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Feature

The Civic Science Imperative

By Elizabeth Good Christopherson, Dietram A. Scheufele & Brooke Smith

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At a time of rapid scientific advances, philanthropy has a vital role to play in building a culture of "civic science": one in which scientists take active roles as citizens, and citizens from all walks of life engage with scientific research and its social and ethical implications.

The Civic Science Imperative

BY ELIZABETH GOOD CHRISTOPHERSON, DIETRAM A. SCHEUFELE & BROOKE SMITH

Illustration by Michael Waraksa

Science, backed in part by philanthropic funding, has made great gains in the global fight against malaria. The World Health Organization estimates that since 2001, these efforts have prevented 6.8 million malaria deaths. What if they all could be avoided? Some 429,000 people still died from malaria in 2015, most of them children. What if we could engineer the extinction of a few species of mosquitos to prevent more deaths? What if doing so required a technology that could, in the wrong hands, be reversed to make mosquitos into new kinds of biological weapons, carrying new kinds of diseases?

What if in the future no one needed to wait for an organ transplant? As of last summer, more than 116,000 people in the United States were waiting for an organ. Twenty die every day while waiting. What if the organs needed to end this continual shortage could be grown in pigs? Would animals that were edited to be "human" enough to serve as sources of organs also have enough human cells in their brains—as some ethicists have argued—to have partially human consciousness?

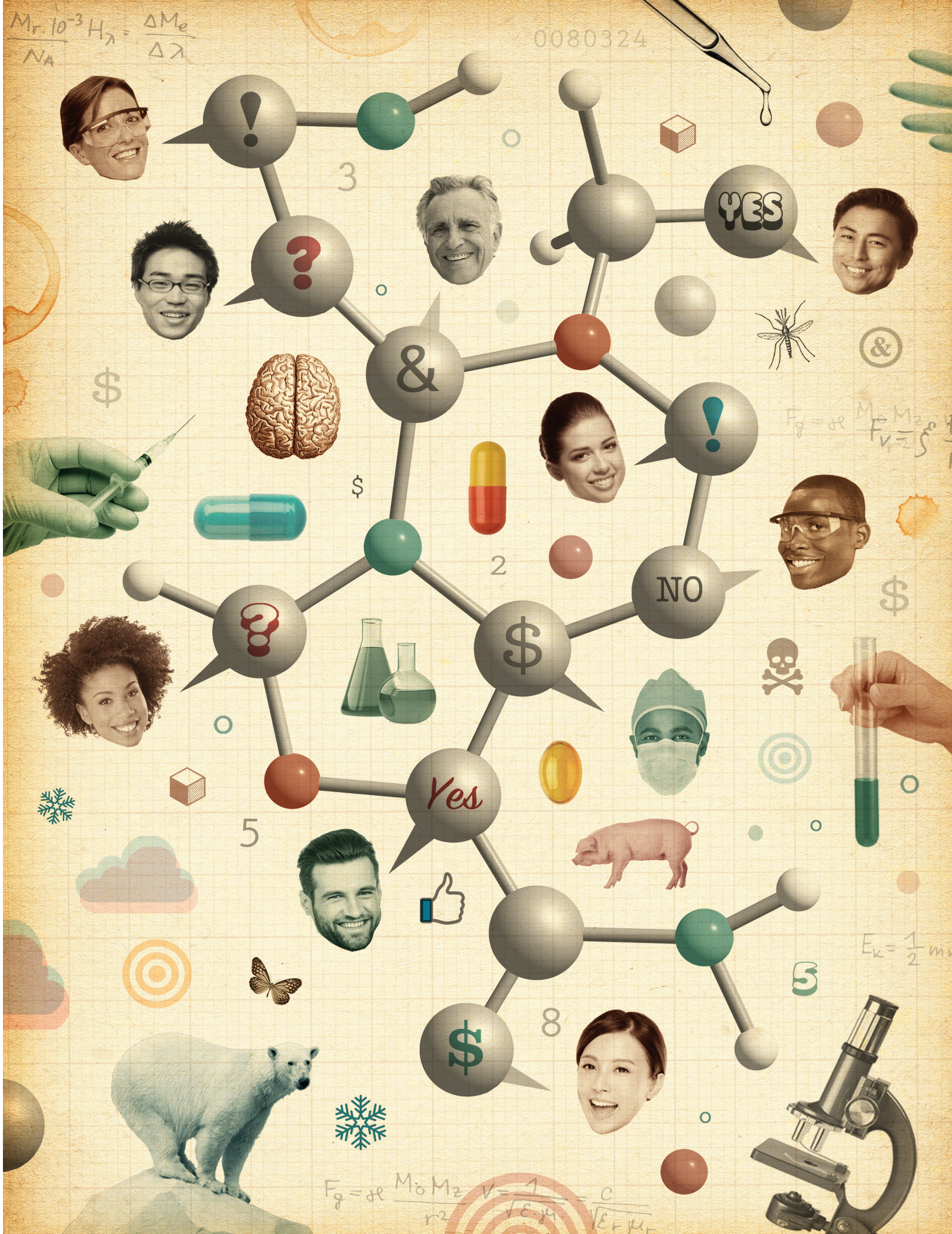
What if a person with the mutated gene that causes Huntington's disease—inevitably, devastatingly, fatally—could have the gene edited and avoid the disease? What if people could make the edit in the genes passed to their children and so eliminate the disease? What if people could also eliminate less damaging traits or add desirable ones? For instance, what if they could make themselves and their children more intelligent? Should they be allowed to? Who would do it? Only wealthy people? People in some countries and not others? Who would decide?

