

History of Science 203 Twentieth-Century Science

Instructor

Christina Matta, Ph.D.
Office: M1036J Engineering Centers Building
Phone: (608) 262 8218
Office Hours: By appointment
Email: matta@epd.engr.wisc.edu

Teaching Assistant

Stephen Neal
Office: 324 Bradley Memorial
Office Hours: Tuesdays, 3 p.m.
Email: sneal@wisc.edu

This course examines the history of science in the twentieth century (focusing primarily on biology and physics, but with discussions of chemistry and astronomy as well) with an eye towards the growing authority and visibility of science in Western (particularly American) society. Through a series of overlapping units, we will examine how society and technology interact – that is, how social expectations, demands, and roles shape scientific knowledge; and how that knowledge, in turn, shapes our social expectations, demands, and roles. Though this course will certainly introduce you to concepts such as general relativity, molecular genetics, and nuclear fission, it will also ask broader questions about the responsibilities scientists hold as purveyors of specialized knowledge. Indeed, the overall goal of the course will be to encourage you to think critically about science, society, and responsibility: both the responsibility scientists hold to society as the codifiers of knowledge about the physical and biological worlds and the responsibility the public holds to society as the consumers of that specialized knowledge. How has science shaped – and been shaped by – culture and society? By policy and politics? What role do scientists play in that shaping? Finally, what values does twentieth-century science reflect?

Required Materials

Course packet, available through the Social Science Copy Center, and costs associated with printing the additional readings posted on the course website.

The following books are available at A Room of One's Own Bookstore, 315 W. Gorham Street (go up State Street towards the Capitol and take a right onto Gorham):

Albert Einstein and Leopold Infeld, *The Evolution of Physics: The Growth of Ideas from Early Concepts to Relativity and Quanta*. The exact edition does not matter, but the page numbers on the syllabus refer to the 1967 edition published by Touchstone.

John Hersey, *Hiroshima*. The exact edition does not matter, but I would recommend the 2009 edition with Hersey's postscript.

James D. Watson, *The Double Helix*, ed. Gunther S. Stent (Norton: 1980). Please make sure you buy this exact edition so you have the commentaries.

Vouchers for Lauren Redniss, *Radioactive: Marie & Pierre Curie, A Tale of Love and Fallout* (It Books, 2011) will be distributed in class or in discussion section.

You will note that I have required these books even though we will not read them in their entirety. This is due to copyright laws that limit how much of any one book I can include in the course reader. If you are concerned about the cost of materials for this course, I encourage you to buy used or older editions or to photocopy the required sections from the copies on Reserve at College Library. However you procure the materials, you are expected to read them (of course) and bring them to discussion section with you.

Assignments and Grading

The assignments for this course will include a series of short writing assignments based upon the course reading, two mid-term essays, and a final essay synthesizing the major themes of the semester – all balanced according to the percentages below. In addition, 25% of your grade is based upon your attendance and thoughtful participation in discussion section, along with any quizzes or assignments your TA may give in section. The weighting for these assignments is as follows; note that the weighting is heavier at the end of the semester.

Essay 1	20%
Essay 2	25%
Final essay	30%
Participation/quizzes	25%

The grading criteria for written work are at the end of this syllabus. Your TA will set the grading standards for participation; realize, however, that unprofessional behavior (such as consistent tardiness, texting during class, or other counterproductive behavior) will lower your overall grade even beyond the 25% allotted. *It is impossible to achieve an A in this class without first achieving at least an AB for participation, regardless of the rest of your grades.*

Honors students will write an additional paper (6-8 pages) on a topic developed in consultation (and continued discussion) with me and give a presentation on their research. These assignments will count for 25% of the final grade and the percentages for the other requirements will be adjusted accordingly.

Students enrolled in the Technical Communication Certificate have the option of meeting the Honors requirements for an additional Independent Study credit that will count towards the certificate.

Late Work

Late work will only be accepted at the discretion of your TA; I will not override his decision. Be aware that turning in an assignment late may result in a grade penalty and that extensions may only be granted in exceptional circumstances. If you foresee anything that may impede your ability to meet the course deadlines (or if unexpected personal issues jeopardize your performance), please contact the TA as soon as possible. Do not wait until the end of the semester to seek help; neither the TA nor I will be sympathetic in December.

