Liberal Studies 304  
Science in the Modern World  
Prof. Craig McConnell • Fall 2004

This course examines the content and culture of the natural sciences in the modern period. Content will include relativity theory, quantum theory, nuclear physics, the standard model in particle physics, advances in astrophysics and cosmology, genetics, the evolutionary synthesis, molecular biology, and work on genome sequences. As these bodies of knowledge are examined, we will also consider the culture of science, individual and collective styles of working in science, the role of the scientist in the culture at large, and the larger cultural and philosophical relevance of scientific knowledge.

In the course of the semester, you will be exposed to the core concepts of modern science, you will be introduced to a number of perspectives from which science can be studied, and you will write critically about science. An outline of the topics for the semester follows.

Reading assignments are indicated as follows:
- **K1** = Read Keller, Chap. 1.
- **Cr4** = Read Crick, Chap. 4.
- **R3** = Read item 3 in the course reader.

Refer to the list of assigned reading on page 3 for a complete key.

Do the Reading Before Class on the Day Indicated.

Writing assignments are indicated as follows:
- **A1 Due.** You will find the assignments on the course web site:
  [http://faculty.fullerton.edu/cmcconnell/304/Resources.htm](http://faculty.fullerton.edu/cmcconnell/304/Resources.htm)

Introductions and Semester Preview

Aug. 23  

Aug. 25  
Physics from Newton to Einstein; Biology from Harvey to Mendel.
Scientific Literacy. The Study of Science. **R1 R2 R3 HTintro CPintro [A1 Due.]**

Aug. 30  
Looking forward: Current Issues in Science.

Sep. 1  
Does each science need its own philosophy? Mayr vs. Kuhn. **HT1 R4**
Personality and Science. **C8 Cr1 Cr2 K2 R5**  
[A2 Due.]

Final Presentations Assigned

Innovations in Turn of the Century Science

**A. Advances in Experimental Physics**

Sep. 6  
[Labor Day]

Sep. 8  
X Rays, Radioactivity, Transmutation. **HT2 R6 C1 C2**  
[A3 Due.]

**B. Quantum Theory**

Sep. 13  
Planck and discontinuity in black body radiation. Bohr’s atom. **HT4 C3 C4 C5**
**C6 C7**

Sep. 15  
Wave behaviors and de Broglie’s atom; the probabilistic view. The Copenhagen Interpretation and the Quantum Legacy. **HT5 C9 C10 C11**
C. Relativity Theory
Sep. 20 Einstein, *Gedankenexperimenten*, and the origins of Relativity Theory. HT3 R13
Sep. 22 The relativity of length, time, and mass. Lorentz transformations, space-time diagrams, the twin paradox. HT12
Sep. 27 General Relativity and the curvature of Space-Time. The twin paradox resolved.
Sep. 29 Experimental confirmation. Einstein’s Legacy CP2 R7 [A4 Due.]

Oct. 4 Exam I

Modern Syntheses
A. The Evolutionary Synthesis
Oct. 6 Paleontology, natural history, population genetics. The Evolutionary Synthesis. HT17 R8
Oct. 11 The chemical approach to understanding life: Watson, Crick, and the Structure of DNA HT15 Cr3-Cr6 R9 [A5 (1a & 2 only) Due.]
Oct. 13 Breaking the DNA Code. Barbara McClintock and Com Genetics HT16 Cr8-Cr13 K3-K6
Oct. 18 The Molecular Revolution. K10-K12 [A5 (1b & 2 only) Due.]

B. Nuclear Physics
Oct. 20 Advances in Nuclear Physics.
Oct. 25 Nuclear Power. HT8 [A6 Due.]
Oct. 27 The Evolution of Particle Accelerators and High Energy Physics.

Nov. 1 From the Particle Zoo to the Standard Model. HT9 R10 [A7 Due.]

C. Astrophysics
Nov. 3 Gravitational & Nuclear Physics (Local). HT10 CP7
Stellar Astrophysics, Supernovae, Quasars, Black Holes
Nov. 8 Gravitational & Nuclear Physics (Global), Cosmology. HT11 CP5 [A8 Due.]

Big Science
Nov. 10 Big Science: The SSC and the HGP R11
Nov. 15 Big Science: NASA’s Apollo Program R12 [A9 Due.]
Nov. 17 Exam II

Presentations:
Nov. 29 Student Presentations
Dec. 1 ""
Dec. 6 ""
Dec. 8 Closing Remarks, Course Evaluation
Required Texts:

Assessment:
Each student’s performance will be assessed in four distinct ways:
1. Examinations. These will occur on Oct. 4 and Nov. 17. Each exam will include an identification section, a short answer section, and an essay section. Each exam will account for 25% of your final grade.
2. Final Project. A detailed description of this assignment will be distributed and discussed in class on Sep. 1. You will be part of a group effort and will present your results to your classmates in the last weeks of the semester. All work related to the presentation will make up 25% of your final grade.
3. Class Participation. Your contribution to the learning community includes discussion of assigned reading and active engagement during your classmates’ presentations. Active participation in all facets of the course will make up 15% of your final grade.
4. Writing Assignments. These are described on page 4 of the syllabus. They are designed to keep you on track with the reading and to prepare you for the exams. They will not be formally graded. The writing assignments will make up 10% of your final grade.

Absenteemism:
The purpose of this course is to expose you to a variety of perspectives and issues in contemporary science. Excessive absenteeism will be disruptive to your ability to integrate the material presented. The class participation portion of your final grade will suffer dramatically if you are absent without cause more than twice in the course of the semester.

Contact Information:
I am here to help you do well in this course. I am available to help you during office hours and by appointment. Don’t hesitate to ask for an appointment—problems are easiest to resolve when they are brought up early. Don’t feel like you need to have a problem in hand to come see me.
Office: EC 626
Office Hours: MW 9-10, M 4-5, and by appointment
Office Phone: (714) 278-3935 (24-hour voice mail)
email: cmcconnell@fullerton.edu
online resources: http://faculty.fullerton.edu/cmcconnell/304/Resources.htm
Writing Assignments

Available at the course web site:  http://faculty.fullerton.edu/cmcconnell/304/Resources.htm

All assignments are to be typed, double spaced, in a reasonable font (i.e., no smaller than this one and no larger than this one), with a header like the sample in the upper right corner of this page (use the assignment’s due date).

The progressive nature of these assignments means that they must be turned in on time. An assignment is late if it is not turned in at the beginning of the class session that it is due (there is therefore never a reward for skipping class to finish up or print out an assignment). It is better to turn an assignment in late than to not turn it in at all. I will not accept any written assignments after November 15, 2003.

Take the page limits on each assignment seriously. Do not attempt to get around them by using small margins, small fonts, or spacing the text too closely. These pieces should be written in two stages—a rough draft, in which you say everything that you have to say, and a final draft, in which you edit your rough draft until it communicates your ideas within the space allotted.

The purpose of these assignments is for you to articulate your reactions to the reading that you are doing. Quotations from these texts should not be necessary.

Remember that a good paragraph is one that presents a clear idea and supports it with pertinent evidence. Do not try to squeeze more than one clearly stated idea into one paragraph, and do not present evidence without stating a concrete idea that it is meant to support.

Whereas this is not primarily a “writing class,” writing well is an important aspect of this course (and the Liberal Studies program in general). Schedule your time so that you can write and revise carefully. (For a quick brush-up of essay writing skills, refer to Strunk and White, Elements of Style.)
Readings

R1 Craig McConnell, “A Brief Overview of Science Studies.”