Those who have been following the rapid development of the new gene editing technique called CRISPR/Cas9 (or simply "CRISPR") know that steps have been taken toward all of the possible futures described above, although some seem within reach, while others are, at this point, purely speculative.

A nonprofit research consortium called Target Malaria is using CRISPR—a kind of molecular find-and-replace function—to develop *Anopheles* mosquitos that can only produce non-biting male offspring and that can spread this trait throughout a mosquito population, eventually causing the population to collapse. Earlier this year, researchers at the Salk Institute in San Diego used CRISPR to grow a functioning rat pancreas, heart, and eyes in a mouse embryo. They also generated human cells and tissues in an embryonic pig, which is the right size to host human organs. We are still far from knowing how to modify genes to produce complex traits such as intelligence. But researchers, using mice, were able to edit the mutant *Htt* gene that causes Huntington's disease, nearly eliminating the toxic protein that causes the breakdown of cells during the course of the disease. And in August, scientists at Oregon Health and Science University reported successfully editing a gene responsible for heart failure in a human embryo.

These advances are remarkable examples of the miraculous discoveries of contemporary science. The immensity of the radical new kind of power that CRISPR represents has led it to be compared—even by the scientists who invented it—to atomic energy. Like any powerful technology, it can be used for purposes that most of us would applaud or for purposes that most of us would condemn. And there is a lot of gray territory in between. Only a few years old, CRISPR has put humankind on a path that is unmapped and uncharted—not just scientifically, but also ethically, socially, and legally.

Instances of discrimination, eugenics, and persecution based on genetic traits are part of a troubling strand of medical history. Will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our new ability to edit the human genome create new pressure for some populations to be genetically edited, perhaps against their will? Will it increase discrimination against those who choose not to? What other challenges will emerge?

Many of the questions CRISPR raises are not scientific or technical, nor do they have "correct" answers that scientists can provide. CRISPR represents a type of emerging science that within the lab has manageable technical risks but outside it generates ethical, political, and other societal dilemmas that only become clear once we begin to consider concrete applications. As with human genome editing, issues raised by stem cell research, synthetic biology, nanotechnology, and artificial intelligence fall squarely in the category of "wicked problems"[1]—those that require a careful weighting of different known and unknown consequences and the connections among them. Ideally, we will determine how to handle these issues through what the editors of *The Lancet* recently called "exhaustive and effective" public engagement about their scientific potential alongside the moral, political, and societal trade-offs involved.[2]

The fact that we are in uncharted territory in so many areas of science opens up tremendous opportunities to re-envision how we as a society debate and guide the development of new knowledge and technology. Philanthropy has a vital role to play in fostering the discourse necessary to navigate these opportunities successfully.

