INTRODUCTION TO SCIENCE AND TECHNOLOGY POLICY ANALYSIS
PUBLIC POLICY 650
WINTER 2019

Prof. Joy Rohde
Office: 4211 Weill Hall
joyrohde@umich.edu
Office hours: Tues. 11:30-12:30; Thurs. 2:30-3:30, sign up via Canvas

Course: Tuesdays, 8:30-11:30 am
1110 Weill Hall

GSI: Katie Allan
Office:

krallan@umich.edu
Office Hours:

COURSE DESCRIPTION
Science and technology intersect with multiple areas of public policy. Think of the growing concerns over technological surveillance, the debates over policy for climate change mitigation, the challenges posed by global health crises, or the fear that American research and development competitiveness is eroding in a globalized economy. These issues reflect important questions about the relationship between science, technology, and public policy. Are scientific and technological developments governable, and if so, how and by whom? Is more and better science always better for policymaking? Who is the best judge of the value of scientific research programs and the validity of scientific findings? Are scientific and technological innovations generally socially beneficial, and who decides?

This course introduces theories and methodologies for science and technology policy analysis. You will learn how science and technology policy is made, with specific attention to the roles of government agencies, expert advisory committees, the private sector, and the public. You will learn qualitative analytical tools for science and technology policy analysis, including values analysis, technology assessment, and consensus conference design. And you will learn to apply cutting edge theories and approaches for governing science and technology to a number of policy problems. This analytic toolkit will be drawn from literature in a range of disciplines, including political science, philosophy, sociology, history, and the science of science policy.

This course will provide:
- Background on the science and technology policy environment
- An understanding of the "social science" of science and technology policy
- Skills to think critically about how science and technology can be used to help solve social problems
- A multidisciplinary toolkit for analyzing and influencing science and technology policy
- Expertise in conducting S&T policy analysis

PubPol 650 is a core course in the Science, Technology, and Public Policy (STPP) Graduate Certificate Program, but is not limited to STPP students. It is designed for graduate students from diverse disciplines, including public policy, public health, law, business, engineering and the social, biological, and physical sciences. No scientific, technical, or policy background is required to take the course.

COURSE REQUIREMENTS

Class participation	*25%*
Class Discussion Board	*25%*
Papers:	
Research Funding Memo	*10%*
Controversy Paper Proposal	*P/F*
Backgrounder	*20%*
Governance Recommendation	*20%*

A. ***Class participation.*** This is a discussion-intensive course. <u>Preparation, attendance, and active participation are mandatory and will be important parts of your final grade.</u> Each class session includes discussions and activities that <u>require</u> that you have read the week's readings. Your preparation for class should not be a passive process of absorbing facts from readings; rather, while reading, you should actively identify (and write down!) questions you have, possible avenues of discussion, and potential points of application of the readings to current events. Along these lines, you should pay attention to current news in science and technology policy. These topics will often come up in class as examples. Some of my favorite sources for keeping up with this news are: Nature News and Comment (nature.com) @NatureNews; *NYT* Science @NYTScience; and *Guardian* science @guardianscience.

B. ***Class Discussion Board*** To assist you in fulfilling (A), during the course of the semester you will post on the class discussion board in advance of <u>ten</u> class meetings. At least <u>three</u> posts should be stand-alone posts based on the readings (300-400 words in length); at least <u>seven</u> should be comments on/responses to your classmates' posts (200-250 words in length). Each post should be for a separate day of class. You are welcome to write additional posts or comments, either on the readings or on current events/news related to the class, etc.

The discussion posts and comments <u>should not summarize the reading</u>. They are think pieces—opportunities for you to refine questions and/or discuss insights from the readings. Your entries should <u>reflect holistically on all of the readings</u> assigned for the day, not just one or two pieces. You can also use your posts to explore the relationship between the readings and the topics chosen for your class papers, between a particular set of readings and readings from another week, or between the readings and current events. <u>Treat these posts as formal pieces of writing. Be clear and succinct.</u>

Posts should be up by **Sundays at 8 pm**, and **comments** by **Monday at 10 pm.** I will draw on them to frame discussion.

