ARTSSCI 4HS3 –History of Science Inquiry – Fall 2020 (2020-21)

Instructor: Matthew Jordan (jordanml@mcmaster.ca)
Office Hours: Monday & Thursday, 10am – 11am on Zoom or by appointment
Course Time: Mondays 11:30am – 2:20pm
Course Location: Zoom

Course Description: Science may appear orderly and objective, but its history is messy and deeply human. This course explores the blunders, biases, and glimpses of brilliance that have defined science over the past 400 years. This historical grounding will then allow us to ask philosophical questions about the meaning of "science," and sociological questions about how scientific knowledge production really works.

Intended Learning Outcomes: At the end of the course, students should be able to:

1. Appreciate how history can enrich our understanding of contemporary science.
2. Confidently analyze historic scientific developments at the level of scientists (i.e. lab techniques, new theories), scientific institutions (i.e. what passes peer review), and society at large (i.e. how science is informed by military concerns).
3. Understand debates about whether science yields objective truth, is socially constructed, has a well-defined method, and ought to be trusted.
4. Communicate clearly and cogently, both in writing and in speech, about science and its history.

Course text: There is no mandatory course text. All readings will be available via the McMaster library database, distributed via email.

Course Format: The course has one 3-hour session per week over Zoom. I will introduce the week's topic in the first 10-15 minutes, then we'll break into small-group discussions, before reconvening for the final hour or so. I will float between the small-group discussions, and during the final hour of class there will be student presentations, as well as a general discussion, and an opportunity for you to ask me questions. There is no formal lecture component to this class. You are expected to do all the readings before each week's class. You will get *much* more out of the course if you do the readings ahead of time, so please do your best to come to class prepared.

A Note on Time and Space: The history of science is an impossibly vast subject. Its objects of study include 5000-year-old Mesopotamian tablets, 7th century Arabic manuscripts, ancient Greek astronomy, Indigenous botanical knowledge, traditional Chinese medicine, and AirPods. A course like this can cover only a vanishingly small fraction of this content. However, you are encouraged to explore any eras or geographies in your essays.

Assignments and Evaluations

Assignment	Length	Due Date	Grade Weight
Weekly Reflections	500 words each	Throughout term	15%
Historiography Assignment	1000 words	October 23	15%
Class Presentation	15 minutes	Throughout term	15%
Final Paper	3000 words	December 11	45%
Participation	–	–	10%

Schedule Overview

Week 1 — What is Science?
Week 2 — From The Closed World to the Infinite Universe
Week 3 — Science, Colonialism, and Empire
Week 4 — Is there a scientific method?
Week 5 — Darwin, Galton, and Eugenics
Week 6 — Scientific funding and publishing
Week 7 — Public health and pandemics
Week 8 — The brain and the mind
Week 9 — The production of scientific knowledge
Week 10 — The rise of Big Science
Week 11 — Science and technology
Week 12 — Critiques of science

Course Schedule

Week 1 — What is Science? — September 14

We begin by attempting to define science. There are no correct answers, and my hope is that this class is largely a collective brainstorm, but given that many people have thought about this question before, we will consult their work too. Who is allowed to do science? Which cultures in history have practiced science? Should the "history of science" begin in 16th century Europe, or should we focus instead on China, India, Mesopotamia, Egypt, Indigenous knowledge, or something else entirely?

Readings

1. AF Chalmers, *What is this Thing Called Science?* (1976) — Introduction & Chapter 1
2. David Pingree, "Hellenophilia versus the History of Science", *Isis* (1992)

Week 2 — From The Closed World to the Infinite Universe — September 21

Did the 16th & 17th centuries see a radical shift in how people made sense of space, time, and our place in the universe, or was there not discontinuous leap from medieval darkness into enlightened modernity? We will question every word in "the" "scientific" "revolution."

Readings

1. Alexandre Koyré, "Galileo and the Scientific Revolution of the Seventeenth Century", *The Philosophical Review* (1943).
2. Roy Porter, "The Scientific Revolution: A Spoke in the Wheel?" in Roy Porter and Mikulas Teich, *Revolutions in History* (Cambridge University Press: 1986).

Week 3 — Science, Colonialism, and Empire — September 28

In 1620, Francis Bacon published the *Novum Organon*, the first book to explicitly outline a "scientific method." Its cover depicts a fleet of ships and a Biblical inscription: "Many will travel and knowledge will be increased." That same year, the *Mayflower* landed at Plymouth Rock and established the second permanent colony in the United States. Modern science has been inseparable from colony and empire ever since.

Readings

1. Francis Bacon, *The New Atlantis* (1623) — Skim the first few and last few pages
2. Francis Bacon, *Novum Organon* (1620) — Forward, Dedication, Preface
3. Rob Iliffe, "Science and Voyages of Discovery" in Roy Porter (ed) *The Cambridge History of Science, Vol 3* (2003).
4. John Gascogne, "The Royal Society, natural history and the peoples of the 'New World(s)', 1660–1800", *The British Journal for the History of Science* (2009).

