The following is an annotated version of the syllabus followed: a few edits have been made for clarity, but the course of readings and work is the one that we followed. 8/1/14

Chemistry 597: Collaboration in Scientific Research: Ethical, Philosophical and Other Perspectives on Scientific Practice

Autumn 2012

Lecture Time:

Monday 1:50pm – 4:30 pm (Actually: arrive early for a class from 2-5pm)

Stuart Building, Room 212
IIT Main Campus

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Faculty:

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Course Goal:

Graduate students acquire a view of science, engineering, and philosophy of science that makes the social and normative aspects of each essential and valuable as part of their understanding of their own respective disciplines and of research opportunities across disciplines.

Work:

In addition to the assigned readings and class participation, students are required to submit weekly responses to questions on the readings, to present on readings at least once, and to complete an extended collaborative essay.

Course Readings:

All required course readings and optional readings, unless otherwise marked are available electronically, either from a publically accessible web site or through IIT's

Comment [1]: See sample questions and responses.

Comment [2]: This essay is the most important activity of the course. The goal is that a STEM student would be paired with an STS student to undertake a philosophical/EVS (or other science studies) investigation related to the research of the science student. The aims, of course, are for the work of each student to illuminate that of the other — but also to learn to collaborate across disciplines.

Our experience from the 2010 and 2011 iterations of the course, backed up by exit interviews and external reviews, was that the students (especially the STEM students, naturally) responded best to case studies. Given the constraints of the course our goal was to use the work of the students as the case study: on the positive side, that meant that they did not have to learn a new scientific topic; on the negative (perhaps) it meant that more responsibility for carrying out the case study fell on the students rather than faculty. For students motivated and able to engage the course material this plan was quite successful. Some students would likely have done better with a more directed project: such students were probably not suited to the ambitious goals of the course, which we still believe are worth pursuing.

Galvin Library Electronic Reserves. To access the readings from Galvin Library, visit http://library.iit.edu/reserves/ and select this course from the drop-down menu. To access these readings from off-campus, you will have to log in using your IIT ID number, or the ID number you receive after registering for this course.

We will also be giving you access to the readings through your IIT Google Documents account. The documents will be in a folder labeled class 1, class two, etc.

If you run into any problems, please feel free to contact the librarian, Kelly Laas, at @iit. .

Schedule:

• **8/27 Class 1: Diversity and Cooperation**

Description: One world and many disciplines: A philosophical and historical accident. The glory and misery of isolated disciplines: the myth, self-sustainability. Why unify scientific practices, and how? What are the hurdles? How surmount them to get the benefits of a different perspective? Critical distances, unique opportunities, and enduring integrations: pure vs. hybrid products and processes.

Latour, Bruno, "Opening Pandora's Box," in *Science in Action*, pp. 1-20: Harvard, 1987.

Kellert, Stephen, Chapter 2, *Borrowed Knowledge*, University of Chicago Press, 2008.

Repko, Allen, Chapter 1, *Interdisciplinary Research: Process and Theory*, SAGE, 2011.

Optional: Kellert, Longino, and Waters, eds., Introduction, *Scientific Pluralism*, University of Minnesota Press, 2006.

• **9/3 Labor Day: No Class**

• **9/10 Class 2: Student Research Presentations**

This week students will give short 15-20 minute presentations on their research (including question time). The presentations will also assist faculty in making presentation-readings assignments appropriate to students.

No assigned readings this week.

• **9/17 Class 3: Values in Science (I)**

Description: Science is valuable because it is constructed with valuable tools and ingredients and practiced with values. What makes a scientific product or process, an idea, technique or communication, intelligible, relevant, promising, unbiased, acceptable or successful? Scientific practices are distinguished by a diversity of goals and values

Comment [3]: In the two previous courses we found that science students had a hard time opening up to science studies enquiries. Part of the problem is that they are (for good reasons) taught that all - be it instrumentation, community standards, theory, authority, morality, or whatever - but the very question under investigation is fixed, and therefore not open to discussion, if visible at all. The first chapter of Latour does a good job of focusing attention on these 'black boxes' and how they are 'closed'. It provided a useful metaphor for opening up discussion all through the course, and we and the students referred to the idea regularly.