Academic Honesty and Plagiarism

Plagiarism is the use, citation, or paraphrase of someone else's words or ideas without attribution. It's cheating, plain and simple, and is covered under the university's policy on academic dishonesty – see <http://students.wisc.edu/doso/acadintegrity.html>. Such behavior may result in failure of the class, a disciplinary hearing before the Dean of Students, expulsion, or some combination thereof. At the very least, if either your TA or I catch you plagiarizing from a published source, **you will fail the assignment** on which you have cheated; you might also fail the course as well. If your offense is particularly egregious or if we catch you plagiarizing from another student, we will report you to the Dean.

For more information on what constitutes plagiarism, how to use other people's work responsibly and ethically, and how to use citations, see the handout included in your course packet and/or the UW Writing Center at <http://writing.wisc.edu/Handbook/QuotingSources.html>. (The footnote on the bottom of the Grading Criteria section demonstrates one possible means of citing someone else's work.)

Accommodations and Absences

If you need accommodations such as an interpreter, a note-taker, or course materials in a different format,

please contact the McBurney Resource Center as soon as possible. Their office is at 702 West Johnson Street, Suite 2104, and their phone number is 263-2741. They will evaluate your request and give you a form (VISA) to bring to your TA. The sooner you consult with the McBurney Center, the sooner we will be able to help meet your needs. Do not wait until the end of the course to request accommodations; your TA and I are not obligated to make arrangements for you retroactively (and indeed, we will not do so).

Student athletes should notify their TA of any possible absences resulting from team travel at the start of the semester; likewise, students who need to miss class due to a religious observance should also let the TA know. In general, please *talk to your TA (or to me) immediately* if your performance in this class is jeopardized at any point in the semester.

COURSE CALENDAR

Readings marked with * are available on the course website.

Unit 1: The Expansion of Scientific Inquiry to 1940

Week 1: Introductions

Wednesday, September 5: Course Introduction: Science at the End of the 19th Century

Robert E. Kohler, *Landscapes and Labscapes: Exploring the Lab-Field Border in Biology* (Chicago: 2002) Chapter 2, pages 23-41 and 55-59.

Robert Millikan, "The Evolution of Twentieth-Century Physics." In Millikan, *Evolution in Science and Religion* (Yale: 1927).

(Please read these for section this week. For all other weeks, the reading is due on the day it is listed.)

Week 2: The Invisible Physical World

Monday, September 10: X-Rays and Radioactivity

W.C. Röntgen, "On a New Kind of Rays," *Nature* 53 (1896) 274-276.

A.A.C. Swirton, "Professor Röntgen's Discovery," *Nature* 53 (1896) 276-277.

Lauren Redniss, *Radioactive* (It Books: 2010) Chapters 1-4 (required); skim the rest of the book (recommended).

Wednesday, September 12: Quanta and Atomic Models

Albert Einstein and Leopold Infeld, *The Evolution of Physics* (Touchstone: 1967), "Quanta" (entire section).

Week 3: Uncertainties in Culture and Physics

Monday, September 17: Relativity and Space-Time

Einstein and Infeld, "Field, Relativity", pages 125-150; 177-199, and 209-222.

Wednesday, September 19: The Expanding Universe?

Edwin Hubble, "The Realm of the Nebulae," *The Scientific Monthly* 39:3 (September 1934), 193-202.

*Helge Kragh, "Gamow's Game: The Road to the Hot Big Bang," *Centaurus* 38 (1996) 336-361.

Week 4: The Invisible Biological World

Monday, September 24: The "Rediscovery" of Mendel and Development of Laboratory Genetics

Robin Marantz Henig, *The Monk in the Garden* (Houghton Mifflin Harcourt: 2000), Prologue and Chapter 15, "Mendel Redux."

Robert Kohler, *Lords of the Fly: Drosophila Genetics and the Experimental Life* (Chicago: 1994), Chapter 2, "Crossing the Threshold," pages 19-22 and 37-49.

T.H. Morgan, "The Theory of the Gene." *American Naturalist* 51 (1917), pages 513-529 (required; the rest of the article is optional).

Wednesday, September 26: "Unifying Biology": Genetics and the Evolutionary Synthesis

Sewall Wright, "The Genetical Theory of Natural Selection." *Journal of Heredity* 21:8 (1930) 349-56.

