

History 106: Science and the Modern World

Spring 2022

Mondays & Wednesdays, 10:15–11:30am, Gray 220

Instructor: Evan Hepler-Smith (evan.heplersmith@duke.edu)

Office Hours: Tues 2-4pm & by appt., Classroom Bldg. 319 & via Zoom

TA: Yaming You (yaming.you@duke.edu)

This course surveys the history of science from the 16th century through the present day. It addresses science not just as a body of knowledge and methods but as a cultural activity that has shaped and been shaped by modern global history. Topics will range across physical sciences, life sciences, earth and environmental sciences, and social sciences. This course takes a global perspective, with emphasis on parallels, differences, and interconnections among ways of knowing nature in different places and times, as well as the role of specific materials, environments, technologies, and practical problems in the development of modern science.



Top Left: A scene from the 2017 "March for Science" in Raleigh. Top Right: Duke parapsychologist J.B. Rhine conducts an E.S.P. experiment, 1930s. Bottom: The 5th Solvay Conference on Physics ("Electrons and Photos"), 1927

Sources: <https://indyweek.com/news/archives/we-afraid-action-thousands-march-science-downtown-raleigh/>; <https://www.ncdcr.gov/blog/2015/02/20/j-b-rhine-of-duke-university-father-of-modern-parapsychology>; Benjamin Couprie, Institut International de Physique de Solvay, <http://doi.org/10.3932/ethz-a-000046848>.

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Gaining reliable knowledge about nature hasn't always involved laboratories, universities, government funding, journal articles, hypotheses, experiments, and the like. Following the historical development of modern science and its characteristic features, we will find that science has never stood apart from religious, political, and commercial concerns, and in fact has often grown out of them. We will seek to understand how it is that, notwithstanding these entanglements, scientific methods and knowledge have become so reliable, accurate, and powerful (most of the time).

No special background in science or in history is necessary for this course.

STEM-focused students: This course provides both an introduction to the study of History and historical perspective on STEM fields and their social implications.

Humanities and social science students: This course shows how you can use methods from the humanities and social sciences to ask informed questions about science and technology—questions crucial for responsible participation in present-day society.

Learning Goals: After taking this course, students will be able to...

- identify characteristic fields and features of science and their relationships to society (including how science has both reflected and contributed to ideas about social identity, progress, technology, and environments) in several different global-historical settings since the 16th century CE, through lectures and readings.
- ask and answer historical questions from a range of different conceptions of science as historical subject matter (e.g. intellectual, epistemological, cultural, social) addressing a range of different focal actors, sites, and activities, articulating how the kinds of questions a historian asks may impact the histories they tell, through small-group, section, and full-class in-class discussions.
- make arguments about both past science and its social contexts, based on finding and analyzing evidence from historical primary sources, through in-class practice, writing assignments, exams, and instructor feedback.
- identify and assess historical arguments about science in scholarly secondary sources and elsewhere in present-day public discourse, in-class practice, writing assignments, exams, and instructor feedback.
- employ historical perspective to analyze issues in present-day physical, life, environmental, and social sciences, including scientific practice in STEM fields, scientific controversies, and the relationships between sciences and non-science approaches to knowing the world, by identifying and analyzing historical analogies, genealogies, and precedents for these present-day issues.
- provide examples from the history of science of the social, economic, political, and religious *roots of* present-day science, as well as *alternative ways* science has related to society, economy, politics, and religion in the past.

Acknowledgements*: Duke University sits on ancestral lands of the Eno and Occaneechi people who came to be affiliated within the Saponi Nation, as well as the Tuscarora Nation. These lands are home to present-day Native life and sovereignty: North Carolina's eight [state-recognized Native tribes](#), [urban Native organizations](#) such as the [Triangle Native American Society](#), and Duke's own [Native American Student Alliance](#). Duke, an institution with a [mission](#) to "help those who suffer, cure disease, and promote health," was financed historically by proceeds of tobacco and electrical power generation, and is thus among the beneficiaries of enterprises that also caused great harm to the health of humans and environments. Some of Duke's past patrons and leaders perpetuated exclusion, exploitation, and silencing of Black people, as did the long-segregated University itself. At the same time, Black students, faculty, staff and other contributors—and Native members of the Duke community, and women in the Duke community, and LGBTQ members of the Duke community, and others who have had to fight for full inclusion—are and have long been pivotal contributors to the [university and its institutional evolution](#), including leadership in a present "journey to dismantle behaviors, practices, policies and institutions forged out of white supremacy."¹ As we will learn in this class, much the same could be said of many organizations that have played important roles in the history of modern science.

