BIOLOGY 262 - HUMAN GENETICS SPRING 2009

COURSE DESCRIPTION - Human genetics is a biology major course. It focuses on the major areas of human genetics - Mendelian genetics, molecular genetics (biochemical genetics), cytogeneics, complex genetics (multifactorial genetics) and population genetics. In addition to exams, students will be required to prepare short papers and to present a presentation (this will be done in pairs) on a topic related to human genetics.

INSTRUCTOR: Dr. Karen Kurvink
Associate Professor of Biology
323 Collier Hall of Science
610-861-1428

COURSE INFORMATION:

Lectures – MWF 1
Collier Hall of Science 202
Laboratory – Friday (l2:45 – 3:45)
Collier Hall of Science -303

TEXT: **HUMAN HEREDITY – Principles and Issues**, 8TH edition by Michael Cummings 2009

COURSE GOALS:

1. To interrelate historical and current human genetic topics in a way which will make them more meaningful.
2. To expose students to the research and diagnostic tools of human genetics.
3. To assist student in their development of appreciation, understanding, and/or empathy related to human difference.

COMMENT: Today's students will be the consumers of many of the new biotechnologies currently being developed. We will all need to make decisions about the application and regulation of these technologies. Awareness of human genetics should prepare students to better understand the social impact of science on one's personal life and on society in a more genera sensel.

BASIC INFORMATION:

1. Students are expected to attend both lecture and laboratory (attendance will be taken). If you must miss a class be sure to contact the professor immediately (preferably before the event occurs).

2. Students earn 20 points for attending and participating in each laboratory.

3. Students will play an active evaluation role in terms of the class presentations.

4. Misses exams require a written excuse. If a make-up exam is allowed, it will be an individual exam (usually a combined written/oral exam).

GRADING: The final letter grade will be based on earned points in the course devided by possible points available. The letter grade will be determined by this percentage:

90-100	A	
80-89	B	+ and – will be added at the discretion of the professor
70-79	C	
69-69	D	
below	F	

OPTIONAL OPPORTUNITIES for earning additional points will be announced by the professor. Note: the same criterion will exist for these efforts (ie earned over possible points). These points will be added into the general course grade. Note: the maximum number of points which can be earned is 60 pts.

CONTRACTING: In recognition of student variability in interest and intellectual attributes, an opportunity for contracting is also available. Whether a students selects this option should also be based on available time (this is an add-on to the basic course design). Note: the maximum number of points which can be earned is l50 pts.

ANTICIPATED POINT DISTRIBUTION

Unit exams	400 pts
Short papers	300 pts
Lab	260 pts
Presentation	100 pts
Optional extras	maximum of 60 pts
Optional contract	maximum of l50 pts

Tentative Lecture Schedule

Jan 19 (M)	Perspective on human genetics Brief history Tracing linage – Y chromosome Thomas Jefferson linage Cohen Y haplotype (CMH) – African Lemba tribe Moravian archives	Chapter 1: 1-17
Jan 21 (W)	Somatic cell division and the mitotic cell cycle Germ cell division - meiosis	Chapter 2: 18-43
Jan 23 (F)	Mendel's laws	Chapter 3: 44-69
Jan 26 (M)	Single gene Mendelian patterns autosomal dominant autosomal recessive	Chapter 4: 70-81

**Research paper 1 due*

Jan 28 (W)	Single gene Mendelian patterns X-linked dominant X-linked recessive Y-linked	Chapter 4: 82-99
Jan 30 (F)	Complex genetic conditions Traditional methods of study	Chapter 5: 100-114
Feb 2 (M)	Complex genetic conditions Association mapping	

**Research paper 2 due*

Feb 4 (W)	Cytogenetics	Chapter 6:128-157
Feb 6 (F)	Early development Sex determination Teratogens	Chapter 7: 158-173
Feb 9 (M)	**UNIT EXAM 1** (Chapter 1-5) l00 pts	
Feb 11 (W)	Role of hormones in sexual development X-inactivation Chimera	Chapter 7:173-187

Feb 13 (F)	Nucleic acids: DNA and RNA Chromosome structure DNA replication	Chapter 8:188-209
Feb 16 (M)	Protein synthesis	Chapter 9: 210-230