A GROWING MANDATE FOR PUBLIC ENGAGEMENT

Some in the scientific community have long embraced the idea of engaging the public in broad discussions about emerging technologies and their implications. Writing in 1948 in the *Bulletin of the Atomic Scientists*, a publication founded by Manhattan Project scientists who "could not remain aloof to the consequences of their work," J. Robert Oppenheimer urged greater dialogue between scientists and nonscientists. The "father of the bomb" described a growing consciousness among physicists about the implications of their work, a result of "the experiences of this century, which have shown in so poignant a way how much the applications of science determine our welfare and that of our fellows, and which have cast in doubt that traditional optimism, that confidence in progress, which have characterized Western Culture since the Renaissance."[3]

At the beginning of the 21st century, Alan Leshner, now CEO emeritus of the American Association for the Advancement of Science (AAAS), called for an "honest bidirectional dialogue" about the risks and benefits of emerging science. Scientists, he wrote, "need to respect the public's perspective and concerns, even when we do not fully share them, and we need to develop a partnership that can respond to them."[4]

Yet scientific culture does not typically nurture public engagement by scientists, and often discourages it. The guiding mantra for most scientists' careers is "publish or perish." Scientists must focus on writing grants, doing research, publishing, and teaching. Even if scientists want to take part in civic dialogues, many universities do not adequately incentivize engagement, and professionals who enable effective communication about science often lack adequate support.

However, several recent developments, including the emergence of CRISPR, are contributing to a shift in culture. University of California, Berkeley, biologist Jennifer Doudna, one of CRISPR's pioneers, is also a leading voice for broader societal conversations with social scientists, faith-based communities, regulatory and political actors, and the general public "on how those technologies could, and should, be used."[5] Recent survey data suggest that many citizens agree. People want to be involved in discussions about CRISPR, regardless of their views of it. These views vary in part based on respondents' religious background, their understanding of the technology's technical risks and benefits, and the degree to which they or their family members are affected by diseases that CRISPR may be able to cure.[6]

The public seems ready for such discussions about CRISPR and other emerging technologies, and so do scientists. However, the urgent need for inclusive and constructive debates comes at a less-than-ideal time in our political history. Decreasing levels of political involvement by individual citizens have gone hand-in-hand with a decline in what some term "social capital," as fewer community organizations and other institutions integrate citizens into the social and political fabric of their communities.[7] Recently, this social fabric has been strained even further by an increasing polarization of the electorate[8] and changing, sometimes distorted, media systems that rely more and more on online channels.

Personalized news environments have enabled a new type of hyperselectivity among audiences. Social scientists have long observed that people lean toward consuming information and news that fit their preexisting beliefs.[9] News aggregators such as Google News, Flipboard, and Feedly now allow people to permanently firewall their news diets against certain sources, topics, or viewpoints. With close to 7 in 10 Americans today reporting getting at least some of their news from social media,[10] this problem is becoming even more acute.

These effects are compounded when we deal with complex and emerging scientific topics that bridge traditional disciplines. As scientific information and analysis no longer reliably reach large cross-sections of the population, audiences are better able to shield themselves from information that does not fit their preexisting beliefs. Even when reading about uncontroversial topics such as nanotechnology, experiments have shown that audiences gravitate toward scientific news from sources that fit their own ideological leanings, regardless of the story's headline or content.[11]

To find productive societal responses to emerging science, we need to escape these cycles of polarization, and for that we need more than scientific information. We need to engage in and support the messy, complex work of civic discourse and negotiation.

FIVE WAYS PHILANTHROPY CAN FOSTER CIVIC SCIENCE

A society that embraces both scientific progress and democratic decision making will weigh important possibilities—for example,

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the prevention and treatment of diseases—against regulatory, moral, and societal considerations. At times, these considerations may lead to curtailing what is possible for the sake of what is wise. We can only develop scientific breakthroughs responsibly if we can engage in societal dialogue about their potential and the complexities of introducing their applications.

