to-date conceptual resource for learning the material covered in HC70A. Most of the figures in these chapters provide an excellent conceptual view of the major concepts and techniques covered in the class. Keep in mind that "a picture tells a thousand words!"

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REFERENCE MATERIAL: These books are on reserve in the Powell Library (<http://www2.library.ucla.edu>), and complement and expand on the topics covered in both the lectures and discussions. They represent an excellent collection of reference books on molecular biology, genetics, biotechnology, human cloning, molecular biology history, genetic engineering, and legal/constitutional issues as it applies to breakthroughs in genetic/cloning technologies. *These books may be helpful for your essay, exams, class project, and expanded "horizons" – particularly where your text does not cover the lecture/discussion topic.*

A Practical Companion To The Constitution – J.K. Lieberman
Actual Innocence: When Justice Goes Wrong And How To Make It Right – Scheck et al.
Analysis Of Biological Development -- K. Kalthoff
An Introduction To Genetic Analysis – Eighth Edition -- Griffiths et al..
Asking About Life -- Second Edition -- Tobin & Dusheck
Applied Molecular Genetics -- R.L. Miesfeld
Ascent Of Man -- Bronowski
Asking About Cells -- First Edition -- A. Tobin & R.E. Morel
Biochemistry -- Fourth Edition -- L. Stryer
Biology -- Sixth Edition -- Raven & Johnson
Biotechnology - An Introduction -- Barnum
Chemical & Biological Warfare – Eric Cody
Clone: The Road To Dolly & The Path Ahead – G. Kolata
Cloning And The Constitution – I. H. Carmen
Correcting The Code -- L. Thompson
Dealing With Genes -- Berg & Singer
DNA Science -- Miklos & Freyer
DNA Technology -- Second Edition -- I.E. Alcamo
Eighth Day Of Creation -- Second Edition -- Judson
Essential Cell Biology -- Alberts et al.
Gene Cloning – Third Edition -- T.A. Brown
Genetics -- Analysis Of Genes And Genomes -- Fifth Edition -- Hartl & Jones
Genetics -- Sixth Edition -- Klug & Cummings
Genetics -- From Genes To Genomes - L. Hartwell et al.
Genetics, Society, & Clinical Practice -- Harper & Clarke
Genetic Privacy – Graeme Laurie
Genomes -- T.A. Brown
Human Genetics – The Molecular Revolution -- E. Mcconkey
Human Genetics – Third Edition -- Vogel & Motulsky
Human Molecular Genetics -- Third Edition -- Strachan & Read
Introduction to Biotechnology -- Thiemann & Palladino (**Class Text**)
Life: The Science Of Biology – Sixth Edition -- Purves et al.
Molecular Biology Of The Cell -- Third Edition -- Alberts et al.
Molecular Biology of the Gene -- Fifth Edition -- Watson et al.
Molecular Biotechnology -- Second Edition -- Glick & Pasternak
Molecular Cell Biology – Fourth Edition -- Lodish et al.
Molecular Cloning - Third Edition -- Sambrook et al.
Mood Genes: Hunting For The Origins Of Mania & Depression – S. Barondes
Pocket Guide to Biotechnology, R. Schmid (**Excellent Reference Book**)
Plants, Genes, & Crop Biotechnology – Second Edition-- Chrispeels & Sadava
Principles Of Genetics -- Second Edition -- Snustad & Simmons
Principles Of Gene Manipulation -- Sixth Edition – Primrose et al. (**Excellent Reference Book**)
Recombinant DNA -- Second Edition -- Watson et al.
Rosalind Franklin – The Dark Lady Of DNA – B. Maddox
The Double Helix – Watson (**Class Text**)
Understanding DNA & Gene Cloning -- Second Edition -- K. Drlica

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DISCUSSION SECTION BIBLIOGRAPHY: These articles are required reading for Discussion Section. They can be downloaded from the HC70A class website and opened using Acrobat Reader 6.0 or later. You can print them on your own printer or on a printer in one of the many computer labs on campus (e.g., Powell Library, Life Sciences Building). Recent Scientific American articles can also be downloaded directly from Scientific American using the California Digital Library (<http://cdlib.org/>).

DISCUSSION ONE – The Basics of Genetic Engineering

1. Stanley N. Cohen, *The Manipulation of Genes*. Scientific American, July, 1975, **233 (1)**, 24-33.
2. Clifford Grobstein, *The Recombinant DNA Debate*. Scientific American, July, 1977, **237 (1)** 22-33.

DISCUSSION TWO – Using Genes and Genomics to Make Drugs

1. Walter Gilbert and Lydia Villa-Komaroff, *Useful Proteins From Recombinant Bacteria*. Scientific American, April, 1980, **242 (4)**, 74-94.
2. William A. Haseltine, *Discovering Genes For New Medicine*. Scientific American, March, 1997, **276 (3)**, 92-97.
3. Ken Howard, *The Bioinformatics Gold*. Scientific American, July, 2000, **282 (1)**, 58-63.
4. Kathryn Brown, *The Human Genome Business Today*. Scientific American, July, 2000, **282 (1)**, 50-55.

