

Biology 3183  
History of the Genetics in the 20<sup>th</sup> Century  
Spring, 2009

Tu-Th 11:30 – 1:00

### Syllabus and Class Schedule

The purpose of this course is to explore the broad development of the science of heredity – *genetics* – during the twentieth century. The topic is obviously vast, so the coverage will necessarily be selective. The core areas to be considered include late 19<sup>th</sup> century concepts of heredity (including theories by Darwin, Ernst Haeckel and August Weismann, and Mendel's experiments of 1866); the rediscovery and reception of Mendel's experiments in 1900; the chromosome theory of heredity and its fusion with Mendelism as an interfield theory after 1910; the relationship between genetics and Darwinian theory (the evolutionary synthesis of the 1930s-1950s); the on-again/off-again relationship between genetics and embryology (1920s-1950s); physiological and biochemical genetics (1930s-1940s); the rise of molecular biology (including molecular genetics), and the ramifications of molecular genetics in areas such as recombinant DNA, the Human Genome Project and genomics. In each of these areas, where relevant, the relationship between genetics and economic, social and political issues (eugenics, high-energy radiation and mutation, genetic engineering, and the implications of human behavioral/psychiatric genetics for current social and medical policy) will be discussed. We will also examine the development of genetics in its institutional and national contexts. A contention in this course is that science in general and genetics in particular do not develop in a vacuum, but are very much influenced by their social context. Class will involve a combination of lecture and discussion, while readings will be based on both primary and secondary sources.

A major theme of the course will be the transition of biology in general and the study of heredity in particular, from a largely theoretical, descriptive and speculative science in the late 19<sup>th</sup> century to an experimental, quantitative and predictive science in the early 20<sup>th</sup> century. The areas in which this transformation first manifested itself were embryology and heredity, but similar motivations emerged in evolutionary biology and ecology by the 1920s and early 1930s. In this transformation, genetics led the way after the turn of the century. A secondary theme will trace the influence of changing economic and social policies in the industrialized nations as they came to see the life sciences, like the physical sciences in the 19<sup>th</sup> century, as profitable for capital exploitation (agriculture, medicine, pharmacology and, at present, genomics and pharmacogenomics). Emphasis will be placed on understanding the technical ideas of genetics in each of these areas while also exploring the interaction between genetics, other areas of biology, and with the physical sciences (chemistry and physics). While no specific courses are prerequisite for this course, if you have not had at least the Biology Department's introductory sequence (Biology 2960, 2970 and 3050) you will have to be prepared to learn some of the hard-core genetics as we proceed.

#### Readings

All readings will be on electronic reserve (ERes) for the course. To access the reserve list you will need to go to any computer and type in the reserve **url**:

`http://eres.wustl.edu`>`http://eres.wustl.edu`  
find the class by dept and # or by professor's name  
click on the class (Bio 3183)  
enter password: 20gen

The main text for the course will be:

Allen, G.E. *From Little Science to Big Science: The Development of Genetics in the Twentieth Century* [This is a work-in-progress for Harvard University Press]. The revised chapters of this

book are contained in a folder in Eres, "History of Genetics in the Twentieth Century-Revision Chapters."

Keller, Evelyn Fox. *The Century of the Gene* (Cambridge, Harvard University Press, 2000)

Morange, Michel. *A History of Molecular Biology* (Cambridge: Harvard University Press, 1998)

Primary and secondary sources will consist mostly of published articles or selections from longer monographs, and will also be found in ERes. **Please Note:** ERes lists works alphabetically by title rather than author (it does not include prefatory articles like "A", "An" or "The"), so you will have to know the exact title of the book, article or chapter to locate any specific reading. The course password for ERes is **20gen**.