None of these facts are unique to Duke, or to science. Yet as members of the Duke community and, this semester at least, as historians of science, our collective relationship to them is. The same goes for further facts we may seek out regarding Duke's history, and the history of science, and other histories lived before, beyond, within, alongside, and despite them, and their legacies at present-day Duke. Further, we're a disparate "we," each with our own individual and community histories we may wish to acknowledge and explore, histories shaping our relationships to Duke's history and to each other.

What do we want to do about it? What does it mean to tell histories responsibly and to be responsible to these histories? This course is animated by the conviction that the study of history can be a stepping-stone toward an affirmative kind of responsibility, neither just a roster of blame for unjust harms and undeserved benefits, nor just a realist acquiescence to their inevitability seeking the most efficient means to discharge, erase, and forget such debts, but rather a starting point for fashioning affirmative individual and collective responsibilities based on these histories, and figuring out how to act on them.

¹ The Hurston-James Society, "Juneteenth: An Open Letter to Duke," *The Chronicle*, 18 June 2020, <https://www.dukechronicle.com/article/2020/06/juneteenth-an-open-letter-to-duke>.

* These acknowledgements, a work in progress, draw on text and links generously shared by Prof. Juliana Barr and draw inspiration from the letter cited above and Theresa Stewart-Ambo and K. Wayne Yang, "Beyond Land Acknowledgment in Settler Institutions," *Social Text* 39, no. 1 (146) (March 1, 2021): 21–46.

Grading (rubric for exam/paper grades at end of syllabus):

- Intro survey, mid-semester survey, & course evaluations 5%
- Participation (attendance, discussion, responses, assignments) 25%
- Take-home midterm I 15%
- Take-home midterm II 25%
- Final exam OR final paper 30%

Readings: You should expect to spend an average of 4-6 hours per week outside of class on readings, reading responses, and assignments. Please read the assigned texts before each class meeting. We will provide discussion questions to help guide your reading. From time to time, we will ask you to post brief responses to these questions on our Sakai Forum prior to class, as a starting point for discussion. You should always mark a few passages in each reading that you find especially interesting, important, or puzzling, and/or write down a few general observations and questions about the reading. *Do not worry if you're not quite sure what's going on in a reading!* That's what our lectures and discussions are for.

There is one required book: Michael Gordin, *On the Fringe: Where Science Meets Pseudoscience* (New York: Oxford University Press, 2021), available for \$9-\$18.

All other readings will be accessible via Sakai.

Assignments: Five assignments will give you an opportunity to practice the kinds of historical thinking that we will demonstrate in lectures, explore in discussions, and ask for on exams. Instructors will provide feedback on these assignments. You may submit these assignments in two ways: as open posts on our Sakai Forum (encouraged!), or privately via the Sakai Assignments function. Assignments will be graded on a checkmark basis – we're just looking for sufficient effort to offer you helpful feedback.

Discussion and attendance: You are responsible for all material covered during all class meetings. (Lecture slides will be posted on Sakai.) Since asking and discussing historical questions is a crucial component of our course, attendance is required. But things come up! You are permitted three "personal day" absences, no questions asked. Additional absences will be excused provided you a) submit a note from a physician or documentation of required university activities and b) complete a make-up exercise.

Midterms: We will have two open-book, open-note take-home midterm examinations, on Weds February 16 and Weds March 30 (untimed but designed to be completed in 75 minutes). Each exam will cover all material in readings and lectures to that date. Exams will also ask you to apply historical ideas and approaches covered in class to brief passages from one or more new sources. We will go over sample exam questions in a review session prior to each midterm.