Theodosius Dobzhansky, *Genetics and the Origin of Species* (Columbia: 1951), Chapter 1.

Unit 2: Science as Ideology, 1920-1960

Week 5: Practical Genetics? "Breeding in Human Populations"

Monday, October 1: Social "Interventions" and Eugenics: American Precedents

Edwin Black, *War Against the Weak: Eugenics and America's Campaign to Create a Master Race* (Thunder's Mouth: 2004), Chapter 3 (entire) and Chapter 6, pages 108-123 (required; the full chapter is posted online for optional reading).

Wednesday, October 3: Racial Ideologies and Social Hygiene

Robert Proctor, *Racial Hygiene: Medicine Under the Nazis* (Harvard: 1988), Chapters 2 and 4.

● Essay 1 due in section

Week 6: The Race For An Atomic Program

Monday, October 8: "How World War II Became A Nuclear War"

Michael Gordin, *Five Days In August* (Princeton: 2007), Chapter 1, "Endings".

Albert Einstein, Letter to Franklin Delano Roosevelt, August 2, 1939.

Wednesday, October 10: The Manhattan Project

Richard Rhodes, *The Making of the Atomic Bomb* (Touchstone: 1986), Chapter 10, "Neutrons."

Week 7: Fallout: Scientists and Social Responsibility

Monday, October 15: Consequences and Conundrums

John Hersey, *Hiroshima*, Chapters 1 and 4.

Leo Szilard, "President Truman Did Not Understand."

Redniss, *Radioactive*, Pages 76-85 and 138-143.

Wednesday, October 17: Theoretical Physics after World War II

Laurie M. Brown, Michael Riordan, Max Dresden, Lillian Hoddeson, "The Rise of the Standard Model: 1964-1979." In Hoddeson et al, eds. *The Rise of the Standard Model* (Cambridge: 1993).

Week 8: TBA (Seventh International Conference on Applied Ethics)

Monday, October 22: Topic/Guest Lecture TBA

Wednesday, October 24: Topic/Guest Lecture TBA

Week 9: Molecular Biology and DNA

Monday, October 29: Émigré Physicists and the Development of Molecular Biology

*Evelyn Fox Keller, "Physics and the Emergence of Molecular Biology: A History of Cognitive and Political Synergy." *Journal of the History of Biology* 23 (1990) 389-410.

James Watson, *The Double Helix*, Chapters 1-10.

Wednesday, October 31: Jim and Rosy: The Gendered History of DNA

James Watson, *The Double Helix*, Chapters 27-end; selected commentaries TBA.

Brenda Maddox, *Rosalind Franklin: The Dark Lady of DNA* (Harper Perennial, 2003), Chapters 10-13.

Week 10: Defining Race, Sex, and Gender

Monday, November 5: Defining Race and Racism

Theodosius Dobzhansky, *Evolution, Genetics, and Man* (John Wiley & Sons: 1955), Chapter 13, "Human Evolution" (especially p.331 – end).
Ashley Montagu, UNESCO Statement on Race (1950).

Wednesday, November 7: Sex, Gender, and Sociobiology

E.O. Wilson, *Sociobiology: The New Synthesis, Twenty-Fifth Anniversary Edition* (Belknap/Harvard: 2000), "Sociobiology at Century's End" and pages 547-555.

*Alice H. Eagly and Wendy Wood, "Feminism and the Evolution of Sex Differences and Similarities." *Sex Roles*, 64 (2011) 758-767.

Unit 3: Big Science, Big Questions, 1950-present

Week 11: The Quest for Power and Space

Monday, November 12: The Cold War and the Arms Race

*Isao Hashimoto, "1945-1998." Video available at <http://blip.tv/ctbtomedia/1945-1998-by-isao-hashimoto-japan-2003-1671472>

Michael Gordin, *Red Cloud at Dawn: Truman, Stalin, and the End of the Atomic Monopoly* (Picador, 2009), Chapter 7, "The Year of Joe," and Epilogue, "Tracings and Tailings."

Spencer R. Weart, *The Rise of Nuclear Fear* (Harvard, 2012), Chapter 7, "National Defenses," and Chapter 14, "Seeking Shelter."

Wednesday, November 14: The Space Race

Letter from Wehrner von Braun to Vice President Lyndon B. Johnson, 29 April 1961.