Of course, being able to identify black boxes, and being able to retrace their closing are two different things, and the latter was still very hard. Moreover, some students used the concept to try to avoid engaging - 'that's a black box so we don't have to consider it'. Finally, to the extent that their final projects are on their research work there is a tension here: as soc ...

Comment [4]: In the 2010 and 2011 iterations of the course, the students were assigned more extensive readings, but these proved too much for them, and more than could be discussed in class. The shorter list from 2012 was notably more successful, allowing us to focus on some key issues, which engaged many of the students, without losing indispensable topics.

Some of the original readings remained on the syllabus as optional readings. Unsurprisingly, most students did not take up the option! ...

Comment [5]: Having the students - from science and science studies - present on their own research early in the semester worked very well. It helped integrate their work with the course themes: our discussions could draw on the work throughout the semester, and it showed from the beginning that we would focus on their research. Of course it also required everyone to contribute, and so built class rapport (and helped us learn about personalities quickly, which was helpful in selecting research teams.) This was a very successful meeting.

Comment [6]: We found it necessary to tell students to rehearse their presentations: it was important for cross-disciplinary communication that they take the exercise seriously. They responded well, and generally we all learned a great deal about their work.

Comment [V7]: By entertaining questions from classmates on their work, students take the first step toward collaboration. They begin to see what they need to clarify. This questioning and answering continues within the teams that are formed. In class 7, students present in teams and we expect by then they begin to show an understanding of each other's work. This is the next step in collaboration.

adopted by individuals and groups. Values make groups. Rationality and objectivity are social values in science. Values are means of both differentiation and cooperation between individuals and between groups.

Porter, Theodore, Chapter 2, Trust in Numbers: The Pursuit of Objectivity in Science and Public Life, Princeton University Press, 1995.

Longino, Helen, "Evidence and Hypothesis," in Science As Social Knowledge: Values and Objectivity in Scientific Inquiry, pp. 38-48, Princeton University Press, 1990.

Morrell, Jack, "W.H. Perkin, Jr. at Manchester and Oxford from Irwell to Isis," pp. 104-26, Osiris 2nd Series, Vol.8, Research Schools: Historical Reappraisals, University of Chicago Press, 1993.

Optional: Rocke, Alan J., "Group Research in German Chemistry: Kolbe's Marburg and Leipzig German Institutes," pp. 52-79, Osiris 2nd Series, Vol.8, Research Schools: Historical Reappraisals, University of Chicago Press, 1993.

Brown, John K., "Design Plans Working Drawings, National Styles: Engineering Practice in Great Britain and the United States, 1775-1945," pp. 195-238, Technology and Culture, 41:2, 2000.

Porter, Theodore, Chapter 1, Trust in Numbers: The Pursuit of Objectivity in Science and Public Life, Princeton University Press, 1995.

• 9/24 Class 4: Values in Science (II)

Description: Science is not practiced by isolated individuals: the myth of self-sustainability of individual knowledge and of science without society. Scientific communities incorporate social values, for better or worse. Science and the larger society can shape and benefit each other.

Davis, Michael," Thinking Like an Engineer," Center for the Study of Ethics in the Professions at IIT, 18 Jun, 2010, http://ethics.iit.edu/publication/md_te.html.

Weil, V. and Arzbaecher, R., "Ethics and Relationships in Laboratories and Research Communities." pp. 83-125, Professional Ethics. Spring-Summer: 4(3-4), 1995.

Weil, Vivian, "Is Engineering Ethics Just Business Ethics?" Engineering Ethics. ed. Michael Davis. Ashgate Publishing, 2005.