### Course Requirements

- **Attendance:** Attendance is not required but is *strongly suggested*, as the give-and-take of classroom discussion provides a deeper and more comprehensive understanding of almost any subject. In addition, some of the issues and perspectives presented in the course will be drawn primarily from lecture-discussion and are not always as well represented in the readings. You will be responsible for all material discussed in class, even if it does not appear in the readings or other material.
- **Exams:** There will be a mid-term exam and a final. These will involve some combination of short-answer and short essay questions.
- **Chapter Critiques:** Every student is expected to write a critique (1-2 pages) of each assigned chapter in the textbook, *From Little Science to Big Science* due on dates the respective chapter is assigned for class. The purpose of this assignment is to get your feedback on the chapter revisions. In order to insure fully honest evaluations, you will not be given a letter grade on the critiques, but it is part of the course requirement to turn them all in.
- **Discussion Sections:** There will be six discussion sections throughout the semester. Everyone will be expected to attend the first discussion section, to be held the week of January 26. In addition, you will be responsible for attending *at least* three out of the other five scheduled discussion meetings throughout the semester. The times for these will be decided after the first meeting of the class and in accordance with your individual schedules. The discussion meetings will be based on assigned readings for which you will have to prepare a précis. The discussion sections will be led by the TA for the course, **Nicholas Kooyers**, from the Ecology, Evolution and Population Biology Program in the Division of Biology and Biomedical Sciences (DBBS). His office and e-mail addresses are:

317 McDonnell  
[nkooyers@gmail.com](mailto:nkooyers@gmail.com)

- **Website Project:** There will be a major project in which all students must take part. Working in pairs (or if that is not feasible, individually), everyone will be responsible for designing a web site for the course, focusing on an in-depth historical analysis of a particular set of observations or series of experiments on a particular issue. Some examples might be: Francis Galton's test of Darwin's hypothesis of pangenesis, Johannsen's experiments on pure line selection, the controversy between the Morgan lab and W.E. Castle on modifier genes, Calvin Bridges' experiments on sex determination, H.J. Muller's experiments on x-ray dosage and mutation, the role of information theory in the development of molecular genetics, the Meselsohn-Stahl experiment on conservative *vs* semi-conservative replication of DNA, Linus Pauling's investigations of protein structure and sickle-cell anemia, or dozens of others drawn from class discussion and the various readings, including, *From Little Science to Big Science*. Each web site will contain items such as historical images of the investigators involved, pictures and explanations of specialized apparatus, conceptual diagrams such as early chromosome maps or x-ray diffraction patterns, important primary sources in the field, with your own "Introductions"

for potential readers, important secondary sources, data bases and the like. These websites are open to as much imaginative energy as you can put into them. The idea is that they will serve as companions to the book in a real and useful way (not just an academic exercise). Each group will report on and demonstrate aspects of, their work in the last class period(s) of the semester. A more detailed set of instructions will be handed out in two weeks about this assignment. Meanwhile, you can view several sample web sites designed by students from another course (Bio 3182) in a specially designated part of the home page for Bio 3183.

➤ **Grade Determination:** The mid-term will make up 25% of your grade, the final 35%, discussion meetings (and written work) 10% and the web-page project 30%.

A general course outline follows on the next few pages. If past experience is any guide, we will not keep rigidly to this schedule. I want class time to be as unconstrained and flexible as possible. At each class session assignments will be distributed for the following class period(s), with assigned readings listed and questions to guide you in reading the material. All assignment sheets, as well as lecture presentations (Power-point) will be posted on the course web page.

### **Web page**

There is a web page for the course where all assignments and Power-point presentations will be listed. Power point presentations will be up and available for printing out before each class period (hopefully, the night before!). The web page will *not* contain the electronic reserve readings. The **url** for the web page is:

<http://www.nslc.wustl.edu/courses/Bio3183/bio3183.html>

The course password is: **20gen**

### **Gar Allen Office House**

Wednesdays 1:30 – 3:00  
Life Sciences 202D  
(314) 935-6808  
allen@biology2.wustl.edu

I can make appointments at other times if the office hours are not convenient.

E-mail is probably the easiest way to reach me.

## Biology 3183

## A History of Genetics in the Twentieth Century

**General Course Schedule, Spring, 2007**

- Tu Jan13 Introduction and Scope of the Course; Overview: The Uses of History of Science
- Th Jan 15 Historical and Philosophical Background: Schools of Thought in Modern Science: Idealism, Materialism (Mechanistic, holistic and dialectical materialism), Paradigm Shifts, Social Construction of Science
- Tu Jan 20 Historical and Philosophical Background (cont'd)
- Th Jan 22 The Darwinian Background: Evolutionary Biology 1859-1900; Morphology (Ontogeny and Phylogeny) and Hereditary Paradigms in Darwin, Haeckel and Weismann.
- Tu Jan 27 The Mendelian Paradigm: Economic, Social, Cultural Background; Mendel's Experiments and the 19<sup>th</sup> Century Response

