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# WHERE CIVICS MEETS SCIENCE: BUILDING SCIENCE FOR THE PUBLIC GOOD THROUGH CIVIC SCIENCE



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| Journal: | *Oral Diseases* |
| Manuscript ID | ODI-05-16-IMR-4822 |
| Manuscript Type: | Invited Medical Review |
| Date Submitted by the Author: | 03-Jul-2016 |
| Complete List of Authors: | Garlick, Jonathan; Tufts.University, Cancer Research and Tissue Engineering<br>Levine, Peter ; Tufts.University, Jonathan M. Tisch College of Citizenship and Public Service |
| Keywords: | Civic Science,, Behavioural sciences, public health < Epidemiology |
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# TITLE: WHERE CIVICS MEETS SCIENCE: BUILDING SCIENCE FOR THE PUBLIC GOOD THROUGH CIVIC SCIENCE

**Running Title: BUILDING SCIENCE FOR THE PUBLIC GOOD THROUGH CIVIC SCIENCE**

**Keywords**: Civic Science, Civic Engagement, Citizenship, Democracy, Science Education

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**Date of revision/resubmission:** July 2, 2016

**Introduction-** In America, as in much of the world, public understanding of science and civic engagement on science issues that impact contemporary life matter more today than ever. From the Planned Parenthood controversy, to the Flint water crisis, to Genetically Modified Organisms (GMOs) and the fluoridation debate, societal polarization about science issues has reached dramatic levels that present significant obstacles to public discussion and problem solving. This is happening, in part, because systems built to support science do not often reward open-minded thinking, inclusive dialogue and moral responsibility regarding science issues. As a result, public faith in science continues to erode. This review explores how the field of Civic Science can impact public work on science issues by building new understanding of the practices, influences, and cultures of science. Civic Science is defined as a discipline that considers science practice and knowledge as resources for civic engagement, democratic action and political change. This review considers how Civic Science informs the roles that key participants- scientists, public citizens and institutions of higher education, play in national and international science dialogues. Civic Science aspires to teach civic capacities, to inform the responsibilities of scientists engaged in public science issues and to inspire an open-minded, inclusive dialogue where all voices are heard and shared commitments are acknowledged. This interface between science, citizenship and democracy is summarized in Figure 1. Civic Science links the vast potential of science to civic capacities in our communities in ways that revitalize the democratic purposes of science for the public good.

**Science in the age of polarization-** In today's world science, a crucial source of knowledge and power, constantly impacts society. However, the contentious nature of many science issues, such as climate change, vaccines, water fluoridation and end-of-life decisions, has led to the polarization and politicization of national and international science conversations. In recent years, a growing public distrust of science has undermined its credibility in ways that have limited working across differences to find solutions to societal challenges. As an example, a recent study by the Pew Research Center revealed that while the American public values contributions by science, there are large and growing differences in the way citizens and scientists view science issues (Vergano, 2015). This points to shortcomings in the capacity of scientists to communicate effectively with the public, and suggests that if the public had more information, they would be more likely to make more informed choices. However, improving explanations by scientists is not the only answer to the science-communication problem, as it has been shown that people make decisions on these issues based on many other considerations (Anderson et al., 2012, Burgess, 2014, Fiske and Dupree, 2014). For example, public understanding of science information is confounded by "confirmation bias", which is the tendency for individuals to pursue information from sources that agree with what they already believe and to disregard information that conflicts with these beliefs (Scheufele, 2006).

Scientists contribute to this anti-science sentiment when they engage the public through a "top down" approach that regards citizens as passive consumers of science information who are subject to their persuasion (Connor and Siegrist, 2010,

Yarborough, 2014). Scientists claiming to have "all the answers" are seen as misrepresenting the ability of science to deliver solutions to the big problems facing us. This is compounded by the public's misinterpretation of the iterative nature of the scientific process (Jensen and Hurley, 2010). When new research findings seem to refute previous knowledge, the public feels deceived and the credibility of science is further undermined.

An example of a compelling case for the growing, anti-science sentiment in many societies was made evident in a recent cover article in National Geographic, "Why Do So Many Reasonable People Doubt Science?" (Achenbach, 2015). As denial of widely-accepted scientific evidence grows, science faces opposition that seems to undermine its public value. This growing distrust of science is often driven by individuals expressing doubt about the veracity of science information provided by "scientist-experts". Instead, these individuals rely on their own sources of information to support their interpretations. There are many examples of how the flames of a "war on science" are being fanned to polarize already contentious public conversations on a diverse spectrum of science issues.

One example is the stem cell debate, which intensified when the first pluripotent stem cells were derived from human embryos 15 years ago. Our community of stem cell scientists was faced with many questions that brought into focus how we weigh our search for new disease therapies while respecting the dignity of human life. As scientists, we asked how we could help the public engage in an open and accessible

conversation on this topic. Could we encourage stakeholders to leave behind the dogmatic approach staking claims to one particular viewpoint driving this contentious debate? Could we stimulate a conversation to encourage the soul-searching needed to process the hard choices required? Could we create a forum in which all sides have a voice while working to find common ground on shared values that unite us? How we build this conversation, and other conversations on science issues, speaks to the heart of Civic Science.

**Civic Science as a path to revitalize science for the public good-** This eroding of the public's faith in science necessitates a shift in the way scientists and citizens can work in a collaborative spirit to create common resources that support science-driven, civic outcomes. The field of Civic Science offers a blueprint to guide this shift. Civic Science is defined as a discipline that teaches how science practice and knowledge can serve as tools of empowerment for civic engagement, democratic action, political change and community revitalization. It does this through a participatory approach that fosters an understanding that science is not the exclusive domain of "scientist-experts" and policy-makers. Civic Science accomplishes this by creating an inclusive science communication environment that advances public problem solving. It brings together stakeholders with diverse values and interests and works to build dialogue where all voices are heard and shared commitments to finding common ground are acknowledged. Civic Science offers skills that activate the collective, civic agency of diverse participants to reinvigorate community-based engagement in ways that engender common purpose rather than reinforcing factions on complex, science issues.