The way forward, we argue, lies in advancing a culture of civic science. By civic science, we mean broad public engagement with issues that arise at the many intersections between science and society. In communities that embrace civic science, scientists play active roles as citizens, people from many walks of life access science as part of their decision-making processes, and the environment in which people communicate about science is an inclusive space for public problem solving and discovery.[12]

There are useful models and promising examples of how to build an infrastructure for civic science, but a great deal of work is yet to be done. A crucial early step will come from catalytic investments by philanthropic organizations, which can galvanize new civic science initiatives, scale up existing efforts, and encourage other organizations to do the same. In designing these investments, philanthropists have a critical opportunity to draw on findings from communications research and pilot efforts by adopting five broad approaches:

1. Support effective science communication and engagement. | Many people who set out to communicate about science, including scientists, operate from a set of intuitive ideas about effective communication that research has shown to be wrong. This "knowledge deficit model" of communication goes something like this: This science is complex and new. I will take pains to explain it very carefully, and repeat myself, and use different metaphors, until you understand the facts. The assumption is that simply knowing the facts will lead people—and society—to scientifically sound decisions, such as vaccinating children and investing in renewable energy. Many scientists continue to use this model in spite of decades of research in the social sciences having produced very limited support for this approach.[13] It turns out that trying to change long-held beliefs with scientific evidence is difficult, even when the audience is scientists themselves.

While promoting a better understanding of scientific facts can help alleviate unfounded concerns in some contexts, it may be completely ineffective when science confronts preexisting beliefs or when scientific developments present problems without scientific answers. For example, computer scientists were able to develop artificial intelligence that could learn the language of social media and participate in it. But, as Microsoft programmers discovered when their Twitter chatbot Tay learned bigotry from human users and had to be shut down within a day, participating in a respectful, constructive way requires a different kind of knowledge about culture and values.

A simplistic focus on communicating scientific facts may not only be ineffective—it can also backfire. A recent study showed that among some parents opposed to vaccinating their children, receiving more comprehensive information about vaccinations only made them less willing to follow recommended vaccine schedules.[14]

A number of science communication training programs—including those of COMPASS, founded by the ecologist Jane Lubchenco; the Alan Alda Center for Communicating Science; and the Leshner Leadership Institute for Public Engagement with Science at the American Association for the Advancement of Science—are working to overcome intuitive yet inaccurate beliefs such as those behind the deficit model. Equipped with approaches for active listening and research on what audiences care about, scientists can become more effective "bidirectional" communicators. More universities and philanthropies are investing in communication and engagement training for scientists they support, and they are creating public information offices that encourage and facilitate scientists' connection with the public.

Additional investments in this area are likely to fall on fertile ground, especially for fields of research that deal with wicked scientific problems. Recent surveys among leading scientists in fields such as epidemiology, stem cell research,[15] and nanotechnology[16] show an interest in and openness toward engaging with public audiences, and reflect an overall shift away from academic culture's traditional discouragement of public outreach.

Since the 2016 presidential election campaign, science communication training organizations and academic institutions have been reporting a surge in demand. "I think scientists have tended to roll their eyes when people say, 'I don't believe it,' rather than roll up their sleeves," Denis Wirtz, vice provost for research at Johns Hopkins University, said in July 2017. "[But now] I see faculty come to my office, come to our federal relations office, asking, 'How do I communicate to Congress, how do I communicate to people?' There is a sea change."[17]

Many of those who are leading emerging efforts to better communicate science are eager to incorporate findings from empirical social science about what approaches are likely to be effective. To meet increasing demand, philanthropic investments in science communication will need to intensify. Particular opportunities for widespread philanthropic influence lie in developing a useful and accessible body of applicable social science research, as well as encouraging public engagement by scientists and universities through funding, convening, and communication of cultural expectations. The Kavli, Moore, Packard, and Rita Allen foundations have begun a new effort to understand what an effective support system for scientists' communication and engagement could be, by convening professionals who support effective communication along with researchers and systems designers to share insight and develop collaborative work. (One of the authors is president and CEO of the Rita Allen Foundation; another recently joined The Kavli Foundation after serving as executive director of COMPASS.)

2. Capitalize on the strength of diverse coalitions. | The scientific community cannot make this shift toward engagement alone. Dialogue cannot be confined to what researchers in a field such as gene editing see as the most pressing issues. Identifying emerging challenges and opportunities and enabling meaningful social dialogue requires participation from community groups, political actors, media organizations, industry, journalists, and the broader public, as well as researchers in both the social and natural sciences. Philanthropy can promote coalitions among all of these groups, as well as connections across race, class, culture, geography, and ideology.

