
History and Philosophy of Science Engaging the Public

JANE MAIENSCHHEIN

The premise for this book is that academic study of ethics too often remains separate from ethics in action and that a growing number of scholars want to take their ethics actively into the real world. An underlying assumption is that action that serves as advocacy does not always find a comfortable home in the academic world. Other chapters in this volume present examples in which scholars have felt the need to step outside the academic world to promote and advocate for justice.

At Arizona State University (ASU), we are working toward a different model called the “New American University.”¹ Here the university is very much explicitly and reflectively engaged with the world, and faculty members are encouraged to pursue “use-inspired” as well as “curiosity-driven” research. Those who embrace this approach have no problem pointing to important “broader impacts” in their proposals for federal grants, and they have developed a diverse set of education and training programs based on the values and intended goals of the new model. Along the way, assessment of each faculty member’s teaching and research is supposed to consider impact and outcomes along with the usual measures of success, and “service” is to be taken not as a separate category, but rather as fully integrated.

This chapter starts by outlining this model for a New American University, taking a look at a few of the design principles on which it is built. Then it moves to a discussion of my own choices about how to become engaged in the community outside the academy and what it has meant to advocate for reasoned decision-making. My approach leads to a focus on the ways in which history and philosophy of science joins bioethics to inform understanding and action in the world today. Finally, I discuss the implications of this approach for connecting

¹ “New American University,” Arizona State University (2016). Available at: <https://newamericanuniversity.asu.edu/>. Accessed on: October 28, 2016.

research and education through the example of the Embryo Project, which goes beyond what any one of us can do alone by drawing on collective action.

The ASU Model for a New American University

When I arrived at ASU in 1981, I initially pursued the traditional academic career path, writing books and articles, giving professional lectures, and carrying out academic service at ASU and for professional organizations. I gave occasional talks in the community and spoke to newspaper reporters about why evolution is important, but it was clear that those activities counted as “extra” work and were not particularly valued by my colleagues. This was a typical academic pattern at the time.

As chair of the philosophy department from 1991 to 1996, I began to see other possibilities as then-President Lattie Coor urged the academic leaders, including department chairs, to think seriously about ways to improve education as a matter of the university’s civic responsibility to the state of Arizona. The state was then one of the lowest in the country in most measures related to educating its citizens (including per capita spending on education, percentage of students finishing high school, percentage of students who finished high school going on to college, and teacher salaries), and the state legislature did little to change that sad fact. Coor’s leadership pointed to ways that we could each work with underprepared students arriving in our classes to help them succeed rather than weeding them out. This was a first step and a foundation for what the next and current President Michael Crow points to as a policy of inclusion. As our new university charter puts it: “[W]e are measured not by whom we exclude, but rather by whom we include and how they succeed.”²

It always takes a while for new ideas to take root. In 2002, when President Crow arrived, past-President Coor’s ideas became entrenched in our university’s mission. Crow arrived with an expansive vision, which he articulated energetically in his inaugural address. Since then, he has brilliantly expanded, extended, and implemented that vision.³

² ASU, *Arizona State University Charter* (Office of the President, 2015). Available at: <https://president.asu.edu/about/asucharter>. Accessed on: October 28, 2016.

³ *Higher Ed Mavericks: How Four Visionaries Are Leading the Charge for Change*, thematic issue of *The Higher Education Workplace*, 2:2 (Fall 2010), 14–28.

Not everybody is a fan or accepts the “design principles” or changes involved in transforming the university; yet many do, and today ASU is a different place.⁴ It is different from what it was when I began my career, and, in many ways, it is different from most other academic institutions, though many are adopting and adapting the ideas as well. The vision and energy behind our new university charter allowed me to take a different path – allowed me to diverge from traditional expectations and to call for new measures of success. It is important to understand the values underlying this transformation, since few institutions have provided such strong support for community engagement as ASU is doing.

Crow’s recent book with historian William B. Dabars, *Designing the New American University*, outlines the vision, principles, and goals of the university and places that discussion in a larger context of educational history. We need, they argue, a new approach to higher education. The model in which a relatively few elite institutions select their favorites and proudly display statistics about how many they excluded has to change. There is strong evidence that a more egalitarian approach can help promote productive “socioeconomic engineering,”⁵ which should speed up and improve much-needed social transformations.

