

## Appendix G: Teaching Notes

M.J. Peterson  
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The IDEESE Asilomar Conference on Laboratory Precautions case includes appendices so that instructors may use the case for a variety of purposes. The following list describes the more popular approaches for using the case and recommends the best appendices for each approach.

### INDIVIDUAL CLASS SESSIONS

#### Four Approaches to Teaching Ethics with the Asilomar Case:

##### 1.) Workplace Ethics in Transnational Contexts

This case deals with a particular aspect of responsible conduct of research, paying heed to and organizing work to minimize significant hazards to persons inside and outside the laboratory. Though most of the participants were US citizens working in US-based labs, and the guidelines they helped develop were adopted by a US government-funding agency, everyone involved understood that the discussions would have considerable transnational impact and agreed to include foreign scientists in the process of discussion. This case can be used to discuss transnational aspects of determining how to address potential hazards of work in an emerging area of science.

Recommended Appendices:

- Appendix A: Chronology
- Appendix E: Ethical Evaluation of Recombinant DNA Research

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## 2.) International Accountability

International-level mechanisms that hold researchers, research institutes, firms, or others accountable to society are often difficult to perceive. This case can be used to discuss the pressures the leading rDNA experimenters felt as they considered how to address the potential hazards of their work.

Recommended Appendices:

- Appendix A: Chronology

## 3.) Responsible Participation

Scientists and engineers participate in international regulatory processes in a variety of ways. This case may be used to better define the varieties of experts' participation, particularly *responsible* participation, in developing regulations for their work.

Recommended Appendices:

- Appendix A: Chronology

## 4.) Stakeholder Inclusion

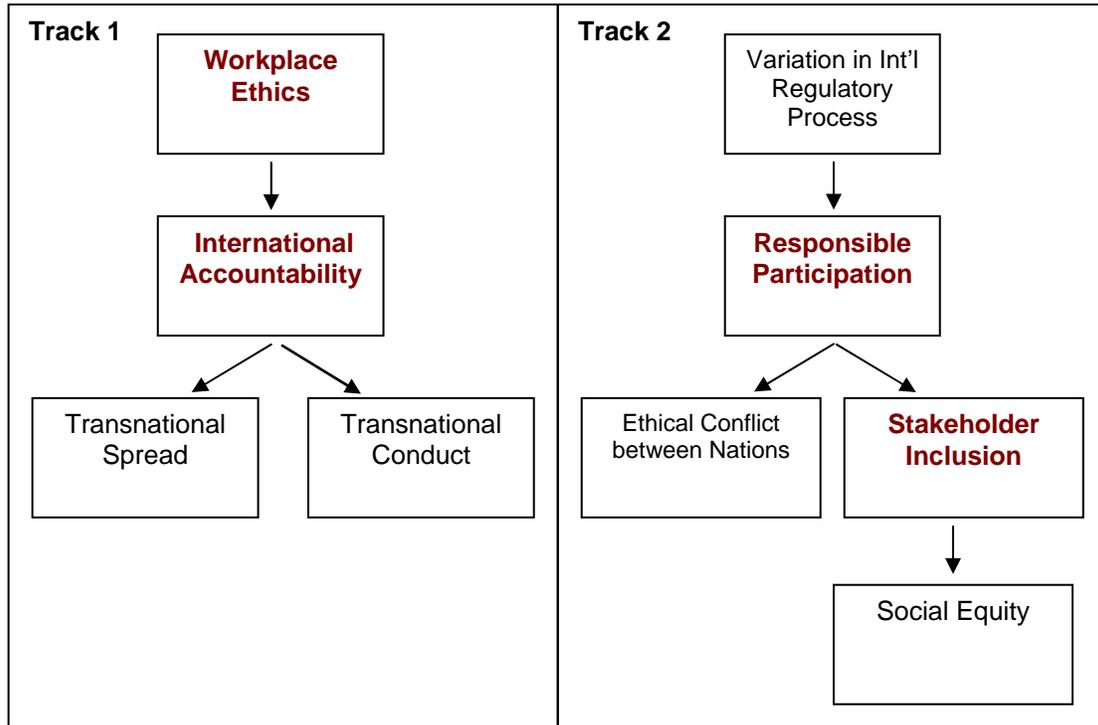
The social context of science and engineering includes many actors. This case can be used to consider when and how stakeholders' participation in debates might be limited, and whether limitations accepted in the mid 1970s would be accepted today.