Comment [8]: The students found this topic a little abstract at this stage of the course. It would have been better as the final Values topic (week 8).

Comment [9]: In reality this day was focused on values in engineering - obviously important at IIT, or any course in which a number of students are engineers. Since engineering is highly applied science, it is easier to see issues of values. Probably in our case this unit should have been the first values topic (Week 3), to start to explore that question - as a stepping stone to values in other STEM areas. (The description should have been revised also.)

Davis, Michael, “Conflict of Interest,” in Ruth Chadwick, editor. Encyclopedia of Applied Ethics, Second Edition, volume 1. San Diego: Academic Press; 2012. pp. 571–577.

• **10/1 Class 5: Instruments and Experiments**

Description: Experiments differ interestingly from observations or measurements. What possibilities and challenges do they offer? What is the role of technology? Why do we trust instruments? What are the limitations of our technology/instruments? What is the difference between testing theories and testing technology? And the difference between knowing the world and constructing the world? What is the role of experimenters? Experimental settings and results are highly localized artificial systems and events; yet we expect results to be replicated in other settings, and to be relevant, even more broadly, to non-experimental environments.

Bogen, James and Woodward, James, “Saving the Phenomena.” The Philosophical Review, Vol. 97, No. 3 (Jul., 1988): 303-325.

Chalmers, Alan, “The Theory-Dependence of the Use of Instruments in Science.” Philosophy of Science, Vol. 70, No. 3 (Jul., 2003), pp. 493-509.

Longino, Helen, “ Biological Effects of Low Level Radiation: Values, Dose-Response Models, Risk Estimates,” pp. 391-404, Synthese, Vol. 81, No. 3, 1989.

Optional: Radder, Hans, “Experimental Reproducibility and Experimenter’s Regress, “ pp. 63-73, PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association, Vol.1, 1992.

• 10/8 IIT Autumn Break No Class

• **10/15 Class 6: Varieties of Representation and Understanding: Modeling and Explanation**

Description: Modeling is central to representing, exploring and engineering the world. Glory and misery of modeling as building idealized and abstract pictures: the myth of the whole truth and nothing but the truth. Our knowledge of the world is made up of models that are inexact and incomplete representations. What do they represent? What else can they do? How can inexactness and incompleteness be their strengths? How are they built? What are their strengths? What are the limits of their application? Models and experiments share key characteristics that enable one to test the other.

Wimsatt, William C., “False Models as Means to Truer Theories.” from Re-Engineering Philosophy for Limited Beings: Piecewise Approximations to Reality. pp. 94-132, Harvard University Press, 2007.

Winsberg, Eric, “Simulated Experiments: Methodology for a Virtual World,” pp. 105-125, Philosophy of Science 70, 2003.

Craver, Carl F., “When Mechanistic Models Explain.” pp. 355-376, Synthese 153, 2006.

Optional: Cartwright, Nancy, “Causal Laws and Effective Strategies,” pp. 419-437, Noûs, Vol. 13, No. 4, Special Issue on Counterfactuals and Laws (Nov., 1979).

• 10/22 Class 7: Meet the Research Teams

This week the students will present in teams, to explain what they find interesting - probably, but not necessarily, vis á vis the goals of the course - in their teammates' research. Team members will be expected to show an understanding of each other's work - though we expect significant clarification to occur as a result of this week's work. The goal is to start to find topics on which collaboration could be undertaken. Each group will have around 20 minutes + questions. No assigned readings this week

• **10/29 Class 8: Evidence and Values (Values III)**

Description: Philosophers, historians, sociologists, psychologists of science as well as scientists and engineers have been concerned with evidence for scientific claims for centuries. What data and hypotheses are to be accepted? What's the difference between reliable evidence and bias? The scholarly and public debates have pointed to the crucial role of different criteria, standards, values within science and society more broadly. Different research communities often bring different values and standards of evidence.