Final exam / final paper: For our end-of-term evaluation, *you may choose **either** a final exam **or** a final paper*. Our final examination will be an in-room exam (open-book, open-note) on Monday April 25 (9am-12pm). The final exam will be cumulative, inclusive of material covered in all readings and lectures. In addition to questions resembling those on

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the midterms, this exam will present one or more essay questions asking you to draw connections across the long-term span covered in our course.

Final papers should be 8-12 pages in length (2000-3000 words, not counting notes and bibliography), presenting a historical argument based on analysis of primary-source evidence and engaging seriously with the argument of at least one secondary source. We will also consider proposals for alternative project formats of comparable scope and rigor. Students interested in writing final papers are encouraged to consider working with rare books or manuscripts at Rubenstein library. All students choosing to write a final paper must consult with a librarian before submitting the project proposal. Students opting for the final project must **submit a one-page proposal by 5pm, Friday, April 8.**

Collaboration and academic integrity: You are warmly encouraged to consult with one another, with others outside of class, and with your instructors in studying for exams, on your forum posts, and (if applicable) on your final paper. After exam questions are circulated, please work on your own and direct questions to instructors only. All work you submit for evaluation should reflect your own reading, thinking, and writing about the topic. If you have any questions about appropriate collaboration, ***please ask!*** This course is subject to the [Duke Community Standard](#)—make sure you’re familiar with it.

Collegiality and mutual support: We all bring different perspectives, experiences, identities, and concerns to this class. Some topics may be a matter of positive personal experience to come, negative personal experience to others, and entirely unfamiliar to still others. You will all disagree (we hope!) with some of the arguments advanced by our authors, instructors, and each other. We ask that you join in supporting our mutual growth by posing frank questions, presenting sincere arguments, testing uncertain ideas, and listening and responding to each other in a tough-minded spirit of generosity. Please keep an eye on the syllabus and our communications regarding what’s coming up; if you have any concerns, please let us know.

Electronics, accommodations, and accessibility: We want to do all we can to ensure that this class is accessible, inclusive, and equitable for all students. Please notify us within the first two weeks of class (or as soon as possible for concerns arising mid-semester) with information about accommodations that we can provide to ensure accessibility, per the [Student Rights and Responsibilities](#) of the Duke accessibility office. If you have other concerns about classroom inclusiveness, please let us know. We will work with you!

Please join us in directing all in-meeting electronics use and multitasking toward activities that feed into our course rather than distract from it. Note-taking, consulting readings electronically, and searching online resources for discussion-relevant information are appropriate; social media, shopping, email, and other non-course-relevant activities are not. We strongly prefer that you stick with tablets or laptops during class meetings and keep phones away. However, we are happy to make any exceptions that will aid rather than impede full participation by all. Again: please ask!

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Duke University is committed to providing equal access to students with documented disabilities. Students with disabilities may contact the Student Disability Access Office (SDAO) to ensure your access to this course and to the program. There you can engage in a confidential conversation about the process for requesting reasonable accommodations both in the classroom and in clinical settings. Students are encouraged to register with the SDAO as soon as they begin the program. Please note that accommodations are not provided retroactively. More information can be found online at access.duke.edu or by contacting SDAO at 919-668-1267, SDAO@duke.edu.

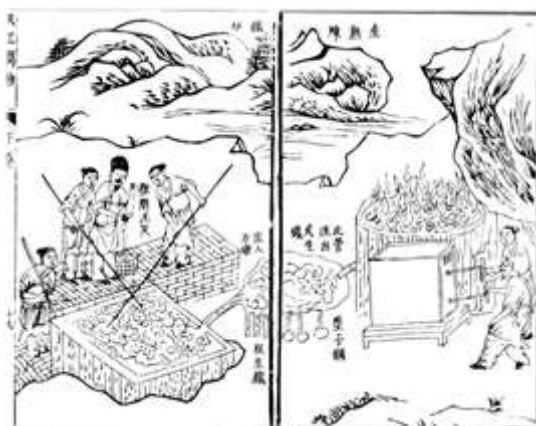
Unforeseen conflicts: If you anticipate trouble, speak with me as soon as possible. If you can inform me of serious adverse circumstances in advance, we can make accommodations that are fair to you and your fellow students. It is more difficult to do so after the fact.