Recommended Appendices:

- Appendix A: Chronology
- Appendix B: Views on the Asilomar Process

**MULTIPLE CLASS SESSIONS**

In a series of class sessions organized to follow the tracks of responsible conduct of research and responsible participation in policy, this case could be used in the following places (indicated in red letters) in each sequence:



## GENERAL TEACHING NOTES

Two sets of 20<sup>th</sup> century scientific breakthroughs inspired serious debates among scientists about whether and under what conditions further research should be undertaken and technologies based on applying the new scientific knowledge should be developed. The first, realization among physicists that knowledge of the structure of atoms had advanced to the point of revealing potential for explosive applications, was complicated by the political conditions of the late 1930s and early 1940s. In early 1939 Leo Szilard urged the physicists trying to confirm that bombarding uranium with neutrons would release other neutrons (which would confirm that a chain reaction of splitting atoms is possible) not to publish their results, but they were published in *Nature*.<sup>1</sup> Discussion of the experiment's implications also became public knowledge, leading Szilard to recruit Albert Einstein to inform US President Roosevelt of the possibilities in October 1939. During World War II, Germany, Britain, and the USA all pursued development of atomic bombs.

The second, discovery of methods for separating and recombining genetic material by manipulating DNA also inspired concern about the possibility of developing new biological weapons, but the scientists involved were operating in a different context. First, the nuclear example shaped many of the participants' thinking. Second, the prospect of using recombinant DNA to make a "war winning" weapon was more distant, partly because the characteristics of recombinant DNA organisms were harder to predict than the amount of energy that could be released by splitting uranium atoms (which had been calculated by Lise Meitner in December 1938), and partly because the superpowers were already in the process of agreeing to ban development and use of biological weapons.

These questions can be used to start discussion.

1. Why were the scientists involved willing to adopt a suspension of research but not an outright ban?
2. Would a decision-making process involving members of the general public have resulted in adoption of a ban?
3. If the Asilomar Conference had ended with agreement to end all recombinant DNA research, or an alternate process led to a ban, how would the ban have been enforced? Would enforcement have been complete?

The following pages provide two exercises that can be used with this case.

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<sup>1</sup> The publishing physicist, Pierre Joliot-Curie, later claimed he published after Szilard had failed to respond to a follow-up query. John Cornwell. 200 . *Hitler's Scientists: Science, War, and the Devil's Pact* (London: Penguin Books, 2003), p. 222-23.

## Exercise 1. Different Approaches to Regulating Scientific Work

The Asilomar Conference was a highly focused and unusually organized discussion about the hazards of a particular line of research among the scientists most closely engaged in it. The scientists organizing the conference were working within the traditions of scientific self-regulation but went beyond usual scientific practice by gathering a wide selection of scientists at the cutting edge of an emerging field, or otherwise very knowledgeable regarding its likely implications, in a single place for sustained dialogues about how the scientific community as a whole should proceed.

Governments were generally willing to defer to the experts' judgment and leave the process of formulating rules regarding conduct of laboratory research to the scientists themselves. While ready to backstop the regulations by providing enforcement capacity, governments also allowed scientists to continue dealing with the government bodies most closely attuned to scientific practices, such as national research committees or science funding organizations. Only when rDNA techniques were applied to making practical things like new drugs, gene tests, or new varieties of plants, did government agencies dealing with the general population, such as ministries of health or agriculture, get involved in regulating work with rDNA.

Since regulations were first adopted in the mid-1970s, most governments have supported addressing the potential hazards of rDNA experiments through two methods of reducing the potential for harm: biological containment by creating rDNA in organisms bred for inability to live outside laboratory conditions, and physical containment by constructing laboratories and requiring work routines in them that minimize the chances of any rDNA-containing organism getting outside the lab and interacting with organisms in the wider environment.