Research and education should embrace more transdisciplinary thinking that is globally engaged while also locally invested. Rather than reforming every institution in the same way, we need a set of design principles to help guide the building of each individual, contextually responsive institution. This diversity will yield a stronger result than seeking uniform goals. Let us rethink the social contract for science and knowledge more generally, Crow and Dabars urge, and move toward a knowledge economy based on discovery, creativity, and innovation all oriented toward increasing social good. Let us ask why we want to study nature through science, for instance, and how we can best learn from a history of wise, pragmatic thinkers.

One could be rather cynical about what may look like just slogans, and it is fair to ask whether all this rhetoric is also real. The answer is “yes”; Crow and his New American University are committed to putting the

⁴ J. Warner, “ASU is the ‘New American University’ – it’s terrifying,” *Inside Higher Ed* (January 25, 2015). Available at: www.insidehighered.com/blogs/just-visiting/asu-new-american-university-its-terrifying. Accessed on: October 28, 2016.

⁵ M.M. Crow and W.B. Dabars, *Designing the New American University* (Baltimore, MD: Johns Hopkins University Press, 2015), p. 30.

scholarship and ideas into practice. He uses his presidency for advocacy and engagement in much the same way the examples in this volume are asking people to do. Crow is a leader for a new University Innovation Alliance,⁶ which brings together eleven research universities that teach nearly half a million students each year. The goal is to support all students, including those from lower income brackets, to succeed in college and gain the skills to succeed thereafter. Success means helping to make society better, by focusing on useful and valued outcomes. Success also means supporting faculty members who carry their scholarship into the world.

Thomas Jefferson had it right, Crow and Dabars believe, when he tied universities to the goals of democracy: “If a nation expects to be ignorant and free, in a state of civilization, it expects what never was and never will be.”⁷ Moreover, “no other sure foundation can be devised for the preservation of freedom and happiness . . . [than] the diffusion of knowledge among the people.”⁸ James Madison was also on the right track: “Knowledge will forever govern ignorance: And a people who mean to be their own governours must arm themselves with the power which knowledge gives.”⁹ On this view, in short, a university should function as a sort of use-inspired effort to improve society.

That goal means that education should build strong foundations and build on traditional scholarship, but we should also ask: Why and for what purpose? It should bring discussion of the problems to be addressed into discussions of how to address them. There is no one prescription for a new university, because each needs to be locally contextualized. Yet the design principles carry over (see Table 8.1). Above all, Crow and Dabars include integrating scholarship with action. This kind of setting has made it possible for me to take up my own approach to action, arguing for reasoned decision-making in pursuit of a better society.

⁶ “Who we are,” University Innovation Alliance (2016). Available at: www.theuia.org/#about. Accessed on: October 28, 2016.

⁷ T. Jefferson (1816), as cited by M.M. Crow and W.B. Dabars, *Designing the New American University*, p. 28.

⁸ T. Jefferson (1816), as cited by M.M. Crow and W.B. Dabars, *Designing the New American University*, p. 28.

⁹ J. Madison (1822), as cited by M.M. Crow and W.B. Dabars, *Designing the New American University*, p. 28.

Table 8.1 *Design Principles for a New American University**

Principle	Explication
1 Leverage Our Place	ASU embraces its cultural, socioeconomic, and physical setting.
2 Transform Society	ASU catalyzes social change by being connected to social needs.
3 Value Entrepreneurship	ASU uses its knowledge and encourages innovation.
4 Conduct Use-Inspired Research	ASU research has purpose and impact.
5 Enable Student Success	ASU is committed to the success of each individual student.
6 Fuse Intellectual Disciplines	ASU creates knowledge by transcending academic disciplines.
7 Be Socially Embedded	ASU connects with communities through mutually beneficial partnerships.
8 Engage Globally	ASU engages with people and issues locally, nationally, and internationally.

* M.M. Crow and W.B. Dabars, *Designing the New American University*, p. 243.

Exploring the Larger World

I direct the Center for Biology and Society,¹⁰ which resides within the School of Life Sciences at ASU and embeds ethicists, historians, and philosophers of science in a life sciences unit. The Center's mission is to promote understanding of the diverse ways that biology plays out in society and to examine the nature of the intersections and how they have changed over time. It is a kind of center that could not quite exist in other places, because the administration values different kinds of actions and does not measure success in only the traditional academic ways where the emphasis is on publications and, increasingly, on external research funding (and, in some institutions, on student teaching evaluations) with scant attention to public education and engagement. History and philosophy of science provides a foundation for our work, which involves community education activities of many different sorts, including

¹⁰ Center for Biology and Society, Arizona State University (2016). Available at: <https://cbs.asu.edu/>. Accessed on: October 28, 2016.

participating in more traditional venues and in developing new approaches to ethics-in-action for the biosciences.

