

Training Undergraduates in Ethics and Responsible Conduct in Research

We will actively train all students involved in our research programs in the responsible conduct of research, also known as the "ethics component" of our research program. The pedagogical approach in this ethics component is to engage and to place students in a "self-reflection" mode of thinking for the entire research experience. A self-reflective mode encourages research students to consider how their actions and decision affect others in the lab and even outside their lab. Research students should understand that ethics is involved in all stages of research, which includes: the design phase, the laboratory phase, the writing phase, and the post-publication/presentation phase. In each phase, students will reflect on how choices made in the conduct of their research impacts others and come to terms with possible implications of their choices. This will allow the research students to engage in safe, self-observations.

The following summarizes the specific training tools that will be used to help connect students to ethical conduct in scientific research:

- 1) Lectures or talks alone on case studies are not the path to take to engage students. Small group discussions improve the value of the experience. More creative avenues, such as *role-playing*, have been found to be most effective with students allowing them to see alternative perspectives. A role-playing exercise, facilitated by faculty, will occur during the first week of summer research. The *role-playing* exercise will focus on a real cases that are "acted" or "played" out by faculty in front of a live audience, the research students. A discussion of safety in the laboratory and chemical hygiene along with the role-playing exercise will provide an excellent venue of activities to introduce research ethics on a personal level. We envision this initial "ethics" session to be an extension of our current chemical hygiene training – required for all students.

Specific topics addressed in this aspect of the training include:

1. Data acquisition, management, sharing, and ownership,
 2. Mentor/trainee responsibilities,
 3. Publication practices and responsible authorship,
 4. Peer review,
 5. Collaborative science,
 6. Conflict of interest and commitment.
- 2) Students will keep an ethics notebook (electronically or hardcopy), which is separate from the laboratory notebook, where they record observations of their decisions. The notebook will serve as a self-reflection aid. During the course of the summer, with entries from all required by the end of the summer, students will post to a chemistry department blog that discusses and reflects upon their observations. These observations will be related to, but not limited to the list above, addressed in the initial training session. The PI, along with the help of research mentors, will periodically post questions pertaining to various aspects of the ethical conduct of research and each student will be required to submit responses to the questions electronically. The questions designed by the PI and research mentors will serve as a starting point to assist students in what to include in their end of the summer blog. To ensure 100% participation from research students, each research student will be required to sign and return a contract (as we already do), which will outline the activities of the ethics component. The contract must be returned before the start of summer research.

- 3) The research mentor will periodically check the notebook, and ask the student how his/her decisions affected others (reflection). Reflection should also mature significantly over the 10-week experience.
- 4) Famous case studies do not necessarily catch the interest of students. Many times, students do not see the connection of famous case studies to their experience in the laboratory. During the course of the summer, the PI will design specific “ethics” sessions covering: 1) Intellectual Property and the Laboratory Notebook, 2) Legal Ethics, and 3) Citizenship and Community. The topic of Citizenship and Community will focus on two scientific documentaries: 1) *Percy Julian: The Forgotten Genius*, and 2) *Lise Meitner*.