Posts will be graded on a scale of 0 to 3, with the expectation that most posts will receive a 2.

Discussion Board Rubric

Points	3	2	1	0
Criteria	Accurate, thoughtful and holistic analysis/response. Evidence of exceptional effort and insight.	Good effort to connect most/all readings. Demonstrates reasonable effort and insight.	Responds in general way; lack of specificity or insight indicates more time was needed to flesh out reflection.	Provides only summary; shows little engagement or insight; clear that work was hurried or careless.

C. *Written Assignments:* The course emphasizes writing for the policy environment, which may be a new skill for some of you. Policy writing requires front-loaded arguments, concision, clarity, and specificity. We'll discuss the genre, individual paper requirements, and tips throughout the term and in advance of assignments. I'm also available to meet with you regarding this, as are the Ford School's Writing Instructors. All students in the course—even if you are not a Ford student—can meet with them. If you want to make an appointment, you can do so here: https://fordschool.mywconline.com/ Note that you must first register with the site (i.e., create a login and password). Plan ahead—they book up quickly.

1. *Research Funding Written Testimony:* Choose an area of research that you believe deserves more government funding, and a stakeholder (e.g., a scientific/professional organization, patient advocacy organization, or civil society group) who is interested in increasing research funding this area. You, on behalf of your organization, have been asked to testify in front of a U.S. Congressional committee (you must find the relevant committee and address your memo accordingly) to make your case. Using no more than 700 words, provide written testimony explaining why Congress should increase funding for your desired area of research. Compelling written testimony will include answers to the following questions: Why is this area of research in the public interest? Why and how will it benefit the country? What is the return on the investment? As you write this memo, you'll need to think hard about how to explain and justify this area of research (and the need for government research funding in particular) to a "lay" audience and the most powerful way to make your case to decisionmakers in this venue. (Hint: both the audience and politics matter in terms of how you frame your argument and evidence!)

   Keep in mind that you are purposely being asked to make a complex argument in a very limited space in order to ensure that your writing is concise.

2. *Science or Technology Policy Controversy Papers*
   a) **Topic Choice**. Choose an ongoing controversy related to a specific science or technology policy that you want to focus on for your last two papers. There are a variety of possibilities to choose from, but it is very important that you choose a current, specific controversy that is being actively discussed by stakeholders and policy officials. Controversies are likely to focus on one of two questions: 1) should an area of science or technology move forward (e.g., proposals for developments pertaining to synthetic biology, geoengineering, natural resource development, etc.); or 2) should we regulate a particular area of science and technology (e.g., greenhouse gases/fossil fuels, genetically modified organisms, genetic testing). Choose a local, state, or national context in which an actual controversy is taking place. Answer the following questions: What are the main topics of controversy, and what is the history and context of the issue? What is the evidence of a live, ongoing controversy? Who are the stakeholders involved? Who are the decisionmakers involved? Who are the experts involved? Why is this controversy of interest to you in the context of this course? Is any specific policy or legislation being debated?

b) **Backgrounder**. This paper should provide an analytic explanation of your controversy. It should be addressed to a real decisionmaker in the controversy, from you as a science and technology policy analyst. It should use concepts, skills, and analytical approaches from the course to clearly, succinctly, and neutrally explain the issues underlying the controversy. Your memo should include a brief history of the controversy, an overview of the stakeholders involved (who they are, their interests, values, and positions on the issue), the main issues of controversy, and any previous efforts at resolution. Be sure to be specific. All of this information should be conveyed in the context of your explanation of what the main issues of the controversy are. Beneath the surface, what disputes over values, expertise, knowledge, power, etc., are at play? This paper should be no more than 1000 words. Be sure to use analytical concepts and tools from the course in your analysis.