Okhrulik, Kathleen, “Gender and the Biological Sciences,” in J.A. Cover and Martin Curd (eds) Philosophy of Science: The Central Issues. Norton, 1998.

Douglas, Heather, “Rejection the Idea of Value-Free Science”, in Harold Kincaid, John Dupre, and Alison Wylie (eds). Value-Free Science? Ideals and Illusions. Oxford University Press, 2007, pp. 120-139.

Cohen, Jacob, “The Earth is Round,” American Psychologist. Vol 96, No. 12, 997-1003.

Optional: Longino, “Biological Effects of Low-level Radiation: Values, Dose-Response Models, Risk Estimates,” pp. 391-404, Synthese, Vol. 81, No. 3, 1989 (from Class 5).
Lacey, Hugh, Is Science Value Free? , London: Routledge, 2004

Comment [10]: This exercise was very important. In the past the students had not always formed effective collaborative teams. As the reviewers noted, the papers sometimes read as if each student took on the half in their expertise, and then they pasted the two parts together. We used this session to push students to understand each other better, so that they could produce more collaborative work.

Comment [11]: This topic should probably have been raised earlier. A number of our students work in environmental engineering, and it would have helped their projects to have had a discussion of these issues earlier on. In addition, it is a good topic provoking discussion about somewhat abstract arguments.

Comment [12]: Since we taught in 2012 a very nice essay by Elliot and McKaughan (Nonepistemic Values and the Multiple Goals of Science, in Philosophy of Science 81, 2014) has appeared. It would be well worth including.

Comment [13]: This probably makes more sense the following week.

• **11/05 Class 9: Deception, Self-Deception, and Self-Regulation in Scientific Research**

Description: Periodically, spectacular cases of scientific fraud come to light. Do these cases show the failure or success of scientific regulation, such as replication? More generally, what are the goals of peer review? Do they conflict? How can they be balanced and maximized? Is openness or blind reviewing best? And what about subtler barriers to scientific research: how good is statistical research based on null hypothesis significance testing? How is it affected by values? What sciences are most affected by these problems?

Nature's Peer Review Debate http://www.nature.com/nature/peerreview/debate/

(Selection of 6 items TBD)

Adam, David and Jonathon Knight, "Publish and Be Damned," pp. 772-776. Nature. 419, October 2002.

Ioannidis, John P. A., "Why Most Published Research Findings Are False," pp. 0696-0701. PLoS Med 2(8):e124. 2005.

Bartlett, Tom, "Is Psychology About To Come Undone?" Chronicle of Higher Education August 17, 2012. http://chronicle.com/blogs/percolator/is-psychology-about-to- come-undone/29045

Comment [14]: It would have been good to have found more articles to do with issues in engineering or physical science since that is the area of the students. The topics here are also very current, and it would be worth reviewing the most up-to-date research.

• **11/12 Class 10: Bridging and Producing the Joint Problem**

Comment [15]: This was a crucial session. In previous years some groups had run into trouble by underestimating the work involved and not starting early enough. We emphasized that this meeting was to be taken seriously; of course the responsibility of presenting to the class as a whole helps motivate them.

This week student research teams will present the nucleus of research proposals for comments and feedback from faculty and the class. The presentations will last 15 minutes with 15 minutes for discussion - they should be turned in ahead of time.

• **11/19 Class 11: Presentation of the Outline**

Comment [16]: As important as putting an early effort into the project is giving serious consideration to the work of the other groups. We strongly encouraged students to think carefully about the other presentations and give thoughtful feedback. We were partially successful, but more could be achieved, perhaps through required responses, written or verbal. (In addition, perhaps the faculty should not respond at all during this session, or the next, but give feedback outside the classroom; though this would have been logistically difficult in our case.)

• **11/26 Class 12: First Drafts of Research Presentations**

• **12/03 Class 13: Further Discussion of Drafts**

Comment [17]: We included this session partly because in previous years we ran over in the previous meeting. It wasn't so necessary this time, but it was useful to have some flexibility built into the syllabus.