John F. Kennedy, "Address at Rice University on the Nation's Space Effort, September 12, 1962"

*Bradley G. Shreve, "The US, the USSR, and space exploration, 1957-1963." *International Journal on World Peace* 20:2 (2003) 67-83.

*NASA, "Apollo 11 Introduction." Video available online at <http://www.nasa.gov/multimedia/hd/apollo11.html>

●^{MC}Essay 2 due in section

Week 12: "Big" Science on the Small Scale

Monday, November 19: From Fermilab to the Large Hadron Collider

*Mark Bodnarczuk and Lillian Hoddeson, "Megascience in Particle Physics: The Birth of an Experiment String at Fermilab," *Historical Studies in the Natural Sciences* 38:4 (Fall 2008), 508-534.

Peter W. Higgs, "Broken Symmetries and the Masses of Gauge Bosons." *Physical Review Letters* 13:16 (19 October 1964), 508-509.

*NASA with Jorge Chan, "The Higgs Boson Explained," Available online at <http://apod.nasa.gov/apod/ap120501.html>

Wednesday, November 21: The Human Genome Project, Cells, and the Self

*Stephen S. Hall, "Revolution Postponed: Why the Human Genome Project Has Been Disappointing." *Scientific American* (2010).

Rebecca Skloot, *The Immortal Life of Henrietta Lacks* (Crown, 2010), Prologue, "The Woman in the Photograph," and Afterword.

Week 13: Regulating or Restricting: Stem Cells and Science Policy

Monday, November 26: Stem Cells and Regulating Research

*James A. Thomson *et al.*, "Embryonic Stem Cell Lines Derived from Human Blastocysts." *Science* 262 (November 6, 1998) 1145-1147.

- *Jonathan Knight, "Bush Compromise Raises Doubts Over Stem-Cell Resilience" and Paul Smaglik, "Biologists Officially Welcome Plan." *Nature* 665 (August 16, 2001) 665.
- *Gina Kolata, "Man Who Helped Start Stem Cell War May End It." *New York Times* (November 22, 2007).

Wednesday, November 28: **THANKSGIVING WEEKEND - NO CLASS** (Sections do not meet this week.)

Week 14: Fact or Fiction? (Or: Who "Decides" Science?)

Monday, December 3: The Scopes "Monkey" Trial and the Evolution/Creation "Controversy"

Edward J. Larson, *Summer for the Gods: The Scopes trial and America's Continuing Debate over Science and Religion*, 2nd ed. (Basic: 2006). Introduction; Chapter 7, and Afterword.

*"An Act to amend Tennessee Code...relative to teaching scientific subjects in elementary schools." Senate Bill 893, available at <http://www.capitol.tn.gov/Bills/107/Bill/SB0893.pdf>

*Eugenie C. Scott and Glenn Branch, "Evolution: What's Wrong with 'Teaching the Controversy'." *Trends in Ecology and Evolution* 18:10 (October 2003) 499-502.

Wednesday, December 5: Climate Change and Popular Skepticism

Roger Revelle and Hans E. Suess, "Carbon dioxide exchange between atmosphere and ocean and the question of an increase of atmospheric CO₂ during the past decades." *Tellus* 9:1 (1957) 18-27.

Spencer Weart, *The Discovery of Global Warming* (Harvard, 2008), Chapter 8, "Speaking Science to Power"; Chapter 9, "The Work Completed...And Begun", and "Reflections."

General Assembly of North Carolina, House Bill 819: Coastal Management Policies.

Week 15: Anti-Science, Social Authority, and Public Participation

Monday, December 10: "God Help Us; We're in the Hands of Engineers": Fukushima Daiichi, the LHC, and Popular Fear

Luis Sancho, Walter L. Wagner vs. US Department of Energy, Fermilab, CERN, NSF, etc. "Complaint for Temporary Restraining Order."

Union of Concerned Scientists, "U.S. Nuclear Policy Safety One Year After Fukushima" (2012). Executive Summary and Chapters 1-3.

*Randall Munroe, "Radiation Dosage Chart." Available online at <http://xkcd.com/radiation/>

Wednesday, December 12: Wrap-Up: Why Science Is Awesome

*Neil deGrasse Tyson, "The Case for Space." *Foreign Affairs*, 91:2 (2012) 22-33. Also watch at least part of any of the videos of Tyson's May 2012 talk at UW available on YouTube; one possible link available on course website.