Week 1: Introduction

Weds, Jan 5: What is science? What is history?

Mon, Jan 10: Asking historical questions about science

- *Secondary:* Kapil Raj, "Thinking Without the Scientific Revolution: Global Interactions and the Construction of Knowledge," (2017), 445–58; Subramaniam, *Ghost Stories for Darwin* (2014), vii-xii, 1-8, 20-23; Kuhn, *The Structure of Scientific Revolutions* (2012 [1962]), 1-11, 35-42.



Smelting iron in late Ming China (early 17th century)

Source: Song Yingxing, *Tiangong Kaiwu* (1637),
<http://donwagner.dk/MingFe/MingFeFigs/MingFeFig10.jpg>.

Unit I: From connected worlds to universal progress

Week 2: Natural history & natural philosophy in the early modern world

Weds, Jan 12: Plants, empires, and exchange

- *Primary:* Lawson, *A New Voyage to Carolina* (1860 [1709]), 93-99, 277-284, 353-361.
- *Secondary (recommended):* Carolyn Roberts, "Medicine, Knowledge, and Power in the Atlantic Slave Trade," 2021, <https://www.youtube.com/watch?v=35xDEtCWuo4>.

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Weds, Jan 19: The connected world

- *Primary*: Song Yingxing, *Tiangong Kaiwu* (*The Works of Heaven and the Inception of Things*) (1966 [1637]), "Metals," 235-259.
- *Secondary*: Schäfer, *The Crafting of the 10,000 Things* (2011), 1-4, 9-19.
- *Secondary (recommended)*: Principe, "The Connected World" (2011), 21-38.

Assignment 1, due Fri Jan 21 by 5pm: Song close reading

Week 3: Specialization and universal knowledge*Mon, Jan 24: Newtonian science & the Encyclopédie*

- *Primary*: Émilie du Châtelet, *Foundations of Physics* (2009 [1740]), Preface, Ch. IV, Ch. VI, Ch. XI (116-124, 147-163, 174-187).
- *Secondary (recommended)*: Blair, *Too Much to Know* (2010), 1-9.

Weds, Jan 26: Scientific revolutions?

- *Primary*: Marcet, *Conversations on Chemistry* (1809), 1-10.
- *Secondary*: Kuhn, *The Structure of Scientific Revolutions*, 92-110.



The continents offer gifts to seventeenth-century Amsterdam

Source: Jacob van Meurs, frontispiece to *Historical Description of Amsterdam* (1663), <https://archive.org/details/historischebesch00dapp>.

Week 4: Engines of progress

Mon, Jan 31: Progress and its limits: science addresses societies

- *Primary:* Condorcet, *Progress of the Human Mind* (1802 [1795]), 209-231; Malthus, *Principle of Population* (2018 [1798]), Ch. I (34-39).
- *Secondary (recommended):* Trouillot, *Silencing the Past* (1995), 70-95.

Weds, Feb 2: Fueling progress: coal and guano

- *Secondary:* Wu, *Empires of Coal* (2015), 33-65.

Assignment 2, due Fri Feb 4 by 5pm: Condorcet/Malthus comparison

Week 5: The nature of progress

Mon, Feb 7: Darwin and Darwinism

- *Primary:* Darwin, *The Origin of Species*, 6th ed. (1872), “Historical Sketch on the Progress of Opinion on the Origin of Species” (Preface) + Introduction + Chapters III-IV + Chapter XV.