Week 4 — Is There a Scientific Method? — October 5

This week, we explore the questions that have motivated the philosophy of science for nearly a century: does science have a fixed method? How can we distinguish science from pseudoscience? Why should we trust the knowledge scientists produce?

1. Imre Lakatos, "Science and Pseudoscience", BBC Radio Talk (1973).
2. Naomi Oreskes, "How do We Know We're Not Wrong?", *Climate Modelling* (2018).

Week 5 — Darwin, Galton, and Eugenics — October 19

This week, we explore how Charles Darwin built on decades of work in geology, biology, and economics to develop the theory of natural selection. Darwin's work caused a seismic shift in our understanding of life on earth, but it was also appropriated by eugenics, a social movement that sought to improve human populations through controlled breeding. We will ask whether Darwinian theory and "Social Darwinism" are inherently linked, or whether both are simply outgrowths of a Victorian culture obsessed with heredity, classification, and reproduction.

Readings

1. Charles Darwin, *The Descent of Man, and Selection, in Relation to Sex* (1871) — Skim
2. Charles Darwin, *On the Origin of Species* (1859) — Introduction, Conclusion
3. Diane B. Paul, “Darwin, Social Darwinism and Eugenics”, *The Cambridge Companion to Darwin* (2003)

Week 6 — Scientific Funding and Publishing — October 26

Scientists in the 21st century spend a great deal of their time trying to acquire funding and reviewing other scientists’ work for journalists, typically for free. These issues are not new. Scientists have always needed to find patrons to sponsor their work, and the scientific community has always had internal correction mechanisms and a culture of criticism.

Readings

1. Richard Westfall, “Science and patronage: Galileo and the telescope,” *Isis* (1985)
2. Mario Biagioli, “From book censorship to peer review”, *Emergences Journal for the Study of Media & Composite Cultures* (2002)

Week 7 — Public Health and Pandemics — November 2

Pandemics are nothing new. In fact, widespread disease has been the default state of affairs throughout most of human history. This week, we look at how society was transformed by past pandemics like the Black Death and the Spanish Flu, as well as the public health measures that have made our water, our air, and our food safer.

Readings

1. Roy Porter, *The Greatest Benefit to Mankind* (1999) — Chapter XII

Week 8 — The Brain and the Mind — November 9

Our understanding of the brain has evolved dramatically over the past 300 years. During the Industrial Revolution, the brain was understood to be a hydraulic system that could “let off steam.” After the invention of the digital computer and the discovery of the action potential, scientists re-formulated cognition as symbolic information-processing. This week, we discuss the idea of the brain, and the history of thought about thought.

Readings

1. Arturo Rosenbluth, Norbert Wiener, Julian Bigelow, “Behavior, Purpose, and Teleology”, *Philosophy of Science* (1943).
2. Matthew Cobb, *The Idea of the Brain* – Introduction

Week 9 — The Production of Scientific Knowledge — November 16

On reflection, the production of scientific knowledge is a remarkable thing: researchers take tangible data from test tubes, particle colliders, or archeological digs, and use them to make claims about things we will never see—genes, the big bang, velociraptors. This week, we look at how theories and observations gain the approval of the scientific community and become established facts.

Readings

1. Harry Collins, “The Seven Sexes: A Study in the Sociology of a Phenomenon, or the Replication of Experiments in Physics”, *Sociology* (1975).
2. Donald Mackenzie and Graham Spinardi, “Tacit Knowledge, Weapons Design, and the Uninvention of Nuclear Weapons”, *American Journal of Sociology* (1995).

Week 10 — The Rise of Big Science — November 23

In the second half of the 20th century, science exploded to a scale unmatched by any other academic enterprise. The making of the atomic bomb gave rise to a military-industrial-scientific partnership that persists to the present day. Scientific research became an international collaborative effort, moving from small labs to international research centers, underground particle colliders, multi-decade genomic efforts, and permanent space stations.

Readings

1. Jeff Hughes, *The Manhattan Project: Big Science and the Atom Bomb* (Columbia University Press, 2002) — Chapter 1 & 2.
2. Daniel Kevles, “Big Science and Big Politics in the United States: Reflections on the Death of the SSC and the Life of the Human Genome Project”, *Historical Studies in the Physical and Biological Sciences* (1997) — the sections on the Human Genome Project

Week 11 — Science and Technology — November 30

What is the relationship between science and engineering? Is it true that scientific breakthroughs lead to technological advancement, which in turn becomes a commercializable product?

Readings

1. Robert Heilbroner, “Do Machines Make History”, *Technology and Culture* (1967)
2. Benoit Godin, “The Linear Model of Innovation: The Historical Construction of an Analytical Framework”, *Science, Technology, and Human Values* (2006)
3. Vannevar Bush, “Science: The Endless Frontier” (1945)

Week 12 — Critics of Science — December 7

In the 1990s, many critiques were leveled at the scientific community. Feminists noted that women had been systematically excluded; critical theorists asserted that scientific theories are socially

constructed and contingent; philosophers and religious scholars castigated scientists for thinking they had a monopoly on rationality and truth. This week, we take science's critics seriously, asking whether science is in fact "socially constructed," whether it's inherently androcentric, and whether it has a unique claim to objectivity.