In my case, the focus remains on embryos, stem cells, and, more recently, gene editing. This work is guided by the conviction that reason should trump intuition in guiding political choices: Decisions related to the biosciences should at the least be consistent with the best available scientific knowledge, understood both “in-the-now” and “in-the-past.” Reason and reflection are virtues.

History and Philosophy of Science Informing Science and Society

While the current ASU vision has been established by Crow building on the strong foundations set in place by Coor, it was during Coor’s presidency that I had my first chances to diverge from the traditional academic path toward engagement of a type that has worked beautifully for me. From January 1997 through December 1998, I had the wonderful opportunity to learn about the larger world when I served as a Congressional Fellow and senior science advisor to Arizona Congressman Matt Salmon during the 105th congressional session. This occurred because Salmon came to ASU and said to Coor, in effect, “I’m on the House Science Committee, I have ASU in my district, and I need help being informed about science.” The congressman wanted someone with a broad view who was willing to work with him and help provide reliable information. Coor pointed to someone at the intersections of history and philosophy of science and the biological and biomedical sciences, someone who could advocate for scientific understanding rather than representing any one part of the scientific research enterprise. Taking on the role of Congressional Fellow involves a different sort of advocacy – namely, advocacy for grounding decisions on the best available evidence and information, committed to avoiding political advocacy.

Of course, any knowledge can be contested. There are obviously “deniers” for many scientific claims. This is where history and philosophy of science becomes useful. It is not necessary to take sides among those yelling at each other right now. A historical perspective can help illuminate what is at issue and how different positions have developed over time. Philosophical inquiry can help articulate underlying assumptions that shape how partisans see available information.

During the 105th Congress, I brought a history and philosophy of science perspective to understanding embryos. The year 1997 introduced

cloning, with Dolly the sheep, and 1998 brought human embryonic stem cell research. In both cases, public outcry led congressmen to draft legislation. Most of this draft legislation was very poorly conceived and based on faulty assumptions. One proposed bill, for example, aimed to outlaw “genetic copies” and was written in such a way that it would have outlawed naturally occurring identical twins. Other proposed bills would have criminalized women’s decision-making regarding whether and how many embryos to transfer by labeling decisions about selective embryo transfer as homicide. In these and other instances, many of the claims and the underlying reasoning were quite wrong. Bringing a history and philosophy of science perspective to bear on these debates informed the congressmen about what really was at issue and what we already knew from science.¹¹ Fortunately, none of these flawed draft bills ever reached the floor.

Working with Congress was hugely educational, and I’ll point to two lessons in particular. First, I learned that decision-making rarely relies on serious (scientific or other) research and typically draws heavily on party politics. The “whip” helps make sure that party members are “whipped” into line with their votes (which is to say that they cast their votes in line with party objectives and politics). It takes considerable courage to vote in other ways on highly contested, political matters. As a Congressional Fellow, I was able to help staffers from several offices interpret materials supplied to them. This work made a difference in two areas. I was able to help make sure that no “stupid” embryo bill went forward by providing clear basic information about the science of embryo development. I was also able to inform some decisions about the environment by showing how certain policy options would impact constituents in Arizona in more complex ways than the party leadership understood.

The second lesson I learned was about “acknowledgment” and, more specifically, who gets credit for what. I wrote a number of speeches and opinions, none of which ever had my name on it. This taught me humility. It also allowed me to see that academics are not rewarded enough for working anonymously for the public good or for teamwork. This lesson reminds me to look more closely at the records and contributions of my own faculty members when I am evaluating their work,

¹¹ J. Maienschein, “Understanding embryos in a changing and complex world: A case of philosophers and historians engaging science,” *Erkenntnis* 79: Suppl. 5 (2014), 999–1017. J. Maienschein, *Embryos under the Microscope: The Diverging Meanings of Life* (Cambridge, MA: Harvard University Press, 2014).

and to help the institution recognize a more diverse set of academic contributions that need not include identified authorship.¹²