Weds, Feb 9: Reading, writing, and speaking science

- *Secondary:* Elshakry, *Reading Darwin in Arabic* (2013), 1-23; Mavhunga, *The Mobile Workshop* (2018), 29-48 (plus Glossary, as needed)

Week 6: Unit I wrap-up

Mon, Feb 14: Unit I in review; pre-midterm Q&A

Weds, Feb 16: No class meeting -- work on Midterm I

Unit II: Making scientific futures

Week 7: Science, industry, medicine

Mon, Feb 21: Distilling modernity: The chemistry of coal tar, dyes, and drugs

- *Primary:* Schweitzer, “The Influence of Sir William Henry Perkin's Discovery Upon Our Science” (1906), 481-488.
- *Secondary:* Homburg, “Chemistry and Industry: A Tale of Two Moving Targets” (2018), 565-576

Weds, Feb 23: Fermenting modernity: biotechnology and microbiology

- *Secondary:* Lee, “The Microbial Production of Expertise in Meiji Japan” (2018), 171-190.

Assignment 3, due Fri Feb 25 by 5pm: Historical arguments & historiographic debates



*Statue of Rokeya Sakhawat Hossain, Begum Rokeya
Memorial Center, Pairaband, Bangladesh*

Source: NahidSultan, [https://commons.wikimedia.org/wiki/File:BirthPlace_of_BegumRokeya_\(11\).jpg](https://commons.wikimedia.org/wiki/File:BirthPlace_of_BegumRokeya_(11).jpg)

Week 8: Being scientific and being modern circa 1900

Mon, Feb 28: Uncanny universalism: Relativity, radioactivity, and uncertainty

- *Primary:* Einstein, "On the Electrodynamics of Moving Bodies" (1905), 123-139; Meitner and Frisch, "Disintegration of Uranium by Neutrons: A New Type of Nuclear Reaction," (1939), 239-240.

Weds, Mar 2: Alternative sciences and alternative modern worlds

- *Primary:* Hossain, "Sultana's Dream" (1905); Gajjar, "The Industrial Conference: Welcome Address," (1907), 1-21; Gandhi, *Hind Swaraj or Indian Home Rule* (1909), 29-34, 68-83

S p r i n g B r e a k



Source: jgs, ASCII Art Archive, <https://www.asciart.eu/nature/beach>.

Week 9: Science in the body, science at war

Mon, Mar 14: "Progressive" science: experimental medicine, eugenics, and birth control

- *Primary:* Bernard, *An Introduction to the Study of Experimental Medicine* (1949 [1865]), 15, 87-104; Brown, *Eugenical Sterilization in North Carolina* (1935), 3-15 + skim tables & form
- *Secondary:* Soto Laveaga, "Uncommon Trajectories: Steroid Hormones, Mexican Peasants, and the Search for a Wild Yam," 743-60.
- *Contemporary:* He Jiankui et al., "Draft Ethical Principles for Therapeutic Assisted Reproductive Technologies" [retracted] (2018)

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Weds, Mar 16: Science at school: discipline, interdisciplinarity, and universities

- Primary: Duke Endowment Indenture of Trust (1924)
- Secondary: Owens, "Pure and Sound Government" (1985)
- Secondary: Wang, "The Cold War and the Reshaping of Transnational Science in China" (2014), 343-369.

Week 10: Rubenstein visit

Mon, Mar 21: Sections 1 & 2 meet in Rubenstein; sections 3 & 4 work on assignment