c) **Governance Recommendation.** Choose one or more of the approaches designed to resolve science and technology policy controversies that you think is/are best suited to help address or resolve your policy controversy. Write a memo to a decisionmaker involved in the controversy (i.e. someone who would be in a position to implement your proposal) that: 1) explains why your approach is the best means to address your controversy; and 2) provides a blueprint for implementing your approach. Be specific: who should be involved and how will the process work? How will you ensure that the mechanism makes a difference in the controversy? Why is this a better approach than previous or status quo approaches in this or similar policy controversies? What political benefits—in the form of transparency, democratization, etc.—does your proposal offer? What kinds of concerns might the decisionmaker have about your proposal, and how will you respond (i.e., address counterarguments)? Be specific! This paper should provide a blueprint for putting your chosen approach into action in your specific controversy. This paper should be no more than 1200 words. Be sure to use concepts from class discussion and the readings in your analysis. You do not need to revisit the background discussed in the "Backgrounder" memo.

COURSE POLICIES

1. Attendance: Because this course depends heavily upon discussion and in-class scenarios, I expect students to make every effort to attend all class sessions. Please notify me **in advance** if you will miss class; excused absences can be granted for things like illness and family emergencies, but only if I hear from you **in advance**. Any unexplained absences will negatively affect your grade. So will repeated tardiness; I expect you to arrive on time. Please also refrain from going in and out of the room during class.
2. Late assignments: Extensions require arrangements with the instructor made well in advance of the due date. Late assignments will lose **five points for each 12 hour period**, or fraction thereof, that they are late.
3. Academic honesty: All students are expected to abide by the University's standards of academic honesty, integrity, and professionalism. For details, see http://www.rackham.umich.edu/policies/academic_and_professional_integrity/.
4. Electronic devices: **Laptops and other devices are NOT allowed in class.** While I recognize that this may cause consternation, such technologies negatively impact the character and quality of class discussion. Because discussion is so important to the

intellectual task we face, the costs of laptops outweigh the benefits. Out of respect to the instructor and your fellow students, **put your cell phone away for the duration of class.**

5. Syllabus: Because many topics we cover are subjects of ongoing discussion, I may make occasional changes to the course readings over the semester. I will always notify you in advance of any changes.

FORD SCHOOL AND UM POLICIES

Inclusivity at the Ford School: Members of the Ford School community represent a rich variety of backgrounds and perspectives. We are committed to providing an atmosphere for learning that respects diversity. While working together to build this community we ask all members to:

- share their unique experiences, values and beliefs
- be open to the views of others
- honor the uniqueness of their colleagues
- appreciate the opportunity that we have to learn from each other in this community
- value one another's opinions and communicate in a respectful manner
- keep confidential discussions that the community has of a personal (or professional) nature
- use this opportunity together to discuss ways in which we can create an inclusive environment in Ford classes and across the UM community.

Academic Integrity: The Ford School academic community, like all communities, functions best when its members treat one another with honesty, fairness, respect, and trust. We hold all members of our community to high standards of scholarship and integrity. To accomplish its mission of providing an optimal educational environment and developing leaders of society, the Ford School promotes the assumption of personal responsibility and integrity and prohibits all forms of academic dishonesty, plagiarism and misconduct. Academic dishonesty may be understood as any action or attempted action that may result in creating an unfair academic advantage for oneself or an unfair academic advantage or disadvantage for any other member or members of the academic community. Plagiarism involves representing the words, ideas, or work of others as one's own in writing or presentations, and failing to give full and proper credit to the original source. Conduct, without regard to motive, that violates the academic integrity and ethical standards will result in serious consequences and disciplinary action.

Additional information regarding academic dishonesty, plagiarism and misconduct and their consequences is available at: http://www.rackham.umich.edu/current-students/policies/academic-policies...

Accommodations for Students with Disabilities: If you believe you need an accommodation for a disability, the University's Services for Students with Disabilities office (SSD) can be a valuable resource with which to start. In addition, if you believe you need an accommodation for a disability in any of your courses, please let the course instructor know at your earliest convenience. You need to allow sufficient time for your faculty member to respond, minimally 7 days, preferably more, in advance of when the accommodation is needed. Some aspects of courses may be modified to facilitate your participation and progress. As soon as you make your

instructor aware of your needs, they can work with Student & Academic Services and/or the SSD office to help determine appropriate academic accommodations. Any information you provide will be treated as private and confidential.