In addition to working with Congress, I had the good fortune to spend a great deal of time and energy educating federal judges through the Federal Judicial Center's education programs. Under the aegis of this program, I presented seminars and/or keynote lectures at the 9th, 10th, and 11th District courts' annual meetings. For the 9th Circuit Court meeting held in Hawaii, some of the California judges wanted more insight into how others were using genetics in legal cases involving human embryos. Understanding embryos and their role in law and policy made for lively discussions. The 10th Circuit Court met in Santa Fe, New Mexico. The program was designed to include an after-lunch friendly competition. Several of us who would be presenting in the afternoon were invited to give a three- to five-minute preview for our session so as to recruit our audience for the afternoon session. My planned seminar on embryos attracted one of the largest audiences. This experience contrasted markedly with what happened the following year. At the 11th Circuit Court meeting in Florida, the session began with posting of the flag, reciting the Pledge of Allegiance, and other appropriately patriotic rituals. Then, as I was introduced as the opening keynote speaker to discuss the science and social understanding of embryos, a small group walked out in protest. I can only presume that they did not want to hear what I had to say; they already had their intuitions and opinions, and they were engaging in a sort of denial that scientific or historical knowledge could make any difference.

Sometimes, however, luck favors learning. As part of my keynote address at the 11th Circuit Court meeting, I explained the ruling by Judge Royce Lambert of the District of Columbia courts, and I noted that a ruling on an appeal was due any day.¹³ As it turns out, the ruling I alluded to was rendered that very day. Later during that meeting as I walked around Disneyworld in Orlando during a scheduled afternoon off, I kept encountering judges who had heard my keynote address. They thanked me for my contribution and said they would not otherwise have paid any attention to news of the Lambert ruling. A few of the judges also acknowledged that while they previously thought they knew that "life begins at conception," they now understood that this was biologically

¹² D. Chubin and J. Maienschein, "Staffing science policy-making," *Science*, 290:5496 (2000), 1501.

¹³ For further discussion, see J. Maienschein, *Embryos under the Microscope*.

complex and they could see how this complexity in turn raised challenging and intriguing social, legal, and policy questions. In general terms, then, my goal of educating judges about the subtleties and complexities of science worked, notwithstanding the fact that several judges elected to walk out before I had uttered a word. From this experience, I conclude that scholarly history and philosophy of science studies can help some understand why we need to accept nature as it is and not as some may wish it was.

While I have found it fascinating and gratifying to have had these two types of real-world applied teaching experiences about embryos and society – with congressmen and judges – as I become more senior, I find myself focusing on the fact that one person's work is likely not enough to bring about long-term sustainable change. This brings me to my current work at ASU's School of Life Sciences. I believe that all university faculty have a responsibility to help grow academic institutions to support the kind of use-inspired and engaged work with significant impact that this volume is presenting. One way to do this is through educational programs.

Extending the Impact: The Embryo Project in Action

Graduate students at ASU's School of Life Sciences can study history and philosophy of science through the history and philosophy of science PhD program. Alternatively, they can pursue one (or more) of three tracks within the biology and society master's of science and PhD programs. The first track, history and philosophy of science, explores foundational biological sciences and the social contexts for the historical cases and philosophical analyses. The second track, bioethics, policy, and law, looks at issues at the intersection of these areas of study. The third track is ecology, economics, and ethics of the environment (4E), and it engages policy and ethical study in ways that cut across traditional disciplinary boundaries and go beyond traditional environmental studies.

The students in these graduate programs work together with faculty members to build an innovative educational and research environment with considerable potential for broad social engagement and impact. One example of this is the Embryo Project.¹⁴ The Embryo Project is a

¹⁴ J. Maienschein (director), *The Embryo Project*, Center for Biology and Society, Arizona State University (2016). Available at: <https://cbs.asu.edu/embryo-project>. Accessed on: October 28, 2016.

collaborative initiative that engages and connects researchers interested in the history, science, and context of embryos. It has overlapping mandates to pursue and promote university education, research, and public outreach.

The Embryo Project produces the online and open access *Embryo Project Encyclopedia*,¹⁵ which has an ISSN and now receives more than a million page views per year. The use of Facebook, Twitter, Reddit, and other social media outlets has considerably expanded the reach of the *Encyclopedia*, which now reaches a wide international audience. Designed for broad, general audiences (persons who have between a ninth grade and undergraduate education), the *Encyclopedia* is reaching teachers, high school students, and public officials. We know this from the many messages we receive from these audiences. The *Encyclopedia* is also proving to be a useful resource for scholars. We know this from the scholarly citations in articles published in journals like *Science*, *PLOS Biology*, and the *Proceedings of the National Academy of Sciences*, as well as more public outlets.