Coalition-building can come from within the academic system. In 2006, for instance, the US National Science Foundation funded two Centers for Nanotechnology in Society to study the ethical, legal, economic, and policy implications of the emerging field. The centers, based at Arizona State University and the University of California, Santa Barbara, were interdisciplinary efforts, spanning the social, natural, and engineering sciences. They deployed creative

approaches to bring scientists and societal stakeholders together—for instance, organizing city tours for experts and the public to spark dialogue about nanotechnology in specific urban environments.

Collaborative civic science organizations and movements can also exist outside of institutional settings. Genspace, a community lab in Brooklyn, connects science enthusiasts, high school students and teachers, professional scientists, artists, designers, and a variety of nonprofits. People not formally trained in science might work on projects side-by-side with trained scientists—for instance, developing a biosensor that provides real-time data on pollution in Brooklyn's Gowanus Canal. With support from the Richard Lounsbery Foundation, Genspace hosts a series of community lectures and conversations about contemporary issues in genomic research alongside opportunities for anyone to use lab equipment to investigate the DNA of everyday materials—enabling people to identify fish from the market and backyard weeds, for example.

In addition to providing support for coalitions, philanthropists can catalyze promising connections by supporting gatherings of disparate groups and providing seed funding for new collaborations. For example, the Rita Allen Foundation and other partners are supporting multidisciplinary, cross-sector convenings at the National Academies of Sciences, Engineering, and Medicine, including the recent Sackler Colloquium on the Science of Science Communication. (One of the authors was an organizer of the Colloquium.) These events, which focus on contentious and emerging topics such as artificial intelligence and human genome editing, are beginning to show results in new partnerships between social scientists and science communicators in governmental and scientific institutions. They also engage philanthropists themselves as active participants and encourage them to listen for opportunities and contribute ideas.

3. Build capacity to deal with moving targets. | Given the rapid emergence of new science and technology—not to mention unexpected crises such as the Zika virus outbreak in 2015—we must build into civic science qualities that allow it to quickly adapt to new topics and circumstances.

Breakthroughs in CRISPR technologies, for example, leave scientific and policy-making communities with little time to discuss the potential need for new regulatory frameworks—even as researchers around the world begin to work on early human trials. "I've never seen science move at the pace it's moving right now," CRISPR biologist Doudna said at a University of California, Berkeley, meeting last summer. "Which means we can't put off these conversations."[18]

Doudna's call to action echoes the concerns of University of South Carolina ethicist George Khushf over a decade ago:

> We are already approaching a stage at which ethical issues are emerging, one upon another, at a rate that outstrips our capacity to think through and appropriately respond. Whether we have already reached this stage or not, I am not sure, but of this I am certain: On the immediate horizon arises a point at which the traditional way we have addressed ethical issues fails, because it does not and cannot keep up with the rate at which new challenges emerge.[19]

The "moving target" problem arises not only from rapidly emerging areas of science, but also from the similarly disruptive, simultaneous transformations of our information, media, and civic environments noted earlier. These shifts complicate our ability to think through the intended and unintended consequences of emerging scientific issues and raise their own sets of questions. If trust in news media continues to decline, who, if not journalists and scientists, will be the arbiters of facts in public debates surrounding science? If we do hope for professional journalists to play that role, how can we make quality news environments financially sustainable? What opportunities exist in current and emerging online environments to foster the kind of deliberative spaces that have declined in our offline, face-to-face interactions?

Civic science philanthropy can begin to address moving targets by incorporating openness and flexibility into grantmaking approaches. Grantmakers should be willing to see projects change based on new circumstances and understanding, provide funding that isn't earmarked for particular uses, open routes to funding for new ideas and organizations, and speed up review processes when necessary to meet timely opportunities.

Building capacities that can be flexibly applied in new situations among individuals, organizations, and sectors is also key. Investments in a civic science system that is resilient and responsive might include, for example, helping equip scientists to speak about their own work as it develops; supporting intermediary organizations to build relationships among scientists, journalists, and policy makers; and creating lifelong learning opportunities to improve the public's ability to assess the quality of new scientific information. While education in a school setting is the rightful focus of much philanthropic effort, it is essential to understand that exposure to scientific topics happens primarily outside of school—especially for emerging topics such as human genome editing and nanotechnology.[20]

Rapid change and unexpected crises also can be an inspiration for civic science innovation. The nonprofit Public Lab, which now serves as a hub for collaboration on do-it-yourself environmental science tools and community-led investigations, began in the days following the 2010 BP oil spill in the Gulf of Mexico. When reliable official information wasn't available about the extent of the spill, community members from diverse professional backgrounds collected aerial images of the coastline using cameras launched on balloons and kites, and they combined them using an open-source platform they created. Since then, tools developed by Public Lab have been used for community science projects around the world, such as locating stray patches of invasive water chestnut for removal in Massachusetts' Pioneer Valley, monitoring an open landfill adjacent to wetlands and residential areas near Boston, and guiding wetlands restoration around Lake Pontchartrain, Louisiana.

