

History of Science 202:
The Rise of Modern Science
Integrated Liberal Studies 202:
Western Culture: Science, Technology, Philosophy II
Spring 2023
Rm 180 Science Hall
Lectures: Tues/Thurs 8:50 AM – 9:40 AM
University of Wisconsin-Madison

Instructor: Nicholas Jacobson	Hist Sci TA: Tiffany Van Winkoop	ILS TA: Ethan Dickler
Off. Hrs.: MW 12:30-2:30*	Off. Hrs.: T 2:30-3:30, W 3:30-4:30*	Off. Hrs.: W 9-11*
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*Or by appointment

Course Summary

Greetings! And welcome to HSCI/ILS 202: a course that treats the rise and development of the modern sciences from ca. 1600 – 1900. The course surveys some of the major scientific achievements of the modern age including Newton's elaboration of celestial mechanics, the establishment of the science of thermodynamics, Darwin's theory of evolution, and the germ theory of disease. In covering these topics, we will look at the strategies that different figures used to ask questions and find out answers about nature. We will consider why they believed their approaches were reliable and "scientific," while also highlighting that these approaches differed – sometimes drastically – according to time and place. The sciences, like any other human activity, are grounded historically in specific social and cultural contexts. With this in mind, we will tackle such messy topics as the relationship between science and religion, the influence of institutions on determining what "counts" as scientific knowledge, the political and economic motives that often drive scientific research, and the importation of culturally laden biases into the practice of science and the theorizing of nature. Such topics remind us that the boundaries we have drawn to define what is science (and what is not) are not stable, and will continue to be contested today just as they were in the past.

Course Description

Credits: 3

Course Designations and Attributes:

ILS 202

Breadth – Natural Science

Level – Elementary

L&S Credit – Counts as LAS credit in L&S

Hist Sci 202

Breadth – Humanities

Level – Elementary

L&S Credit – Counts as LAS credit in L&S

Requisites: None

Instructional Modality: In-Person

Course Requirements and Grading

- 1.) Attendance of lectures and discussion sections.
- 2.) Preparation of weekly readings for every weekly discussion section.
- 3.) Composition of 2 graded essays over the course of the semester, as well as participation during weekly discussion sections.

Note: The first essay will be a process paper with time apportioned to write your rough draft and workshop your paper before turning in a final draft.

Here is the breakdown of graded assignments:

Participation in Discussion Section	30%
Rough Draft of Essay #1 (Due Friday March 3)	20%
Final Draft of Essay #1 (Due Friday April 7)	20%
<u>Final Draft of Essay #2 (Due Monday May 8)</u>	<u>30%</u>
Total	100%

Course Website

We will be using Canvas, an interactive course website, for distributing writing assignments and handouts and for important website links and other information. To access the Canvas site for HSCI 202 and ILS 202, follow these two steps:

- 1.) Go to <http://learnuw.wisc.edu>, or access it from the UW home page. Click on “Canvas” and then click on “Login to Canvas.” Type in your username and password to get to the next screen, which is your Canvas “portal page.” Notice that on this page there is a red “Help” button in the upper right-hand corner to click on if you have any trouble navigating to the site or getting any of the information. The Help Desk is available to assist you around the clock for navigation issue, so please contact this number: 608-264-HELP.
- 2.) Once on your Canvas portal page, you will see a column called “My Courses,” which will list all your UW courses that have a Canvas website. Look for “2022 Spring;” you may need to expand that semester by clicking on the “>” button. Click on the link under this heading for “HSCI 202” and “ILS 202” and you’ll arrive next at the course website.

Course Learning Outcomes and Course Credit Expectations

- 1.) In this course, students will read and analyze primary and secondary source texts pertaining to the history of the modern sciences. Students will take notes on and recall specific details and overarching themes from the course readings, lectures, and discussion.
- 2.) As part of mastering the content of this course, students will learn:
 - a.) about the methods that scientists have developed to arrive at reliable knowledge about nature
 - b.) that scientific knowledge, like all human enterprises, has a history, has changed, and will continue to do so in time
 - c.) that modern sciences have long traditions that are deeply rooted in the past
 - d.) that scientific knowledge has been shaped by the social and cultural contexts out of which it emerged
- 3.) In addition, students will develop historically sensitive critical thinking skills that will enable them to:
 - a.) break down complex historical problems into manageable parts through the close analysis of texts
 - b.) bring together multiple topics and themes introduced in the course to make synthetic judgments about the historical development of the sciences
 - c.) communicate clearly and with the support of evidence their knowledge of topics in the history of modern science, both in written and oral formats
- 4.) This course meets for two 50-minute lecture periods and one discussion section each week throughout the semester, and carries the expectation that students will work on course learning activities (reading, writing, studying, etc.) for about 2 hours outside of the classroom for every class period. The syllabus includes additional information about meeting times and due dates for student work below.