**Week of January 26: 1<sup>st</sup> Discussion Sections Meet**

- Th Jan 29 The Rediscovery (1900) and Bateson's Promotion of the Mendelian Paradigm: Anomalies, Puzzles and the Mendelian-Biometrician Controversy in England
- Tu Feb 3 Sex Determination and the Introduction of *Drosophila* by the Morgan Group
- Th Feb 5 The Development of the Mendelian-Chromosome Theory of Heredity (the MCTH) as an Interfield Paradigm: Its Puzzles and Articulations (Chromosomal Aberrations, Position Effect, the Nature of Mutation, Lateral Transfer)

**Week of February 9: 2<sup>nd</sup> Discussion Sections Meet**

- Tu Feb 10 Reception of the MCTH by Country and Research Field (Embryologists, Cell Biologists); the "Problem" of Cytoplasmic Inheritance); the Role of Model Organisms (*Drosophila*, Maize), Research Groups and Developing an Institutional Base for Genetics Research (USDA, Rothamsted, Kaiser-Wilhelm Institutes, Pasteur Institute, Svalöf, and the Multitude of Russian Agronomy Institutes)
- Th Feb 12 Genetics and the Mechanistic Conception of Life
- Tu Feb 17 Capitalism Discovers Genetics: Hybrid Corn and the Industrialization of Agriculture, 1910-1950; the Russian-American Exchange
- Th Feb 19 The Control of Human Evolution: Eugenics in Europe and the United States

**Week of February 24: 3<sup>rd</sup> Discussion Sections Meet**

- Tu Feb 24 Eugenics (concluded)
- Th Feb 26 The Synthesis of Genetics and Evolution (The Origins of Population Genetics)
- Tu Mar 3 Genetics and Evolution: Field Population Studies, Paleontology and the Unity of Science Movement
- Th Mar 5 MID-TERM EXAM

## S P R I N G   B R E A K

Tu Mar 17      Genes As Functional Units: Biochemical and Physiological Genetics, 1900-1941

Th Mar 19      World War II and Genetics: The Atomic Bomb Casualty Commission and Cold War Biology (The Lysenko Case)

**Week of March 23: 4<sup>th</sup> Discussion Sections Meet**

Tu Mar 24      The Molecular Basis of Genetics: The Origins of Molecular Biology (Genes as Proteins or Nucleic Acids (Griffith; Avery, MacLeod and McCarty; Hershey-Chase); Linus Pauling, and the Concept of "Molecular Disease" (Sickle-cell anemia)

Th Mar 26      Class/ Consultation on Website Design (David Heyse)

Tu Mar 31      The Molecular Biology of the Gene: The Structurists' Approach (Sanger and Insulin, Pauling and the  $\alpha$ -helix; Perutz, Kendrew and X-ray Crystallography)

Th Apr 2        The Molecular Biology of the Gene: The Informationists' Approach. Language, Codes and the Informational Content of Molecules (Bohr, Schrödinger, Luria; Virology and the Origins of Phage Genetics)

**Week of April 6: 5<sup>th</sup> Discussion Sections Meet**

Tu Apr 7        Biochemical and Molecular Triumph: Elucidating the Structure of DNA, 1940-1953 (Wilkins, Franklin, Pauling, Chargaff, Watson and Crick)

Th Apr 9        Development of the DNA Paradigm: Puzzles and Articulation (DNA Replication, The Genetic Code, Mechanism of Protein Synthesis, Regulation and the Lac Operon)

Tu Apr 14      Biology, Biotechnology and Big Science: From Gene Isolation, Gene splicing and Genetic Engineering Controversies to the Human Genome Project (1980-2000)

Th Apr 16      Lecture/Discussion: The History of GMO Crops, Current Controversies and Ethical Implications (Nic Kooyers)

**Week of April 20: 6<sup>th</sup> Discussion Sections Meet**

Tu Apr 21      Web Page Progress Reports

Th Apr 23      Web Page Progress Reports

Tu May 5        Web Page Projects due (e-mailed or disk form to David Heyse (Natural Sciences Learning Center, Rm 138)

Wed May \_\_\_    F I N A L   E X A M (Life Sciences 118)