4. Focus on shared values. | Despite disagreement on key issues such as climate change, GMOs, and vaccine safety, Americans largely support and trust science and scientists. In fact, confidence in the scientific community is higher than for most other institutions in the United States, second only to the military. Eight in 10 American adults say in surveys that science has made life for most people easier.[21] Even in a polarized age, civic science presents opportunities for nonprofits and philanthropists to help find solutions to complex problems and forge connections across divisions of geography, ideology, race, and culture around a common interest in discovery and progress.

For this to succeed, however, it is critical to identify and connect with shared values. Climate change can be described in the context

of the need for new regulations and environmental protections, which are likely to appeal to people who identify as liberal, but not to those who identify as conservative. On the other hand, a discussion of climate change centered on the value of investments in alternative energy sources, with an eye toward energy independence and competitiveness in global energy markets, has the potential to draw more conservative agreement. While conservative Christians are less likely to believe that global warming is caused by human activity, the climate scientist Katharine Hayhoe, an evangelical Christian, is trying to change attitudes through presentations to Christian audiences that include in-depth discussions of the different roles that science and faith play when considering climate change and what to do about it. "For Christians," Hayhoe says, "climate change directly intersects with mandates to be responsible for creation, to love others as Christ loved us, and to care for the poor and needy," as climate change disproportionately affects the poor.

We know from decades of research in linguistics,[22] sociology,[23] media effects,[24] and psychology[25] that the way information or choices are presented or framed can change how audiences interpret them.[26] Framing helps us make sense of complex issues by connecting them to existing mental schemas[27] and potentially channeling them through one ideological or value-shaped interpretive pathway instead of another—especially in the case of highly complex scientific issues that can be interpreted in a variety of ways.

In building civic science, we cannot simply "stick to the facts" or—even worse—to frames that are likely to alienate particular audiences. We need to understand that people's values, along with evidence, are central contributors to their decision making. Some religious audiences will use their faith to help inform their decisions about human genome editing, for example; parents who are carriers of Huntington's disease might make the health of their future children the primary basis of their choices and views. There is no one correct way of looking at the issue. Ongoing interpersonal and societal debates can help us identify values that we can agree on and allow us to make regulatory and ethical choices with broad public support.

Philanthropists can contribute to these conversations by communicating the core values that drive their own support of science, civic life, and their intersection. They can also fuel dialogues about science and values—in person, in the media, and in digital spaces.

The Alfred P. Sloan Foundation's program to promote public understanding of science, technology, and economics provides an example of multifaceted philanthropic support of science-related media, theater, film, and, recently, virtual reality that appeals to shared values. The program has supported works of popular nonfiction including *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race*, the book by Margot Lee Shetterly that was turned into the widely acclaimed film. Doron Weber, who directs the program at Sloan, noted the success that *Hidden Figures* had in challenging damaging stereotypes about who scientists are, and at the same time resonating with people across the political spectrum. "Works of art can bring people together," he said. "And when they do that, you can walk out of the theater and maybe … it expands your understanding of other people."[28]

Experimentation in science-related visual media as a means to promote shared values has ample room for growth. A recent Pew study found that 45 percent of Americans get their science news from documentaries and other science video programs, making these the second most common source of science news after general news outlets. Videos are also among the most trusted sources of science news—second only to science museums.

5. Build trusting relationships through applied research and feedback loops. | To ensure that people who may be affected by emerging developments in science and technology can participate in productive dialogue around these issues, we must establish a baseline of trust and familiarity between scientists and community members. Philanthropy can encourage this process by supporting the development of new pathways for scientific research that are more responsive to societal needs across many fields.