Course Policies

- 1.) Any student who thinks they may be eligible for special accommodations, please contact the **McBurney Disability Resource Center** at 608-263-2741 or <http://mcburney.wisc.edu/students/howto.php>.

The McBurney Center will determine what services you may be eligible for, and then we will be able to work with you to meet your needs for the course. Please contact your TA and instructor at the beginning of the semester, so that we can decide upon the best accommodations for you as soon as possible. Any such requests will remain confidential.

- 2.) If you cannot attend class for a justifiable reason (e.g. illness, religious observance, family necessity etc.), please contact your TA as soon as possible so that you can duly prepare any make-up assignments and keep up with the schedule of the course. For the sake of the student and the TA, due dates of assignments are strictly enforced. Plan well ahead to ensure that you can meet course deadlines.

3.) Academic honesty is essential to student success and is central to the mission of the university (<https://conduct.students.wisc.edu/academic-integrity/>). In keeping with the university's commitment to academic integrity, all work submitted must be one's own. Plagiarism is not tolerated, and will result in academic disciplinary action.

Reading Materials

The textbook below may be purchased at the University Book Store. There also may be copies available at College Library, Helen C. White Hall for in-library use. The relevant passages for reading in this class will be digitized and put on Canvas.

Peter Bowler and Iwan Rhys Morus, *Making Modern Science: A Historical Survey* (Chicago: Univ. of Chicago Press, 2005).

All other readings for this course will also be made available electronically on Canvas for the course HSCI 202 or ILS 202. Readings that include an asterisk are required reading, while those without an asterisk are recommended but not required.

Course Schedule

Unit 1: The New Sciences

Week 1: The "New" Sciences

Tuesday, 1/24: *Introduction: What Makes Science Modern?*

Readings:

**Making of Modern Science* (Henceforth abbreviated as *MMS*), pp. 1-19.

Thursday, 1/26: *A New Cosmology*

Readings:

**MMS*, pp. 25-33.

*Nicolaus Copernicus, *On the Revolution of the Heavenly Spheres*, trans. Charles Glenn Wallis (Amherst, NY: Prometheus Books, 1995), pp. 3-7.

*Owen Gingerich, "From Copernicus to Kepler," in *Proceedings of the American Philosophical Society* vol. 117 no. 6 (Dec. 31, 1973), pp. 513-522 (Oxford: Oxford University Press, 2016), pp. 58-72.

Avner Ben-Zaken, "The Heavens of the Sky and the Heavens of the Heart," in *The British Journal for the History of Science* vol. 37 no. 1 (Mar. 2004), pp. 1-28.

Week 2: A Mechanical Philosophy

Tuesday, 1/31: *New Views of the Body*

Readings:

**MMS*, pp. 33-39.

*William Harvey, *On the Motion of the Heart and Blood in Animals*, trans. Willis and ed. Bowie (Chicago: H. Regnery Co., 1962), 198-206.

Howard B. Burchell, "Mechanical and Hydraulic Analogies in Harvey's Discovery of the Circulation," in *Journal of the History of Medicine and Allied Sciences* 36 no. 3 (July 1981), pp. 260-277.

Thursday, 2/2: *Machines and the Mechanical Philosophy*

Readings:

- *René Descartes, "Sixth Discourse: On Vision," in *Descartes' Philosophical Writings*, ed. and trans. N. K. Smith (London: MacMillan and Co., 1952), pp. 173-179.
- *Jean-François Gauvin, "Artisans, Machines, and Descartes' *Organon*," in *History of Science* 44 no. 3 (June 2006), 187-216.

Week 3: Experimentation

Tuesday, 2/7: *A Scientific Republic*

Readings:

- **MMS*, pp. 319-326.
- *Francis Bacon, *The New Atlantis*, trans. Alfred Gough (Oxford: Clarendon, 1915), pp. 21-25.
- Jonathan Swift, *Gulliver's Travels* (Ware: Wordsworth Classics, 1992), pp. 131-145.
- Steven Shapin, "The Invisible Technician," in *The American Scientist* 77 no. 6 (Nov.-Dec. 1989), 554-563.