Student Mental Health and Wellbeing: The University of Michigan is committed to advancing the mental health and wellbeing of its students. We acknowledge that a variety of issues, such as strained relationships, increased anxiety, alcohol/drug problems, and depression, directly impacts students' academic performance. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact Counseling and Psychological Services (CAPS) and/or University Health Service (UHS). For a listing of other mental health resources available on and off campus, visit: http://umich.edu/~mhealth/.

COURSE READINGS
All readings are available on Canvas.

COURSE SCHEDULE

I. Thinking Critically about Science and Technology Policy

(1) Jan. 15: Themes, Mechanics, and Introductory Discussion

(2) Jan. 22: Technology, Innovation, and Public Policy (140pp.)
Langdon Winner, "Do Artefacts Have Politics?" in *The Whale and the Reactor: A Search for Limits in an Age of High Technology*, ed. L. Winner (Chicago, 1986), 19-39.
Ronald Kline and Trevor Pinch, "Users as Agents of Technological Change: The Social Construction of the Automobile in the Rural United States," *Technology and Culture* 37 (1996): 763-795.
Jameson Wetmore, "Redefining Risks and Redistributing Responsibilities: Building Networks to Increase Automobile Safety," *Science, Technology, and Human Values* 29 (2004): 377-405.
Shobita Parthasarathy, "Producing the Consumer of Genetic Testing," in *Routledge Handbook of Science, Technology, and Society*, ed. Daniel Lee Kleinman and Kelly Moore (Routledge, 2014), 93-107.
Bill Canis, "Issues in Autonomous Vehicle Deployment," Congressional Research Service, May 17, 2018.

(3) Jan. 29: Science, Social Construction, and Science Policy (120 pp.)
Wenda K. Bauchspies, Jennifer Croissant, and Sal Restivo, *Science, Technology, and Society: A Sociological Approach* (Blackwell, 2006), selections. (28 pp.)
Sheila Jasanoff, "Science and Democracy," in Ulrike Felt et al., *Handbook of Science and Technology Studies, Fourth edition* (MIT, 2017), 259-87.
Emily Martin, "The Egg and the Sperm: How Science Has Constructed a Romance Based on Stereotypical Male-Female Roles," *Signs* 16.3 (1991): 485-501.
Ramya Rajagopalan and Joan H. Fujimura, "Making History via DNA, Making DNA from History: Deconstructing the Race-Disease Connection in Admixture Mapping." In Keith

Wailoo, Alondra Nelson, and Catherine Lee, eds. *Genetics and the Unsettled Past: The Collision of DNA, Race, and History* (Rutgers, 2012), 143-63.

Daniel Sarewitz, *Frontiers of Illusion: Science, Technology, and the Politics of Progress* (Rutgers, 1996), Chapters 1, 3.

Recommended: John Law, "STS as Method." In Ulrike Felt et al., *Handbook of Science and Technology Studies, Fourth edition* (MIT, 2017), 30-57.

II. Rethinking Science Funding to Solve Social Problems

(4) Feb. 5: National Research Policy in Historical and Comparative Perspective (140p.)

Daniel Lee Kleinman, *Politics on the Endless Frontier: Postwar Research Policy in the United States* (Durham, 1995), 52-102, 134-39, 145-58.

Vannevar Bush, *Science: The Endless Frontier. A Report to the President* (US GPO, 1945), Ch. 6.

Daniel Sarewitz, *Frontiers of Illusion: Science, Technology, and the Politics of Progress* (Rutgers, 1996), Chapter 2.

Mariana Mazzucato, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths* (Public Affairs, 2015), 1-16, 63-77.