**Research paper 3 due*

Feb 18 (W)	Genetic errors in metabolic pathways PKU Lactose intolerance	Chapter 10:230-241
Feb 20 (F)	Hemoglobinopathies	Chapter 10:242-257
Feb 23 (M)	Mutation at the molecular level	Chapter 11:258-272
Feb 25 (W)	Mutational repair	Chapter 11:273-283
Feb 27 (F)	**UNIT EXAM 2** (Chapter 6-10)	
Mar 9 (M)	Genes and cancer Oncogenes Tumor suppressor genes	Chapter 12:284-292
Mar 11 (W)	Cancer models Specific chromosomal modifications	Chapter 12:293-305
Mar 13 (F)	Recombinant DNA technologies Restriction enzymes Vectors Recombinant cloning Recombinant libraries	Chapter 13:306-318
Mar 16 (M)	Polymerase chain reaction Southern blotting DNA sequencing	Chapter 13: 319-328
Mar 16 (M)	Genetically modified organisms (GMOs) Transgenic bacteria Transgenic plants Transgenic animals	Chapter 14:330-340
Mar 18 (W)	Genetic screening Microarrays	Chapter 14: 340-346
Mar 20(F)	DNA profiling	Chapter 14: 346- 367

	RFLPs Full DNA profiles DNA sequencing	
Mar 23 (M)	Population genetics **Research paper 4 due*	Chapter 19:546-467
Mar 25 (W)	Microevolution	Chapter 19:468-478
Mar 27 (F)	Genetics of race/eugenics	
Mar 31 (M)	**UNIT EXAM 3** (Chapter 11-14; l9)	
Apr 1 (W)	Genomics/proteomics	Chapter 15:358-375
Apr 3 (F)	Personal genome project	Chapter 15:375-376
Apr 6 (M)	Reproductive technologies	Chapter 16: 382-391
Apr 8 (W)	Gene therapy Gene counseling	Chapter l6: 391- 401
Apr 10 (F)	No class – Good Friday	
Apr 13 (M)	No class - Easter Monday	
Apr 15 (W)	Immunogenetics	Chapter 17: 402-414
**Research paper 5 due*		
Apr l7 (F)	Immunogenetics	Chapter l7: 415-429
Apr 20 (M)	Behavior genetics	Chapter 18: 430-445
Apr 22 (W)	Behavior genetics	Chapter 18: 446-455
Apr 24 (F)	Guest lecture/lab	
Apr 27 (M)	Guest lecture (or video)	
Apr 29 (W)	Presentations (done in pairs)	
**Research paper 6 due*		
May 1 (F)	Presentations (done in pairs)	

UNIT 4 EXAM – Monday May 4th at 8:30 PM (during final exam period 1) (Chapters 15, 16, 17, 18)

TENTATIVE LABORATORY SCHEDULE

Jan 23
Karyotype preparation
Introduction to routine chromosome cytogenetic analysis
Mendelian genetic web sites - OMIM, genetests, and NORD
Huntington's disease exercise
Cystic fibrosis exercise
Stem cell research regulation and ethical dilemmas

Jan 30
Mitosis/meiosis
A. Mitosis – prepare bone marrow sample of mouse or rat
B. Meiosis
- prepare testicular slides of mouse or rat
- mammalian slides of spermatogenesis and oogenesis
C. Sperm variation slides

Set up and maintain somatic culture from rodent embryos

Feb 6
Introduction to pedigree analysis for Mendelian genetic conditions
Genetic problems
Chromosome syndromes with primarily emphasis on Down syndrome
A. Modern molecular cytogenetic procedures (FISH, chromosome painting)
A. Prenatal diagnostic testing
-amniocentesis
- chorionic villi methods

Feb 13
Prepare sex chromatin slides
DNA isolation
DNA molecular structure and associated terminology

Feb 20
Protein synthesis
DNA sequencing exercise – Sanger DNA sequencing
Genetic engineering exercise

Feb 27
Agarose electrophoresis
A. Sickle cell screening
B. Southern blotting of viral DNA