*European Organization for Nuclear Research, "CERN experiments observe particle consistent with long-sought Higgs boson" (July 4, 2012).

*European Organization for Nuclear Research, Latest Results from ATLAS Higgs Search (July 7, 2012).

Additional readings to be provided on the course website

● Essay three due December 21.

Grading Scale for Written Work¹

A (3.8-4.0) For outstanding papers only. A paper that earns an "A" in this class will do more than simply fulfill all of the requirements of the assignment. It should demonstrate excellent argumentative skills – it should be logical, analytical, original, credible, and well supported with evidence from the readings. It should be very well organized (at the micro and the macro level). The grammar, style, punctuation, and usage should be excellent, with typographical and spelling errors. Occasionally a very creative, original, stylistically sound paper may make an "A" even if it has a few very minor flaws in the areas listed above.

AB (3.5-3.7) For very good papers that for some reason fall short of the criteria listed above. For example, the argument may be murky in one place; information may be presented that doesn't directly or clearly contribute to the argument; the writing style may be awkward in places or flawed by one or two consistent (if minor) grammatical errors. It is a paper that may not be as unique in its approach or focus as the "A" paper and, in addition, has a few minor flaws. Such a paper, however, still completes the assignment respectably.

B (3.0-3.4) This grade will be given to papers that fulfill the assignment through strong content but aren't as polished as they need to be. A "B" paper may not show wise use of sources throughout, and sometimes it may have an organizational problem (for example, missing transitions between sentences or paragraphs). The paper may pursue a straightforward but not especially deep or sophisticated argument; it is acceptable as far as it goes, but doesn't analyze the implications or consequences of its conclusions. Even if content, format, and structure are excellent, a paper will make a "B" if it shows multiple significant errors of punctuation, grammar, style, tone, or usage that muddle clarity or create unintentional ambiguities.

BC (2.5-2.9) This grade is usually given to papers that have one or two serious flaws of content, format, or structure, but still show a purpose and audience that are appropriate for the assignment. Such a paper completes the assignment, but is deficient in focus or depth, and may even be missing a minor requirement. Occasionally a "BC" paper has a strong content, format, and structure, but contains several distracting errors of punctuation, grammar, style, tone, or usage. It may show evidence of real research and some original thought, but its flaws are clear.

C (2.0-2.4) This grade is given to a paper that completes the assignment, but is deficient in several areas, including content, format, grammar/usage, style, or structure. The purpose in a "C" paper may not be evident or may not be emphasized adequately. Sometimes a "C" paper shows purpose but is not attuned to audience needs – for example, if a student chooses to ignore valuable criticism on drafts from their peers and/or the instructor, the paper may be given a "C" because it shows little effort to improve the usability of the document. A paper may likewise be given a "C" if the interpretations of its sources are not accurate or if it ignores or overlooks an obvious or crucial perspective on the issue discussed.

D (1.0-1.9) A "D" is rare but possible. I might give this grade to someone who has turned in a document that is so full of sentence-level errors that its readability is significantly affected. Even students who write well at the sentence level will get this grade if they don't show a clear purpose or if they make minimal efforts to meet the requirements of the assignment. "D" papers demonstrate little or no analysis or critical thought, or else show a serious misunderstanding of the nature of the material and/or the assignment. Also used for papers that are just barely coherent or that are substantially shorter than the required length.

¹ These criteria draw upon those written by Laura R. Grossenbacher, Ph.D., "EPD 397 Course Syllabus," and Lynn K. Nyhart, Ph.D., "History of Science 202 Course Syllabus." This footnote, itself, is an example of how you might cite a source in your own writing.

F (below 1.0) For unacceptable papers. I may deem a paper unacceptable if it contains plagiarism (see definition above); if it consists primarily of content inappropriate to the intent of the assignment or the material for this course (for example, if it uses the paper as an excuse to pontificate on matters not related to the course readings); if it shows a complete misunderstanding of the course content or the assignment; if the writing fails to meet standard college-level requirements of basic communication in English; or if it shows no serious attempt at revision following the instructor's comments. Papers that are not turned in at all will receive an F as well.