• **12/10 Class 14: Collaborative Research Colloquium**

Every group will present their work as at a colloquium at a professional meeting – rehearsal is essential.

Comment [18]: We did run the session as a professional meeting, and in general it worked well, with students giving good presentations of their work. It also relaxed the meeting, so that students didn't treat it as an examination.

APPENDIX

ETHICS TERMINOLOGY: “Collaboration in Scientific Research: Ethical, Philosophical, and Other Perspectives on Scientific Practice,” Autumn 2012

MORALITY --- Those standards of conduct everyone (that is, every rational person at his or her rational best) wants everyone else to follow even if everyone else’s following them would mean having to follow them too.

e.g. “Don’t kill”, “Don’t lie”, “Keep your promises”, Help the needy”. Different people may have different reasons for favoring the same standard.

e.g. religious principle, rational grounds, self-interest

What is important is agreement on the standard, not that all individuals have exactly the same reasons.

Morality may be formulated as a series of rules, but these rules have exceptions. e.g. for “Don’t kill: except in self-defense

Morality may also be formulated as the imperative: Maintain a standard of reasonable care.

ACTUAL MORALITY --- Those moral standards that are commonly followed

MORAL IDEALS --- those moral standards that go beyond what morality requires so they are not followed often enough to count as common practice; they are standards to aspire to.

e.g. Enhancing human well being by generous giving

An act is moral (morally right) if it is right (all right) according to actual morality.

An act is immoral (morally wrong) if it is wrong (forbidden) according to actual morality

ETHICS --- The special standards of a group, e.g. a profession, that everyone in the group wants everyone else in the group to follow even if everyone’s following them would mean having to follow them oneself.

LAW --- a standard of conduct applying to members of a group whether they want it to apply or not.
(Laws are rules in a system of law.)

“Law” in this sense includes customs not imposed by government, as well as

standards that governments impose.
Since, by definition, law does not necessarily correspond to what people want, it must have other means of obtaining compliance; hence, the central place of force and punishment in our idea of law.

A Format for Ethical Decision Making

1. ***State problem*** (e.g. “Could this problem cause avoidable harm to people? or even “This makes me uncomfortable.”)

2. ***Check facts*** (some problems disappear upon closer examination of situation; others change, sometimes radically; sometimes problems multiply).

3. ***Identify relevant factors***—people involved or affected, laws, professional code, and other practical constraints (e.g. under $200, within a half-hour).

4. ***Develop list of at least* five *options*** (be imaginative, try to avoid “dilemma”—not “go” or “no go” but who to go to, what to say).

5. ***Test options***, using such tests as the following:

• ***Harm test***—does this option do less harm than any alternative?

• ***Publicity test***—would I want my choice of this option published in the newspaper?

• ***Defensibility test***—could I defend my choice of this option before a Congressional committee, a committee of my peers, or my parents?

• ***Reversibility test***—would I still think the choice of this option good if I were one of those affected (adversely) by it?

• ***Virtue test***—what would I become if I choose this option *often*?

• ***Professional test***—what might my profession's ethics committee say about this option?

• ***Colleague test***—what ***do*** my colleagues say when I describe my problem and suggest this option as my solution?

• ***Organization test***—what ***does*** the organization's ethics officer or legal counsel say about this?

6. ***Make a tentative choice*** based on steps 1-5.

7. ***Review steps 1-6 and ACT***: What could make it less likely you would have to make such a

decision again?

• What precautions can you take as individual (announce policy on question, change job, etc.)?
• What can you do to have more support next time (e.g., seek future allies on this issue)?
• What can you do to change organization (e.g., suggest policy change at next dept. meeting)?

Modified 2009 by Vivian Weil from version by Michael Davis (2003), drawn from a series of earlier versions by both Davis and Weil.