DISCUSSION THREE – Using Animals and Plants as Drug Factories

1. William H. Velander, Henryk Lubon, and William N. Drohan, *Transgenic Livestock as Drug Factories*. Scientific American, January 1997, **276 (1)**, 70-74.
2. Ian Wilmut, *Cloning For Medicine*. Scientific American, December 1998, **279 (6)**, 58-63.
3. William H. R. Langridge, *Edible Vaccines*, Scientific American, September, 2000, **283 (3)**, 66-71.
4. Stephen A. Goff and John M. Salmeron, *Back to the Future of Cereals*, Scientific American, August, 2004, **291 (2)**, 42-49.
5. Kathryn Brown, *Seeds of Concern*, Scientific American, April, 2001, **284 (4)**, 52-57.
6. Editorial, *Green Gene Revolution*, Scientific American, August, 2004, **291 (2)**, 8.

DISCUSSION FOUR – Identifying and Testing for Human Disease Genes

1. Ray White and Jean-Marc Lalouel, *Chromosome Mapping with DNA Markers*. Scientific American, February, 1988, **258 (2)**, 40-48.
2. John Rennie, *Grading the Gene Tests*. Scientific American, June, 1994, **270 (6)**, 89-97.
3. Jeff Wheelwright, *Testing Your Future*. Discover, July 2003, **24 (7)**, 35-40.
4. Nell Boyce, *A Laws Fetal Flaw*. U.S. News & World Report, **July 21, 2003**, pgs. 48-51.

DISCUSSION FIVE – DNA Testing in the Courtroom

1. Peter J. Neufeld and Neville Colman, *When Science Takes the Witness Stand*. Scientific American, May, 1990, **262 (5)**, 46-53.
2. Jerry Adler and John McCormick, *The DNA Detectives*. Newsweek, **November 16, 1998**, pgs. 64-71.

DISCUSSION SIX – Embryonic Stem Cells and Cloning for Medicine

1. Roger A. Pedersen, *Embryonic Stem Cells For Medicine*. Scientific American, April, 1999, **280 (4)**, 68-73.
2. Robert Lanza and Nadia Rosenthal, *The Stem Cell Challenge*. Scientific American, June, 2004, **290 (6)**, 93-99.
3. Jose B. Cibelli, Robert P. Lanza, Michael West, and Carol Ezzell, *The First Human Cloned Embryo*. Scientific American, January, 2002, **286 (1)**, 44-51.
4. Robin Marantz Henig, *Pandora's Baby*, Scientific American, June, 2003, 266 (6), 63-68.
5. Robert P. Lanza, Betsey L. Dresser, & Philip Damiani, *Cloning Noah's Ark*, Scientific American, November 2000, **283 (5)**, 84-89.

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DISCUSSION SEVEN - Gene Therapy: Fixing Human Genetic Defects

1. Inder M. Verma, *Gene Therapy*. Scientific American, November, 1990, **263 (5)**, 68-84.
2. Theodore Friedman, *Overcoming the Obstacles to Gene Therapy*. Scientific American, June, 1997, **276 (6)**, 96-101.
3. Steve Mirsky and John Rennie, *What Cloning Means for Gene Therapy?* Scientific American, June, 1997, **276 (6)**, 122-123.
4. H. Lee Sweeney, *Gene Doping*, Scientific American, July 2004, **291 (1)**, 62-68.

DISCUSSION EIGHT - Understanding and Defeating Cancer

1. Webster K. Cavenee and Raymond L. White, *The Genetic Basis of Cancer*. Scientific American, March 1995, **273 (3)**, 72-79.
2. Dirk M. Nettelbeck and David T. Curiel, *Tumor-Busting*. Scientific American, October 2003, **289 (4)**, 68-75.
3. Stephen H. Friend and Roland B. Stoughton, *The Magic of Microarrays*. Scientific American, February, 2002, **286 (2)**, 44-53.
4. Michael D. Lemonick and Alice Park, *New Hope For Cancer*, Time, **May 28, 2001**, pgs 63-69.

DISCUSSION NINE - Anthrax, Flu, and Defending Against Bioweapons

1. John T. Young and R. John Collier, *Attacking Anthrax*. Scientific American, March, 2002, **286 (3)**, 48-59.
2. Jeffery K. Taubenberger, Ann H. Reid, and Thomas G. Fanning, *Capturing a Killer Flu Virus*. Scientific American, January 2005, **292 (1)**, 62-71.
3. Rocco Casagrande, *Technology Against Terror*, Scientific American, October, 2002, **287 (3)**, 83-87.