Social science has a distinctive role in this system: It can examine and improve how we build connections between science and public stakeholders, and offer key insights for philanthropists who want to maximize their effectiveness. Sociologist Duncan Watts of Microsoft Research recently used the term "solution-oriented social science" to describe growing areas of research that are designed and communicated in ways that allow their findings to be more easily applied to real-world problems. Given that incentive systems in universities rarely encourage solutions-oriented social scientific research, philanthropists can step up to incentivize more use-inspired solutions thinking within the social sciences, including work to help develop more robust positive feedback loops between various scientific disciplines and communities they affect.

Positive civic science feedback loops would increase knowledge through scientists and nonscientists seeking, sharing, and responding to information about the discoveries and practices of science as well as information about social and cultural dynamics and how scientific practices and discoveries affect them. These feedback loops would look different depending on the science and communities involved and might involve formal structures, such as public comment processes, and informal ones, such as conversations hosted by community groups. What's important is that they would be an iterative process based on mutual benefit and learning.

Even in ideal circumstances, these cycles of engagement could not involve every scientist and community member, but they would be sufficiently vital to spread information throughout scientific and public communities. Philosophers of science, going back at least to Francis Bacon, have stressed the importance of such exchanges. Philosopher Kwame Anthony Appiah summarizes this line of thinking: "The advancement of learning is the work of communities, groups of people in communication."[29]

Developing such feedback loops can create opportunities to address distinct issues of trust within particular populations and on particular issues. While scientists are highly trusted overall, trust within some communities and on some issues is lower, often because of historic or contemporary experience. For example, the infamous "Tuskegee Study," in which researchers withheld treatment of rural African-American syphilis patients without their consent between 1932 and 1972, continues to fuel distrust in science and the health care system among African-Americans.[30] It is particularly in communities where trust in scientific institutions is lower that philanthropy has an opportunity to support civic science. Attuning scientists to the needs and experiences of these community members is a crucial step in laying the groundwork for timely dialogue, avoiding further disenfranchisement, and ultimately earning trust.

Philanthropy can contribute to the formation of new ties among scientists, scientific institutions, and diverse stakeholders directly, as well as to bodies of knowledge to make them more effective. Funders can also model more robust feedback loops in their own work. Feedback Labs and the Fund for Shared Insight are relatively new coalitions that provide resources for funders investigating the potential of greater listening and responsiveness to beneficiaries and other stakeholders in the social sector. We are eager to gather in a similarly collaborative fashion with others interested in engaging in the challenging process of building a diverse, widespread, and resilient culture of civic science.

THE FUTURE IS HERE

Civic science is not merely about scientists seeking dialogue with the public. It is not just about creating regulatory processes with as much public input as possible. A culture of civic science requires both of these—and much more. It requires contributions from the academic community, from organizations that have made it their mission to enable a better dialogue between science and society, from patient groups and other affected stakeholders, from religious groups, from diverse populations, and from policy leaders. It requires a difficult, broad-based negotiation of moral, financial, and other societal trade-offs alongside a collective investigation of scientific potential. And to succeed, a culture of civic science requires investments from philanthropic organizations to seed and sustain work with inclusive engagement across sectors and communities.

Of course, these discussions will be difficult, and they will be imperfect. Scientific progress will continue to push boundaries and challenge our understanding of what we as a society find acceptable or desirable. By fostering a culture of civic science, philanthropy can support meaningful deliberation on how best to manage the technical and social risks of emerging technologies in light of their potentially immense benefits.

At a summit on human gene editing hosted by the US National Academies of Science, Engineering, and Medicine two years ago, after a long discussion about the ethical and societal dilemmas surrounding the issue, a woman who had been listening from the audience was called on for the final question. In the room were hundreds of ethicists, scientists, patient advocates, and representatives from think tanks and government agencies.

Her name was Sarah Gray, and she spoke through tears. "I am the mother of a child who died because of a fatal birth defect," she said. "He was six days old. And he suffered every day. And the look on his face was like, 'Mom, what's going on?' He had seizures every day. We donated his body for research. If you have the skills and the knowledge to fix these diseases, then freaking do it." The audience broke out in applause.

We all have a stake in a future that reflects the best of scientific discovery, benefits humanity, and reflects our values and ideals. There is little room for hesitation. The future is here. ■

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