1. Alan Sokal, "A Physicist Experiments with Cultural Studies", Lingua Franca (1996)
2. Bruce Robbins, "Just Doing Your Job," Yale Journal of Criticism (1997)
3. Maralee Harrell, "On the Possibility of a Feminist Philosophy of Physics", *Meta-Philosophical Reflection on Feminist Philosophies of Science* (2016).

Evaluation

All assignments should be emailed to jordanml@mcmaster.ca by midnight on their due date. Unless arranged beforehand, assignments will receive a 5% deduction for every day after their due date they are submitted.

Weekly Reflections | Due every week before class | 15% total

Every week, you will write a 500-word reflection on the content of that week's class and send it to me by email before class begins. You can discuss whatever you choose—you can relate the material to other courses you've taken, summarize the content of the readings, reflect on its relevance in your own life, make connections between other areas of history or science, or anything else. The goal of these reflections is to force you to think beyond the readings, and prepare you for the small-group discussions.

Historiography Essay | October 23 | 15%

Your first essay will be an 1000-word overview of the historiography—that is, the history of the history—of any topic within the history of science. While I would recommend you write about something we cover in this course, you are free to choose any topic in the history of science. Your essay should essentially be a literature review that covers how historians' views on the topic have changed over time. Your essay should address questions like: Who were the first people to explore the topic? What historical theories did they propose? How is the topic thought about now? Is it still an active area of research? What open questions remain?

Class Presentation | Throughout Term | 15%

You will deliver a 15-minute presentation on a topic related to the readings for that week's class. You are free to take this presentation in any direction you choose, based on any reading, or any other material you find about the topic. For instance, for the week on Darwinism and eugenics, you can write about the origins of Darwin's theory in geology and economics, the origins of statistics in the study of human variability, or the eugenic origins of the modern conservation & environmentalist movements.

During the first class, we will pick dates for the presentations. These presentations will take place during the third hour of class, and will be followed by a class discussion. Most classes will have two presentations, and those presentations should not be on the same topic. (There has never been an issue with overlap in the past.)

Final Paper | **December 11 | 45%**

Your final paper consists of a 3,000-word essay on any topic of your choosing related to the course material. I must approve your topic, but given the breadth of what's covered under "history of science," I'm likely to approve most suggestions.

Your essay should consider your chosen topic from a variety of perspectives, from an "internalist" view of scientists' work to an "externalist" view of that work's place in society. It should also address the historiography of the topic. Most professional historians do not write this way—they usually stick to one register, focusing exclusively on technical matters or societal concerns, but not both. But most professional historians were not trained in Artsci. You are in a unique position to seamlessly blend these different types of historical analysis, and your essay ought to demonstrate that societal trends shape the scientific community's research priorities, and scientific ideas shape society in turn.

If you're stuck, there are many sources you can turn to for inspiration on how this style of history is written. Some examples of books are:

- Andrew Hodges, *Alan Turing: The Enigma*, 1983
- Rhicard Rhodes, *The Making of the Atomic Bomb*, 1986
- Rebecca Skloot, *The Immortal Life of Henrietta Lacks*, 2010
- David Kaiser, *How The Hippies Saved Physics*, 2011

I'm also happy to give recommendations for your particular topic!

Your essay should include an abstract, a table of contents, and clear, consistent citations. You should feel free to dig into primary or archival resources—for instance, many universities have put scanned versions of their archives online. Your essay should be framed as the answer to a research question (i.e. "What was the role of telescopes and microscopes in the scientific revolution?"), an argument (i.e. "I will argue that the consensus on the harmful effects of cigarettes was deliberately obfuscated by a small group of politically-motivated scientists"), or a narrative (i.e. "This essay tells the story of how phlogiston theory was overturned").

Participation | 10%

This is a small seminar-style class, which means we'll be spending a lot of time discussing and dissecting texts. Your participation grade is based on whether you come to class prepared to engage with the material each week. You don't need to be the most vocal person on the screen; the important thing is that you've put in the work. Asking questions is just as important as answering them!

SENATE-APPROVED ADVISORY STATEMENTS

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures- guidelines/.

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., online search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ONLINE ELEMENT

Some courses may use online elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses online elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

CONDUCT EXPECTATIONS
As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES
Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK
McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)
Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING
Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES
The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be

communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

NOTES FOR ALL ARTS & SCIENCE COURSES

1. Some of the statements above refer to a “Faculty Office”; please note that the Arts & Science Program Office serves in this capacity.
2. It is the responsibility of students to check their McMaster email regularly. Announcements will be made in class, via A2L, and/or via the course email distribution list <d-as4HS3@mcmaster.ca>.