In 2006, we began the Embryo Project with an initial grant from the National Science Foundation.¹⁶ Without these initial funds, several subsequent grants and the steadfast generous support of ASU President Crow, the Embryo Project would not have been possible. We started with a small cohort of several graduate students and a handful of undergraduate students (many of whom benefited from the very successful *Ask a Biologist*¹⁷ outreach project).

As part of the Embryo Project, we offer a semester-long writers' seminar with a view to helping students learn how to produce content for the *Embryo Project Encyclopedia*. Initially, the seminar was held once a year and about half a dozen students participated. Now we offer the seminar every semester for a dozen or so students. Students apply to take the seminar and most of those admitted take it more than once. The

¹⁵ *Embryo Project Encyclopedia*, Center for Biology and Society, Arizona State University (2015). Available at: <http://embryo.asu.edu/>. Accessed on: October 28, 2016.

¹⁶ *SGTR: The Embryo Project Training and Research*. Award Number: 0957085. Principal Investigator: J. Maienschein. Co-Principal Investigators: M. Laubichler, C. Norton, M. Dietrich. NSF Organization: Social and Economic Sciences. NSF Program: Science, Tech & Society. Available at: www.nsf.gov/awardsearch/showAward?AWD_ID=0957085&HistoricalAwards=false. Accessed on: October 28, 2016.

¹⁷ *Ask a Biologist*, School of Life Sciences, Arizona State University (2016). Available at: <https://askabiologist.asu.edu/>. Accessed on: October 28, 2016.

seminar is taught by myself and two graduate students. We each read over 1,000 pages each semester, as we work together through many drafts and revisions.

Each student develops a cluster of articles that connect. The cluster might include articles on a key person, relevant literature, an experiment, or an organization. Topics include anything related to development “from Aristotle up to tomorrow,” as I like to put it. The students come up with great ideas and have lively imaginations. We also guide them with lists of “most wanted” articles. All articles must follow the style manuals developed by the graduate students, in particular Erica O’Neil. Some students have written about issues in reproductive biology, including recently a series of articles on the Catholic and Republican Arizona roots for Planned Parenthood and family planning. Others have written on core biological topics, including an excellent cluster on germ layers. One student has written on in vitro fertilization in China, and this article has attracted a lot of attention, as have a number of articles on cellular aging.

At the end of the semester, students submit their portfolio of articles for grading. Stellar submissions are forwarded to Steve Elliott, the editor in chief of the *Embryo Project Encyclopedia*. Elliott has set up a series of protocols for review, fact-checking, and digital publishing and has developed an infrastructure of graduate students to support the editing and content management required for this project. Elliott and Federica Turriziani Colonna also teach an editing and digital publishing course. This course along with the seminar are part of a new nonfiction writing certificate program offered at ASU.

In addition to the writing, reviewing, editing, and digital publishing (all against a background of well-tested protocols and manuals to provide consistency and quality control), Elliott has developed an internship for illustrators. The illustrators are adding images to the *Embryo Project Encyclopedia* to assist with the interpretation of some of the more complex ideas.

As we look toward the future of the Embryo Project, there are two “next steps” on the horizon. First, with National Science Foundation training grants, we have been able to bring international graduate students and scholars into the process, and we hope to “franchise” the Embryo Project so that others can teach their own writing seminars and have their students submit their articles to our editorial team for publication. Second, we are beginning to add features to the Embryo Project that we are developing as part of the Marine Biological

Laboratory History Project.¹⁸ Thousands of photographs from the archives at the Marine Biological Laboratory in Woods Hole, Massachusetts, have been digitized and made available for the *Embryo Project Encyclopedia*, allowing the public to engage with the *Encyclopedia*'s content in new ways.

The content of both of these projects – the Embryo Project and the Marine Biological Laboratory History Project – reside on servers in the ASU library, and the entries are all part of the HPS (History and Philosophy of Science) Repository.¹⁹ All of this is coordinated and overseen by graduate student and project coordinator Kate MacCord.