Thursday, 2/9: *Newton and the Enlightenment*

Readings:

- **MMS*, pp. 46-53.
- *Isaac Newton, "A New Theory about Light and Colours," in William Francis Magie, ed., *A Source Book in Physics* (Cambridge, MA: Harvard Univ. Press, 1963), pp. 298-305.
- *Michael Ben-Chaim, "Newton's Vocation as an 'Experimental Philosopher,'" in *The British Journal for the History of Science* vol. 34 no. 4 (Dec. 2001), pp. 395-416.
- Newton, *The Principia*, trans. I. Bernard Cohen and Anne Whitman (Berkeley: Univ. of California Press, 1999), pp. 403-417.

Week 4: Movement of Scientific Ideas

Tuesday, 2/14: *The Spread of Newtonian Thought*

Readings:

- **MMS*, pp. 367-371.
- *Newton, *Opticks* (Oxford: William and John Innys, 1721), pp. 370-382.
- *Betty Jo Teeter Dobbs and Margaret Jacob, "Rational Mechanics" and "The Spread of Newtonianism," in *Newton and the Culture of Newtonianism* (Amherst, NY: Humanity Books, 1998), pp. 71-95.
- *I. Bernard Cohen, "Franklin's Scientific Style," in *Benjamin Franklin's Science* (Cambridge, MA: Harvard Univ. Press, 1990), pp. 14-30.

Receive Essay #1 Assignment

Thursday, 2/16: *Travel and the Circulation of Knowledge*

Readings:

- *Hans Sloane, *A Voyage to the Islands Madera, Barbadoes, Nieves, S. Christophers, and Jamaica; with the Natural History*, 2 vols. (London, 1707), 1: pp. cxliii, cxlvii, 2: pp. 49-50.

- *Londa Schiebinger, "Exotic Abortifacients: The Global Politics of Plants in the 18th Century," *Endeavour* 24 no. 3 (2000), pp. 117-121.
 Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (London: Routledge, 1992), pp. 15-29.

Week 5: Science, Society, and Spirituality

Tuesday 2/21: *Natural History as a "Moral" Science*

Readings:

- *MMS, pp. 105-111, 132-136.
 *Thomas Jefferson, *Notes on the State of Virginia* (London, 1787), pp. 64-80
 *Benjamin Banneker, A Letter to Thomas Jefferson, Dated 1791, in *A Hammer in Their Hands: A Documentary History of Technology and the African-American Experience*, ed. Carroll W. Pursell (Cambridge, MA: MIT Press, 2005), pp. 16-19.
 Lee Alan Dugatkin, "Buffon, Jefferson, and the Theory of New World Degeneracy," in *Evolution: Education and Outreach* 12 no. 15 (2019), pp. 1-8.
 Mary Louise Pratt, *Imperial Eyes* (cont'd), pp. 29-37.

Thursday, 2/23: *Science and Religion*

Readings:

- *MMS, pp. 341-354.
 *Isaac Newton, "The General Scholium," in *The Principia: The Mathematical Principles of Natural Philosophy*, trans. Cohen and Whitman, pp. 939-944.
 *Roger Hahn, "Laplace and the Mechanistic Universe," in *God and Nature: Historical Essays on the Encounter between Christianity and Science*, ed. David Lindberg and Ronald Numbers (Berkeley: Univ. of California Press, 1986), pp. 256-273.
 Jean le Rond D'Alembert, "Discours Préliminaire," in *Traité de Dynamique* (Paris: 1757), pp. i-xxxv.¹

II. Unit 2: Matter in Motion

Week 6: Science and Revolution

Tuesday, 2/28: *Revolutions, Chemical and Otherwise*

Readings:

- *MMS, pp. 61-77.
 *Peter Dear, "The Chemical Revolution," in *The Intelligibility of Nature: How Science Makes Sense of the World* (Chicago: University of Chicago Press, 2006), pp. 67-89.
 Lord Ritchie-Calder, "The Lunar Society of Birmingham," in *Scientific American* 246 no. 6 (June 1982), pp. 136-145.