Mar 13
Isolation of plasmid DNA
Dermatoglyphics

Mar 20	DNA fingerprinting Plasmid DNA electrophoresis and identification (from previous lab)
March 27	Population genetics exercise Eugenics - Emphasis on US and Germany examples Evolution discussions
April 3	Dog genetics and its association with human genetics Genetic counseling
Apr 10	Good Friday – no lab
Apr 17	Human chromosome cultures A. Set up cultures (on Tuesday – April 14) B. Harvest cultures (on Friday- April l7) C. Preparation of slides
Apr 24	Photographs of chromosomes
May 1	Presentations on selected topics (done in pairs)

SHORT PAPER ASSIGNMENTS

(50 pts each)

Prepare a short (maximum 3 typed pages) paper on each of the following topics. Be sure to reference any information which is not considered to be general information in the body of the paper and to have a bibliography of at least three citations. The intent of these paper assignments is to provide opportunity for you to research and summarize a specific case (condition) related to the topics covered in lecture. Papers will be graded based on (a) content (b) reference ad bibliography inclusion and (c) organizational design and accuracy.

Assignment 1. Select one of the following topics:

Due date - January 26th

A. Your support or rejection of the possibility of Thomas Jefferson being the father of Sally Hemmings children based on Y chromosome analysis.

B. Your support or rejection of the genetic evidence for a Jewish ancestry of the Lemba tribe based on Y chromosome analysis.

C. What type of genetic information is collected by the Morman church? Is any of this information available to scientists or the general public?

Assignment 2. Select one of the following topics related to stem cells:

Due date: Friday, Feb 2nd

A. The scientific and ethical aspects of using somatic or embryonic stem cells for treatment of a selected human condition (disease or injury).
B Pros and cons of "banking" embryonic cord blood.
C. Pros and cons of using somatic nuclear transfer and donor mammalian eggs in human IVF.

Assignment 3. Select one of the following topics related to genetic **chimerism**

Due date: Monday Feb 16

A. association with ambiguous sexual development
B. etiology and potential genetic identity "spin offs" of chimerism
C. female heterozygosity for a selected X-linked recessive disease
D, interspecies chimeras

Assignment 4. Select one of the following topics related to GM organisms.

Due date: March 23nd

A. Prepare a personal position statement on consumption of GM food.
B. What types of environmental pros and cons exist related to GMOs?
C. Should global labeling of GM food be required?

Assignment 5. Select one of the following topics related to reproductive or genetic biotechnologies.

Due date: April 15th

A. In what ways could the developing genetic and reproductive technologies be leading us into another period of eugenics?
B. How do you think genomics/proteomics may influence your life in the future?
C. What is associative gene mapping? How will it be important in the diagnosis and potential treatment of complex genetic diseases?

Assignment 6. Select a genetic condition related to immunogenetics, cancer genetics, or behavior genetics.

Due date:: April 22nd

For a **specific condition** related to any of these applied genetic topics indicate the current available technologies for diagnosis and/or treatment Indicate, if possible, the importance of animal studies in the research and/or application of these technologies to humans.

PRESENTATION GUIDELINES
(l00 pts/student)

Oral presentations will be given during the last week of the course. The presentations will be researched and presented by pairs of students. The presentation will be 20 minutes in length and should include the following:

(a) outline of topic (l page which will be copied and given to the other students and the professor)

(b) powerpoint presentation (approximately l5 minutes in length) – the last slide should contain references; a copy of the slides should be given to the professor before the presentation.

© question/answer period (approximately 5 minutes)

The goal of these presentations is demonstrate the basic principles learned in the course in a more applied or specific situational case..

Grading: Both students will receive the same grade unless I have been advised otherwise.

The grade will be based on (a) content, (b) presentation effectiveness, and (c)class involvement.