These two projects are oriented toward giving every student a set of skills and experiences with communicating science to multiple audiences and with digital publishing. Students also take turns giving presentations to the public through regular events at ASU, the Arizona Science Center, ASU Homecoming, and other venues in Arizona and nationally. Our group has helped develop outreach programs for the History of Science Society²⁰ and Philosophy of Science Association,²¹ in particular, serving as the organizers for a Joint Caucus for Socially Engaged Philosophers and Historians of Science.²² Our students also help run the international Digital HPS group,²³ which is oriented toward sharing results including about how to present ideas to a broader public. In all cases, the students serve as the organizers and leaders, and they have developed a series of manuals and protocols for all aspects of the work. These are designed to share the skills and tools, and not just the final products, with anybody – in a completely openly accessible and open-sourced way. These students will graduate and others will take their places in this lively training program that engages students in effective public outreach and advocacy for understanding science in its historical and philosophical context.

¹⁸ Marine Biological Laboratory History Project, the University of Chicago (2016). Available at: <http://history.archives.mbl.edu>. Accessed on: October 28, 2016.

¹⁹ History and Philosophy of Science Repository, Arizona State University (2015). Available at: <http://hpsrepository.asu.edu>. Accessed on: October 28, 2016.

²⁰ History of Science Society, University of Notre Dame (2016). Available at: <http://hssonline.org/>. Accessed on: October 28, 2016.

²¹ The Philosophy of Science Association (2016). Available at: <http://philsci.org/>. Accessed on: October 28, 2016.

²² Joint Caucus of Socially Engaged Philosophers and Historians of Science (2016). Available at: <http://jointcaucus.philsci.org/>. Accessed on: October 28, 2016.

²³ Digital HPS. Available at: <http://digitalhps.org>. Accessed on: October 28, 2016.

Conclusion

I remain amazed at my good fortune in being able to work at an institution that values ethics-with-impact work that is at the intersection of scholarship, advocacy, and public good. ASU's charter captures this beautifully:

ASU is a comprehensive public research university, measured not by whom we exclude, but rather by whom we include and how they succeed; advancing research and discovery of public value; and assuming fundamental responsibility for the economic, social, cultural and overall health of the communities it serves.²⁴

Many support this new university model that embraces education, learning, and applying knowledge for the benefit of faculty, students, and the community as a whole. Among the many supporting voices is that of former Columbia University provost Jonathan Cole. At a recent event at ASU, Cole held that Ivy League schools have become predictable and their admission process is so exclusive that "the students are 'boring.' They all have perfect scores. They've never deviated from the beaten path."²⁵ Although Cole's entire education and career has been at Columbia, he said, "The Ivy League is not where it's at."²⁶ But is the ASU model transposable to other places? A study by Jon Marcus for the Hechinger Report, which appeared in *U.S. News and World Report*, asks this provocative question.²⁷ As Cole puts it, we have to make changes because "[m]ost education and most research is taking place at state universities, and we cannot let them fail."²⁸

Inspired by the other stories brought to life in this book, we can all work together to extend the institutional as well as personal support for carrying out scholarship with impact. Individual actions are important, and even necessary. But actions that extend beyond the power of one, especially through education and teamwork, are especially important.

²⁴ ASU, *Arizona State University Charter*.

²⁵ Quoted in: M. B. Faller, "ASU setting path 'Toward a More Perfect University,'" *ASU Now: Access, Excellence, Impact* (March 11, 2016). Available at: <https://asunow.asu.edu/20160311-solutions-asu-setting-path-toward-more-perfect-university>. Accessed on: October 28, 2016.

²⁶ Quoted in: M. B. Faller, "ASU setting path."

²⁷ J. Marcus, "Arizona state president: School is model of the new U," *U.S. News and World Report* (March 17, 2015). Available at: <http://www.usnews.com/news/college-of-tomorrow/articles/2015/03/17/arizona-state-president-school-is-model-of-the-new-u>. Accessed on: October 28, 2016.

²⁸ Quoted in: M. B. Faller, "ASU setting path."

The Embryo Project and ASU provide examples of a firm commitment to supporting the next generation of change makers by helping them learn to communicate effectively with multiple audiences.

Acknowledgment

Thanks to the National Science Foundation for a series of grants and to Arizona State University's president's office for continued support. Special thanks to the Embryo Project team led by Kate MacCord, Steve Elliott, Erica O'Neil, Federica Turriziani Colonna, Valerie Racine, Alexis Abboud, Kelle Dhein, Karen Wellner, and Mary Sunderland. And special thanks to Jessica Ranney.