Anil K. Gupta, "Tapping the Entrepreneurial Potential of Grassroots Innovation," *Stanford Social Innovation Review*, summer 2013, 18-20.

Shobita Parthasarathy, "Grassroots Innovation Systems for the Post-Carbon World: Promoting Economic Democracy, Environmental Sustainability, and the Public Interest," *Brooklyn Law Review* 82 (2017): **pp. 776-81** required, whole article recommended.

(5) Feb. 12: Rethinking the Economic and Social Benefits of Research (190 pp)

Daniel Sarewitz, "Institutional Ecology and the Social Outcomes of Scientific Research." In *The Science of Science Policy: A Handbook*, ed. Kaye Husbands Fealing et al. (Stanford, 2011).

Barry Bozeman and Daniel Sarewitz, "Public Values and Public Failure in US Science Policy," *Science and Public Policy* 32.2 (2005): 119-36.

Ryan Meyers, "Public Values Failures of Climate Science in the US," *Minerva* 49 (2011): 47-70.

Daniel Sarewitz and Roger A. Pielke, Jr., "The Neglected Heart of Science Policy: Reconciling Supply of and Demand for Science," *Environmental Science & Policy* 10 (2007): 5-16.

Julia Lane, "Assessing the Impact of Federal Science Funding," *Science* 24 (5 June 2009): 1273-75.

Philip Mirowski, *Science-Mart: Privatizing American Science* (Harvard, 2011), selections (60 pp).

David E. Winickoff, "Private Assets, Public Mission: The Politics of Technology Transfer and the New American University," *Jurimetrics* 54.1 (2013). (50 pp)

Michael Heller and Rebecca Eisenberg, "Can Patents Deter Research? The Anticommons in Biomedical Research," *Science* 280 (1998): 698-701.

Jack Stilgoe, "Could the best way to make money from science be to give it away for free?" *The Guardian*, Dec. 16, 2016. Link

(6) Feb. 19: HEARING: Who Should Pay for Research, and Why? (140 pp.)

Roger Pielke Jr., "'Basic Research' as a Political Symbol," *Minerva* 50 (2012), READ **pages 339-345, 355-361**

Deepak Hedge and Bhaven Sampat, "Interest Groups, Congress, and Federal Funding for Science," SSRN Electronic Journal, 2011. DOI: 10.2139/ssrn.1962937.

Margaret E. Blume-Kohout, "Does Targeted, Disease-Specific Public Research Funding Influence Pharmaceutical Innovation?" *Journal of Policy Analysis and Management.* 31.3 (2012): 641-660.

David Goldston, "Science Policy and the Congress." In *The Science of Science Policy: A Handbook*, ed. Kaye Husbands Fealing et al. (Stanford, 2011).

Terence Kealey et al. "Who Pays for Science?" *CATO Unbound*, August 2013.

February 22, 8 pm: Research Funding Paper Due!

III.   The Politics of Knowledge and Expertise

(7) Feb. 26: The Political Environments of Science and Technology Policy (95 pp.)

Stephen Hilgartner, "The Dominant View of Popularization: Conceptual Problems, Political Uses," *Social Studies of Science*. 20.3 (1990): 519-539.

Daniel Carpenter, "The Political Economy of FDA Drug Review: Processing, Politics, and Lessons for Policy," *Health Affairs* 23.1 (2004): 52-63.

Susan Kelly, "Public Bioethics and Publics: Consensus, Boundaries, and Participation in Biomedical Science Policy," *Science, Technology, and Human Values* 28 (2003): 339-364.

Sheila Jasanoff, "Technological Risk and Cultures of Rationality," in *Incorporating Science, Economics, and Sociology in Developing Sanitary and Phytosanitary Standards in International Trade*, ed. National Research Council (National Academy Press, 2000), pp. 65-84.

Scott Frickel et al., "Undone Science: Charting Social Movement and Civil Society Challenges to Research Agenda Setting," *Science, Technology, and Human Values* 35.4 (2010): 444-73.