Thursday, 3/2: *Science and Social Improvement*

Readings:

- *Nicolas de Condorcet, *Outlines of an Historical View of the Progress of the Human Mind* (London: M. Carey, 1796), pp. 1-23.

¹ Note: I have not been able to find a modern English translation of this text, but, if I cannot find one, I will provide my own partial translation of this text, including only the passages relevant to the themes of the lecture for the week.

*Lorraine Daston, "Condorcet and the Meaning of Enlightenment," in *Proceedings of the British Academy* 151 (2006), pp. 113-134.

Friday, 3/3 Rough Draft of Essay #1 due in Canvas Dropbox at 11:59 PM.

Week 7: The Industrial Revolution

Tuesday, 3/7: *Science on the Factory Floor*

Readings:

*MMS, pp. 391-407.

*James Patrick Muirhead, "Mr. Watt's Narrative of the Inventions Described in His Specification of 1769, Given in His Notes on Robison," in *The Life of James Watt with Selection from His Correspondence* (London: John Murray, 1859), pp. 74-83.

Donald Cardwell, "Birth of the Factory," in *Wheels, Clocks, and Rockets: A History of Technology*, pp. 153-177.

Thursday, 3/9: *The Many Origins of the Science of Heat*

Readings:

*MMS, pp. 79-95.

*S. S. Wilson, "Sadi Carnot," in *Scientific American* 245 no. 2 (August 1981), pp. 134-145.

*Anson Rabinbach, "Transcendental Materialism: The Primacy of *Arbeitskraft*," in *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (Berkeley: Univ. of California Press, 1990), pp. 45-68, 309-316.

Spring Recess: 3/11-3/19

Week 8: Unifying Science

Tuesday, 3/21: *The Professionalization of Science*

Readings:

*MMS, pp. 329-337.

*William Whewell, "Review of *On the Connexion of the Physical Sciences* by Mary Somerville," in *Quarterly Review* 51 (March and June 1834), pp. 54-68.

*Laura Snyder, *The Philosophical Breakfast Club*, pp. 1-7, 128-157.

Trevor Levere, "Coleridge, Chemistry, and the Philosophy of Nature," in *Studies in Romanticism* 16 no. 3 (Summer 1977), 349-379.

Thursday, 3/23: *Romanticism, Reclaiming the Soul of Science*

Readings:

*MMS, pp. 174-178.

*Mary Shelley, *Frankenstein* (The New American Library, 2000), pp. 28-71.

*Richard Holmes, "Dr. Frankenstein and the Soul" *Age of Wonder: How the Romantic Generation Discovered the Beauty and Terror of Science* (New York: Pantheon Books, 2008), pp. 305-336.

Week 9: Science and Empire

Tuesday, 3/28: *Electricity and Empire*

Readings:

- *MMS, pp. 95-100, 402-414.
- *Bruce J. Hunt, "Michael Faraday, Cable Telegraphy and the Rise of Field Theory," in *History of Technology* 13 (1991), pp. 1-19.

Thursday, 3/30: *Transforming Traditions*

Readings:

- *David Stolz, "Astronomy, the State, and Islamic Authority at the End of the Day," in *The Lighthouse and the Observatory* (Cambridge: CUP, 2018), pp. 271-278.
- *Zhaoyuan Wan, "Recasting Confucianism," in *Science and the Confucian Religion of Kang Youwei* (Leiden: Brill, 2021), pp. 68-96.

III. Unit 3: Progress and Change

Week 10: The Age of the Earth and the Origins of Species

Tuesday, 4/4: *Geology, New Concepts of Progress and Change*

Readings:

- *MMS, pp. 111-124.
- *Charles Lyell, *Principles of Geology* vol. 1 (London: John Murray, Albemarle Street, 1832), pp. 517-553.
- *James R. Moore, "Geologists and Interpreters of Genesis in the Nineteenth Century," in *God and Nature*, pp. 322-350.

Thursday, 4/6: *The Origin of Species*

Readings:

- *MMS, pp. 136-149.
- *Charles Darwin, "Natural Selection," in *On the Origins of Species* (London: John Murray, Albemarle Street, 1859), pp. 80-96.
- *Robert Richards, "Emergence of Evolutionary Theories of Species Change," in *The Meaning of Evolution* (Chicago: Univ. of Chicago Press, 1992), pp. 63-90.

Friday, 4/7 Final Draft of Essay #2 due in Canvas Dropbox at 11:59 PM.