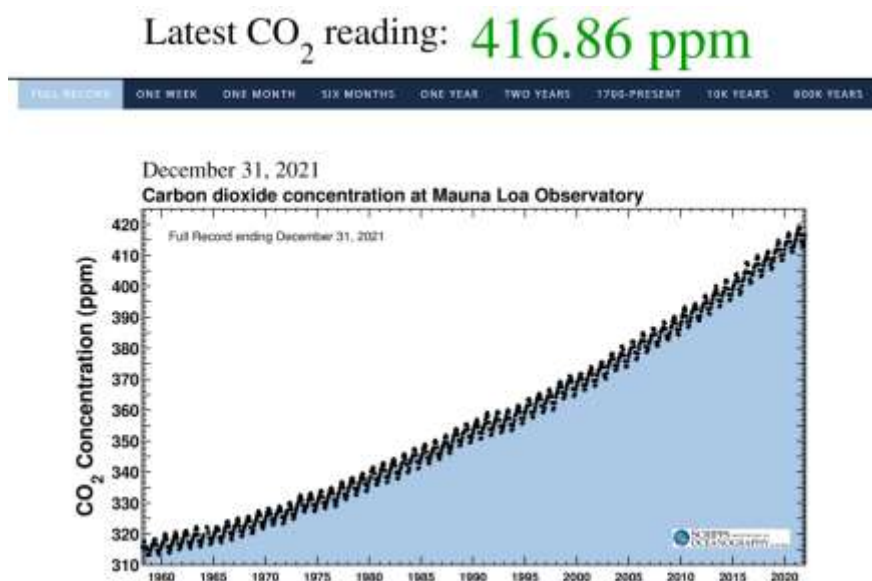
Weds, Mar 23: Sections 3 & 4 meet in Rubenstein; sections 1 & 2 work on assignment

Assignment 4, due Fri Mar 25 by 5pm: Archives and sources

Week 11: Unit II wrap-up

Mon, Mar 28: Unit 2 in review; Midterm Q&A

Weds, Mar 30: **No class meeting** -- Midterm II



The "Keeling Curve" as of Dec 21, 2021

Source: Scripps Institution, <https://scripps.ucsd.edu/programs/keelingcurve/>.

Unit III (Weeks 12-14): Science today and its histories

Mon, Apr 4: Science and the environment: Green revolutions and global climate

- Primary: Carson, *Silent Spring* (1962), Ch. 1-3
- Secondary: Edwards, *A Vast Machine* (2010), 251-285

Weds, Apr 6: Science goes to work: Taylorism, information, & data science

*****For students choosing to write a final paper in lieu of the final exam, paper proposals (1-2pp) are due to the instructors, via email, by 5pm on Friday April 8*****

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Mon, Apr 11: Science and pseudoscience

- *Primary:* Rhine, *Extra-Sensory Perception* (1934), 35-46; Brown & Williamson, "Smoking and Health Proposal" (1969)
- *Secondary:* Gordin, *On the Fringe* (2021)

Weds, Apr 13: Science addresses race and sex

- *Primary:* UNESCO Statements on Race (1950, 1951), 30-43.
- *Secondary:* Gil-Riaño, "Relocating Anti-Racist Science: The 1950 UNESCO Statement on Race and Economic Development in the Global South" (2018), 281-303; TallBear, *Native American DNA* (2013), 31-66.