David Roberts, "The North Carolina town that's scared of solar panels, revisited," *Vox*, December 18, 2015. http://www.vox.com/2015/12/18/10519644/north-carolina-solar-town

Mar. 5: NO CLASS

(8) Mar. 12: Science and Scientists in Policy Controversies (160 pp.)

Ann Campbell Keller, *Science in Environmental Policy: The Politics of Objective Advice* (MIT, 2009), Introduction, Chapters 1-3.

Daniel Sarewitz, "How Science Makes Environmental Controversies Worse," *Environmental Science and Policy* 7 (2004): 385-403.

(9) Mar. 19: Complicating the Idea of Expertise (150 p.)

FILM: *How to Survive a Plague* (watch at least first 45 min.)

Brian Wynne, "Misunderstood Misunderstandings: Social Identities and Public Uptake of Science," in *Misunderstanding Science?* ed. Alan Irwin and Brian Wynne (Cambridge, 1996), 19-46.

Sainath Suryanarayanan and Daniel Lee Kleinman, "Be(e)coming experts: The controversy over insecticides in honey bee colony collapse disorder," *Social Studies of Science* 43.2 (April 2013): 215-40.

Melissa Leach and James Fairhead, *Vaccine Anxieties: Global Science, Child Health, and Society* (Earthscan, 2007), 1-99.

==March 22, 8pm: Controversy Papers Topic Choice due!==

(10) Mar. 26: Risk, Uncertainty, Ignorance, and Trust in Policymaking (100 pp.)

California Ocean Science Trust, *Putting the Pieces Together* (2014).

S. O. Funtowicz and J. R. Ravetz, "Three Types of Risk Assessment and the Emergence of Post-Normal Science" in Krimsky and Golding, eds., *Social Theories of Risk* (Westport, Conn., 1992), 251-74.

Sheila Jasanoff, "Technologies of Humility: Citizen Participation in Governing Science," *Minerva* 41 (2003): 223-244.

Daniel Lee Kleinman and Sainath Suryanarayanan, "Dying Bees and the Social Production of Ignorance," *Science, Technology, & Human Values* 38.4 (2013): 492-517.

Roopali Phadke, "Green Energy, Public Engagement, and the Politics of Scale," in *Routledge Handbook of Science, Technology, and Society*, ed. Daniel Lee Kleinman and Kelly Moore (Routledge, 2014), 225-45.

IV. Rethinking S&T Governance

(11) Apr. 2: New Challenges for Governance, New Approaches to Governance (95 pp.)

Matthew Kearnes et al., "From Bio to Nano: Learning Lessons from the UK Agricultural Biotechnology Controversy," *Science as Culture* 15.4: (2006), 291-307.

Debra J. H. Mathews et al., "A Path through the Thicket," *Nature* Nov. 12, 2015, 159-161.

Shobita Parthasarathy, "Lessons for CRISPR from the Missed Opportunities of Asilomar," *Ethics in Biology, Engineering, and Medicine* 6.3-4 (2015): 305-312.

J. Benjamin Hurlbut, Sheila Jasanoff, and Krishanu Saha, "The Chinese gene-editing experiment," *Washington Post*, Nov. 29, 2018.

Roberta L. Millstein, "GMOs? Not So Fast," *The Common Reader* May 8, 2015. http://commonreader.wustl.edu/c/gmos-not-so-fast/

Jack Stilgoe, Matthew Watson, and Kirsty Kuo, "Public Engagement with Biotechnologies Offers Lessons for the Governance of Geoengineering Research and Beyond," *PLOS Biology* 11.11 (2013): 1-7.

Jack Stilgoe, Richard Owen, and Phil Macnaughten, "Developing a Framework for Responsible Innovation," *Research Policy* 42 (2013): 1568-80.

David E. Winickoff and Mark B. Brown, "Time for a Government Advisory Committee on Geoengineering Research," *Issues in Science and Technology* 20 (2013): 79-85.

(12) April 9: Governance Tools I: Technology Assessment (170 pp.)