Week 11: Darwinism

Tuesday, 4/11: *Evolution and Religion*

Readings:

- *MMS, pp. 149-154, 354-360.
- * Letter from Asa Gray to J.D. Hooker, in *The Correspondence of Charles Darwin, 1860* vol. 8 (Cambridge: CUP, 1993), pp. 15-17.
- * Letter from C. Darwin to Asa Gray, in *The Correspondence of Charles Darwin, 1860* vol. 8, pp. 53-56.
- *A. Hunter Dupree, "Christianity and the Scientific Community in the Age of Darwin," in *God and Nature*, pp. 351-368.
- Extract from Lecture by Agassiz, Boston, January 1860, in *Sir Charles Lyell's Scientific Journals on the Species Question*, ed. Leonard Gilchrist Wilson (New Haven: Yale Univ. Press, 1970), pp. 348-349.

Thursday, 4/13: *Evolution, Race, and Intelligence*

Readings:

*MMS, pp. 154-157, 422-433.

*Francis Galton, "The Comparative Worth of Different Races," in *Hereditary Genius: An Inquiry into Its Laws and Consequences* (New York: D. Appleton & Co., 1870), pp. 316-335.

Stephen Jay Gould, "Galton – Apostle of Quantification," in *The Mismeasure of Man* (2007), pp. 75-77.

John Carson, *The Measure of Merit* (Princeton: Princeton University Press,), pp. 75-109.

Week 12: Human Development, Progress or Declension?

Tuesday, 4/18: *Human Sciences*

Readings:

*MMS, pp. 299-315.

*Herbert Spencer, *The Principles of Sociology* vol. 1 (New York: D. Appleton & Co., 1883), pp. 465-480.

*Victor Hiltz, "Towards the Social Organism: Herbert Spencer and William B. Carpenter on the Analogical Method," in *The Natural Sciences and the Social Sciences*, ed. Robert S. Cohen (Dordrecht: Springer, 1994), pp. 275-298.

Thursday, 4/20: *Environmental Sciences*

Readings:

*MMS, pp. 213-225.

*Frank Egerton, "Humboldt, Nature's Geographer," in *Roots of Ecology: Antiquity to Haeckel* (Berkeley: Univ. of California Press, 2012), pp. 121-124.

*Egerton, "Haeckel's Concept of Ecology" pp. 198-200.

Ernst Haeckel, *Generelle Morphologie* vol. 2 (Berlin: Reimer, 1866), pp. 235-236, 286-289.²

Receive Essay #2 Assignment

Week 13: Modern Medicine

Tuesday, 4/25: *Pasteur and the Agricultural Origins of "Germs"*

Readings:

*Louis Pasteur, *Studies on Fermentation: The Diseases of Beer, Their Causes, and the Means of Preventing Them*, tr. Frank Faulkner and D. Constable Robb (London: Macmillan & Co., 1879), pp. 19-32.

*Gerald Geison, "Pasteur in Brief," in *The Private Science of Louis Pasteur* (Princeton: Princeton Univ. Press, 1995), pp. 22-50.

Thursday, 4/27: *Scientific Medicine and Public Health*

Readings:

*MMS, pp. 439-452.

² Note: I have not been able to find a modern English translation of this text, but, if I cannot find one, I will provide my own translation of the selections from this text.

*Nancy Tomes, “The Private Side of Public Health: Sanitary Science, Domestic Hygiene, and the Germ Theory, 1870-1900,” in *Bulletin of the History of Medicine* 64 no. 4 (Winter 1990), pp. 509-539.

Week 14: Fin de Siècle

Tuesday, 5/2: *Crisis in Physics?*

Readings:

*MMS, pp. 260-265.

*Sir William Thomson, “On the Age of the Sun’s Heat,” in *Macmillan’s Magazine* vol 5 (March 5, 1862), pp. 388-393.

*Helge Kragh, “The ‘New Physics,’” *The Fin-de-Siècle World*, ed. Michael Saler (London: Routledge, 2015), pp. 441-455.

Thursday, 5/4: *Appraisals*

Readings:

*Alfred Russel Wallace, *The Wonderful Century: Its Successes and Its Failures* (New York: Dodd, Mead, and Co., 1898), pp. 150-156, 369-381.

Monday, 5/8 Essay #2 due on Canvas at 11:59 PM.