Order:

Carolina taste papers

IND-16 Identifying Viral DNA by Rapid Southern Blotting - $112.36

Package 3/4 $63.81

IND-9 Producing a strain of E. coli that Glows in the Dark $80.32

3-18 Plasmid DNA isolation Kit $54.71

POSSIBLE OPTIONAL VIDEOS

Harvest of Fear

POSSIBLE CONTRACTING IDEAS

1. Books

   Read and either prepare a short paper or discuss with professor

   Possible considerations:

   THE GENETIC STRAND by Edward Ball

   THE UNFIT BY Elof Carlson

2. Survey

   Type of articles related to human genetics in various type of journals,

newspapers.
Type of genetic information presented to the public via television and/or movies.

3. Counseling services (genetic and reproductive) available locally

4. Perinatal services available locally or in this region of the country.

5. Specific genetic disease review

Example: Tourette's syndrome – see video on reserve in library and research current information

Lecture 1

Y CHROMOSOME HAPLOTYPE AND HAPLOGROUP

Be able to define haplotype and haplogroup:
Haplotype – blocks of nucleotides which travel together (marker groups which have some degree of SNPs

Haplogroup – wider grouping of haplotypes

Markers:

Short tandem repeats
SNPs (snips)

Unique markers for a population:
Duffy locus: FY*O - black sub-Saharan Africa (Duffy-null variation)
On chromosome l
Related to resistance to *Plasmodium vivex*

SRY gene on short arms of Y chromosome

Kits: STR kits
- Power Plex Y
- Y -film

1. Jefferson's Y chromosome

Nature Nov 5 l998 article by Dr. Eugene Foster

Thomas Jefferson and Sally Hemings

Children: Thomas, Harriet, Beverly, daughter, Madison, Eston
Y chromosome : T (K2) haplogroup
25 markers ($169 + 2 handling)
Mark Jobling – Y chromosome spokesperson

2. Cohen Modal haplotype

1997 Michael Hammer – University of Arizonia
rabbinical haptotype

3. Morman geneology

Book: **THE GENETIC STRAND** by Edward Ball 2007

Historical walk using hair DNA

Lst ancient DNA sample – China in l982 (questionable quality)

Two important molecular genetic technologies

1. PCR – Kary Mullis l983 (Nobel Prize)

Amplify a DNA sequence

Dancing Naked in the Mind Field

Kary Mullis and Alec Jeffreys – National Inventors Hall of Fame

2. Sanger – DNA sequencing l970s

Determine nucleotide sequence of short DNA fragments

dideoxy sequencing – manual

l982 – Leroy Hood – fluorescent dies

l986 – lst automated sequencer

1987 – thin tubes + laser scan + computer analysis (print outs)

Places for DNA Analysis

1. Trace Genetics - DNA markers associated with Indian Ancestry

   database – several thousand DNA sequences of Native Americans

   blood quantum – documents and genealogies

2. Vita-Med – Canadian paternity testing

   l0 basic markers

3. European DNA 2.0

   Predict Europea heritage
   - SEE – Southeastern Europe (Armenian, Jewish, Italia, Greek)
   - IB - Iberian (Spanish, Portuguese)
   - BAS – Basque (Spanish, French Pyrenee bordr)
   - CE – Continental Europian CC (German, Irish, English, Netherlands, French, Swiss and Italian)
   - NEE – Northeaster European (Polish, Baltic, Swedish, Norwegian, Finnish, Russian)

   Uses l,349 European Ancestry Information Markers – autosomal markers (not Mt DNA or Y chromosome markers)

4. European DNA 1.0 – lst pan genome test

5. Ancestry by DNA TM 2.5 –

   percentage score of European 50% score
   40% East Asian
   15% Sub Saharan African
   15% Native American

6. DNA Print Genomics, Inc. (Mark Shriver – Penn State University)

   An applied genomic science company – development and marketing of Innovative genetic testing products and services

   Applications: Forensic science
   Genological research
   Pharmeceutical development

7. International Hap/Map Project

Canada, China, Japan, Nigeria, UK, US

Multi-country effort to identify genetic similarities and differences in humans
Disease, medications, environmental

Ethical aspects - challenge of historical cultural and social ideas
Race definition
Anonymous
Conset
Data release policy
Sample storage at Coriell Institute

Blast program – Gene walker program
SNPs
Megablast (database ties to total genome)