One possible measure governments did not consider was licensing individuals to work in rDNA research. More recently, the notion of licensing scientists has come up in discussions of how to minimize the likelihood terrorists get hold of highly infectious pathogens and use them against large populations. Some governments reacted by adopting rules for restricting and tracing the distribution of dangerous microbes, such as anthrax spores, to laboratories. However, this method does have some problems: it is not always easy to distinguish between pathogens which need to be put under restrict and trace regulations from organisms (including milder pathogens) that do not. As Laura H. Kahn argued in 2009, "The public depends on the competence and benevolence of life science researchers just as much as they do with pilots, physicians, and nurses."<sup>2</sup> Rather than deal with dangerous organisms through attempts to distinguish the most dangerous from others, a process that has been difficult to implement, she proposed life scientists be licensed. The exact procedures could vary, as she notes in suggesting two possible models, one based on licensing of pilots and the other on licensing of physicians. Pilots are licensed after classroom work and supervised flying and rated by level of skill. In the USA, the Federal Aviation Agency divides pilots into holders of student, recreational, private, and commercial licenses, and maintains records of all pilots' residences, employers, and flight experience. They have to fly a certain amount of time per year to maintain their licenses. Physicians are licensed after completing medical school, passing three sets of medical examinations, and a year of clinical work supervised by more experienced physicians after graduation. Physicians working with patients needing prescriptions of narcotic drugs for their ailments may

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<sup>2</sup> Laura H. Kahn, "Licensing life science researchers," *Bulletin of the Atomic Scientists* 6 April 2009. Accessed August 6, 2010. <http://www.thebulletin.org/web-edition/columnists/laura-h-kahn/licensing-life-science-researchers>.

need to be licensed separately for that aspect of their practice. In the USA physicians providing treatment with narcotics must register with the Drug Enforcement Agency (DEA). Kahn suggests that either model of licensing could be used for scientists working with pathogens:

If licensure requirements followed the pilot model ... licenses could correspond to a biosafety level (BSL). A researcher who wanted to work in a high containment BSL-4 laboratory [where the nastiest pathogens are investigated] would have to undergo additional education and training to qualify for a BSL-4 license. Alternatively, if the physician model were used, then licensed researchers who wanted to work with dangerous pathogens would have to apply to the CDC for a select agent number analogous to the DEA number assigned to physicians [who prescribe narcotic drugs for patients]. ... As some states have started to fingerprint physicians, this could be an option--albeit a controversial one--to consider for scientists.

Suppose you could time-travel back to 1975 and become a participant at the Asilomar Conference. Would you recommend either 1) requiring the licensing of life sciences research lab personnel instead of biological or physical containment measures, or 2) adding rules requiring the licensing of lab personnel to the requirements for biological and physical containment measures? What values would be affected -- positively or negatively -- by recommending a licensing system?

## Exercise 2: Thinking Through Scenarios of Danger

During work on the Manhattan Project, the US effort to develop an atomic bomb during World War II, some of the senior physicists involved hypothesized that exploding a nuclear fission device would create so much heat that atmospheric ignition would follow. In the most nightmarish versions of this scenario, the fission explosion would set the nearest part of atmosphere on fire, the fire would be so hot that it would become self-sustaining by drawing in additional oxygen, and any life on Earth that breathes oxygen would suffocate as all the oxygen in the atmosphere was consumed by the flames. Such visions were encouraged by what little people knew about the fire-bombing of Dresden Germany in February 1945, in which a large number of fires set close together formed into one huge conflagration that caused an artificial tornado sucking more air and materials into the blaze.

One of the project leaders, Alfred Compton, concluded that if the atmospheric ignition hypothesis was true, the project should be stopped even at the price of accepting an Axis victory. Another senior participant guessed there was a three in one million chance of atmospheric ignition; others gave different odds. They were debating what would happen right up to the first test explosion on 16 July 1945.

It is May 1945. You are Alfred Compton, and you want to determine as best you can whether atmospheric ignition will actually occur. Remember, no one has actually exploded a fission device yet. All of the sustained chain reactions run since Enrico Fermi accomplished the first one in his lab under Stagg Field at the University of Chicago in December 1942 have been designed to be non-explosive. Nor do you have computers you can use to run simulations.

What information would you put together to decide whether to continue or to stop? Can you think of any physical experiments that would provide a reasonable simulation of a fission explosion?

### Hints:

1. 20.9% of the atmosphere is oxygen
2. Fire will spread explosively if fuel and a spark come into contact within a container filled with concentrated oxygen.
3. The steel of tanks or pipes carrying 100% oxygen can become fuel if the oxygen is at pressures equal to or above normal sea level atmospheric pressure, but will not if the pressure is less than normal atmospheric pressure at sea level.
4. The pressure of the atmosphere decreases as altitude increases.
5. The flames made in oxyacetylene welding, in which oxygen and acetylene are brought together can reach temperatures of 3500 degrees C (6300 degrees F) without burning anything that is not touched directly by the flame or making it impossible to breathe in the room where the welding is done.