Albert C. Lin, "Technology Assessment 2.0: Revamping our Approach to Emerging Technologies," *Brooklyn Law Review* 2010: 1309-1370.

David Guston and Daniel Sarewitz, "Real-time Technology Assessment," *Technology in Society* 24 (2002): 93-109.

Richard E. Sclove, "Reinventing technology assessment," *Issues in Science and Technology* 27.1 (2010): 34-38.

David Tomblin et al., "Integrating Engineering Systems into Public Deliberation: Participatory Technology Assessment of NASA's Asteroid Redirect Mission," *Astropolitics* 15.2 (2017): 141-166.

Patrick Hamlett et al., "National citizens' technology forum: Nanotechnologies and humane enhancement," Report R08-003, The Center for Nanotechnology in Society, Arizona State University, 2008.

Cynthia Selin, "The Future of Medical Diagnostics," Scenario Development Workshop Report, The Center for Nanotechnology in Society, Arizona State University, 2008.

T. Versteeg et al., "Exploring emerging battery technology for grid-connected energy storage with Constructive Technology Assessment," *Technological forecasting & Social change* 115 (2017): 99-110.

Optional: Arie Rip and Douglas K. R. Robinson, "Constructive Technology Assessment and the Methodology of Insertion," N. Doorn et al. (eds.), *Early Engagement and New Technologies: Opening Up the Laboratory*; Philosophy of Engineering and Technology, vol 16 (Dordrecht: Springer, 2013).

==April 12, 8 pm: Controversy Backgrounder Due!==

(13) April 16: Governance Tools II: Democratic Deliberation (110 pp.)

Edna F. Einsiedel et al., "Publics at the Technology table: The Consensus Conference in Denmark, Canada, and Australia," *Public Understanding of Science* 10 (2001): 83-98.

Daniel Lee Kleinman et al., "A Toolkit for Democratizing Science and Technology Policy: The Practical Mechanics of Organizing a Consensus Conference," *Bulletin of Science, Technology & Society* 27.2 (2007): 154–169.

Maria Powell and Daniel Lee Kleinman, "Building Citizen Capacities for Participation in Nanotechnology Decision Making: The Democratic Virtues of the Consensus Conference Model," *Public Understanding of Science* 17.3 (2008): 329–348.

S. B. Emery et al., "Maximizing the Policy Impacts of Public Engagement: A European Study," *Science, Technology, and Human Values* 40.3 (2015): 421–444.

Larry Bell, "Engaging the Public in Technology Policy A New Role for Science Museums," *Science Communication* 29.3 (2008): 386-398.

Jennifer Kuzma and Todd Tanji, "Unpackaging synthetic biology: Identification of oversight policy problems and options," *Regulation & Governance* 4.1 (2010): 92–112.

Claire Marris, "The Construction of the Public as a Threat to Synthetic Biology," *Science as Culture* 24.1 (2015): 83-98.

(14) April 23: Sociotechnical Breakdowns (100 pp)

Charles Perrow, *Normal Accidents* (New York, 1984), Introduction and Chapter 1.

Diane Vaughan, "Organizational Rituals of Risk and Error," in *Organizational Encounters with Risk*, ed. Bridget Hutter and Michael Power (Cambridge, 2004).

Richard Hindmarsh, ed. *Nuclear Disaster at Fukushima Daiichi: Social, Political, and Environmental Issues* (Routledge, 2013), pages 1-11 (to remind you of the Fukushima disaster chronology), and Chapter 3.

Neil Smith, "There's No Such Thing as a Natural Disaster," *SSRC Forum*, 11 June 2006, web.

Stephen Hilgartner, "Overflow and Containment in the Aftermath of Disaster," *Social Studies of Science* 37 (2007): 153-58.

RECOMMENDED:

Evan Osnos, "Letter from Fukushima: The Fallout." *The New Yorker*, Oct. 17, 2011.

Watch *Into Eternity: A Film for the Future* (Dir. Michael Madsen, 2010).

April 29, 8pm: Governance Recommendation Due!