8. Mitotyping technologies – forensic DNA analysis – especially of hair samples and ancient DNA

Identificler – STR aalysis

814-861-0676

heteroplsmy – exists to some degree in all tissues
use l50 nucleotide sequence of l2S rRNA (identify species)

Search on http://www.ncbi.nim.gov/BLAST

Class 2

A brief review of HG history - On being normal or abnormal

Reference: **THE UNFIT – A History of a Bad Idea** by Elof Axel Carlson 2001

Web site:

BOOKS

1. **JACOB'S LEGACY: Genetic view of Jewish History** by David Goldstein, 2008 ISBN 978-0-300-12583-2 $26

   Discusses the Cohen Modal Haplotype (CMH) and it distribution to various groups including the Lemba over time.

2. **BLOOD MATTERS: From Inherited Illness to Designer Babies, How the World and I Found Ourselves in the Future of the Gene** by Masha Green 2008 ISBN 978-0151013623 $25

   Covers Green's life as a BRCA-1 mutation carrier at risk for early-onset breast cancer.

3. **Spelling Love with an X: A Mother, a Son, and the Gene That Binds Them** by Clare Dunsford 2007 ISBN 978-0807072790 $24

   Dunsford son was born with fragile X syndrome. The books demonstrates How we can navigate life's events with grace.

4. **DAVENPORT'S DREAM: 21st Century Reflections on Heredity and Eugenics** Edited by Jan A. Witkowski and John R Inglis ISBN 978-08796 9756-3 $55 Cold Spring Harbor Laboratory Press

   This is actually two books in one. It is a collection of essays about Davenport and his work and a reprint of his l911 textbook HEREDITY IN RELATION TO EUGENIC…the first book on human genetics published in the US.

5. **IN PURSUIT OF THE GENE: From Darwin to DNA** b James Schwartz 2008 ISBN 978-0-674-02670 Harvard University Press $30

This is an engaging account of the major discoveries and personalities in the History of inheritace up until the middle of the twentieth century. It includes information on HJ Muller who made major genetic and societal contributions.

6. **GENETIC WITNESS: Science, Law, and Controversy in the Making of DNA Profiling** by Jay D Aronson, 2007, ISBN 978-0-8135-4188-4, Rutgers University Press, $24

   DNA profiling is described and followed in legal cases involving paternity And forensic cases.

7. **THE MURDER OF NIKOLAI VAVILOV: The Story of Stalin's Persecution of One of the Great Scientists of the Twentieth Century** By Peter Pringle 2008 ISBN 978-0743264983, $26

   Good historical biography of a famous Russian geneticist who **fell out of favor during the reign of Josef Stalin.**

8. **ELIZBETH BLACKBURN AND THE STORY OF TELOMERES** by Catherine Brady 2007, ISBN 978-0262026222, $30.

   Story of Blackburn ad her contributions to telomere biology. It is a good story about women in science and some of the scientific politics of that period of time.

9. **THE GENIUS FACTORY: The Curious History of the Nobel Prize Sperm Bank,** by David Plotz 2005 $14.95

10. **TRACE YOUR ROOTS WITH DNA: Using Genetic Tests to Explore Your Family History** by Megan Smolenyak Smolenyak ad Ann Turner 2004 $16.95

    Good book!

11. **THE GOD GENE : How Faith is Hardwired into our Genes** by Dean Hamer 2004 $l4.95

12. **THE AGILE GENE: How Nature Turns on Nurture** by Matt Ridley 2003

13. **ENOUGH- Slaying Huma in an Engineered Age** by Bill McKibben 2003 $14.00

14. **Rosalind Franklin: The Dark Lady of DNA by Brenda Maddox** by Brenda Maddox 2002 ISBN – 978-0060184070 $10

Or
Rosalind Franklin and DNA by Anne Sayre ISBN 987-0393320442, $10

Biobliographies of her life and contributions to the research on DNA structure.

15. **ABRAHAM LICOLN'S DNA AND OTHER ADVENTURES IN GENETICS** by Philip R. Reilly 2000 Cold Spring Harbor Laboratories $16

Very good

16. **MUTANTS: On Genetic Variation and The Human Body** by Armand Marie Lenoi 2005 $11