Assignment 5, due Fri Apr 15 by 5pm: Pseudoscience assignment

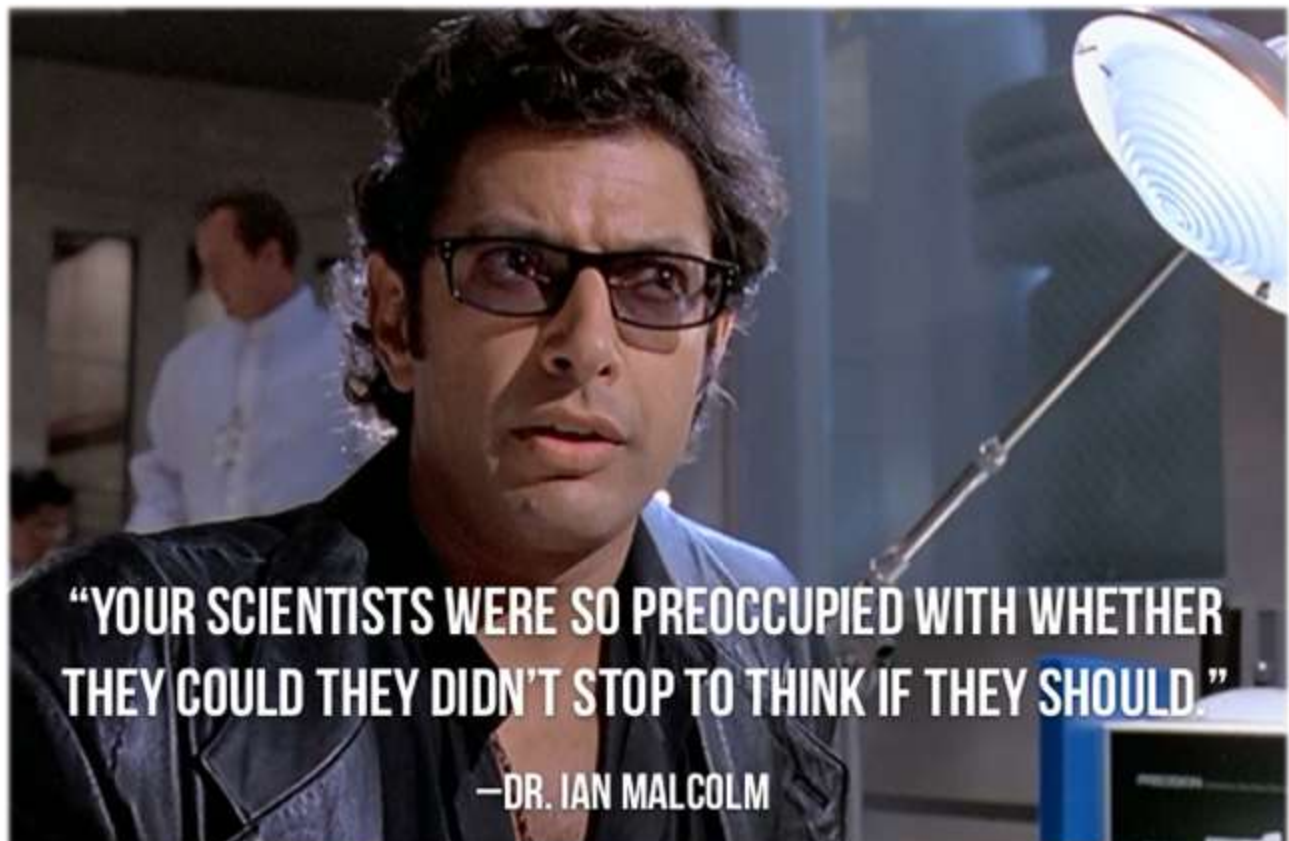
Mon, Apr 18: What is science (revisited)?

- *Primary:* *Jurassic Park* (film) (1993)
- *Secondary:* Subramaniam, *Ghost Stories for Darwin* (2014), 180-199.
- *Contemporary:* March for Science Mission & Values (2017); Duke University Mission Statement (2001)

Weds, Apr 20: Wrapping up

Final Exam on Mon Apr 25, 9am-12pm (for students choosing final exam)

Final Papers due Mon Apr 25, 12pm (for students choosing final paper)



RUBRIC for exams and final papers

- **High A (10/10)** answers address prompts thoughtfully, draw highly pertinent quoted or paraphrased evidence from appropriate readings, display sophisticated analysis based on course readings and discussions (e.g. applying arguments to new circumstances, effectively disputing arguments, suggesting nuances not discussed by the author/instructor, pointing out links between arguments), are well-structured, and are written in clear prose.
- **A-/B+ (7/10)** answers address prompts adequately, draw evidence from appropriate readings (though evidence may not be entirely relevant or may be misrepresented somewhat), display analysis based on course readings and discussions (but may display misunderstandings and/or may not link, challenge, or expand upon them), and are generally well-structured and readable but may be unclear here and there.
- **B-/C+ (4/10)** answers may address prompts inadequately, may include little or no appropriate evidence or analysis based on themes from course readings and discussions, and may display a lack of concern for structure and clarity that impedes understanding.
- **C-/D+ (3/10)** answers may address prompts inadequately or not at all, may include little or no evidence or analysis, and may display a neglect for clarity that seriously impedes understanding.
- **D (2/10)** answers downright hurt our feelings.
- **F (0/10)** answers are missing entirely.

At instructors' discretion, the term grade of A+ may be given in recognition of exceptional all-around work that goes above and beyond course expectations.