Civic Science is based on scholarship that teaches us how public action on science issues can help individuals revitalize the democratic purposes and practices of science (Spencer, 2015). It does this by integrating research and theory in numerous areas of study, including science communication, civic advocacy, social action, civic organizing, deliberative practices, science and technology studies, civic studies, and complex systems theory (Levine, 2011). Civic Science applies these theoretical underpinnings, conceptual approaches and practical skills to bridge the gap between the generation of scientific knowledge and the translation of that knowledge into meaningful civic action that impacts deliberations and decisions on policy and governance. Civic Science partners with institutions of higher education to teach approaches that create an open-minded and public dialogue that respects the opinions and beliefs of all participants. These approaches connect contemporary science issues to our personal, civic, and moral responsibilities and provide us with tools to address society's most pressing challenges where science meets civics.

**A critical role for higher education in Civic Science**- Marc Edwards, the Virginia Tech civil-engineering professor whose intervention called attention to serious deficiencies in the way scientific evidence was managed during the Flint, Michigan water crisis, recently commented that "systems built to support scientists do not reward moral courage and that the university pipeline contains toxins of its own-which, if ignored, will corrode public faith in science" (Kolowich, 2016). This call to action suggests that we need to better enable colleges, universities, and health professional

schools to cultivate the core capacities that can turn science-based information into valuable public knowledge.

Civic Science can rise to meet this challenge by teaching engagement on science issues in several ways. First, institutions of higher education can serve as community information hubs, by acting as curators and disseminators of science knowledge and health information to support public deliberation on issues that impact human well-being and scientific progress (Levine, 2011). Second, teaching foundational science literacy can help our students acquire a vocabulary of science and technology that is directly relevant to their societal concerns. This will help students, from the humanities and social sciences to the life sciences and professions, appreciate that science is accessible, personal, relevant and indispensable for positive civic and democratic engagement. This will give students a "working language" that prepares them to make critical decisions in their personal, professional and civic lives. In this light, acquiring science literacy is as much about understanding scientific facts as it is about appreciating the humanizing principles that inform this knowledge.

Third, Civic Science can train our students in civic capacities that include public and collective evaluation, strategic thinking and one-on-one organizing (Gastil & Levine, 2005, Levine, 2011). Our schools can be a home to develop outreach strategies to create partnerships between our institutions, community-based organizations and local government agencies. Since science is inherently political, how it informs policy, advocacy and governance needs to be taught through field experience and service

learning that maximizes opportunities to exercise citizenship on science issues. Such training in civics and democratic knowledge-production may take the form of community-based participatory research, as well as through crowd-sourced and open-source science (Gastil & Levine, 2005, Levine, 2011)

Finally, higher education can play a central role in training scientists to overcome barriers that limit open-minded dialogue on divisive science issues. Civic Science seeks to redefine the role of the "scientist in society" as civic partners who enhance public empowerment. Pielke described four idealized roles through which scientists can engage in public dialogue on science issues (Pielke, 2007). This includes the "pure scientist" who does not get involved in decisions on science issues, the "science arbiter" who answers expert questions but does not help decide science issues, the "honest broker", who lays out a range of options without intent to persuade, and the "science issue advocate" who can weigh in to narrow the choices of the public decision-maker.

Civic Science provides a framework for the scientist to choose from these roles as appropriate to the context, choices and values presented by a science issue. Ultimately, Civic Science seeks to train scientists as facilitators of an inclusive, public dialogue through which they share accurate science information in a balanced way. This deepens understanding of multiple perspectives, rather than helping one side convince the other as to who is "right or wrong".

Public engagement on GMOs is an example of a global issue that has raised societal, cultural and political concerns about their regulation, biosafety risks, and potential benefits. This issue has created a challenging backdrop on which scientists and citizens

share a dialogue that informs policy formation and public decision making. On one hand, the public's perspective on GMOs is influenced by concerns including economic development, protections from harms, consumer choices linked to food labeling and ethical issues related to genetic modification itself (Rhodes & Sawyer, 2015). Such questions about the impact of GMOs are typical of politicized and polarizing public science issues that are characterized by a significant degree of scientific uncertainty and scientific complexity and the high-stakes outcomes linked them. In light of this, scientists need to consider how to provide useful science information that can be viewed as being credible and valuable for public dialogue, deliberation and decision-making that speaks to a broad range of stakeholders and values systems.

The critical need to create a productive, science communication environment for public conversation on GMOs has been addressed recently in a Workshop Summary published by the National Research Council of the National Academies (Rhodes & Sawyer, 2015). In this Summary, Dominique Brossard noted importantly that the issue "goes beyond food and environmental safety that needs to be thought of in terms of the sociopolitical and cultural context in which the debate is taking place before coming up with general conclusions and assumptions about how we should engage the public". Brossard considers how concerns about GMO technologies vary greatly in specific sociopolitical and cultural contexts of different global regions as exemplified by "concerns in African and Asia that regulatory mechanisms ensure that cities are adequately protected while in Europe concerns for local farmers are important" (Rhodes & Sawyer, 2015). Examples of sociopolitical and cultural questions raised by GMOs are

listed in Table 1 and demonstrate that these issues need to consider these questions to limit the development of a polarizing public debate on issues related to GMO technology (Rhodes & Sawyer, 2015). Civic Science offers a path forward by representing a diverse spectrum of expert views through which scientists present the most accurate science knowledge about GMOs that can be framed in the context of these societal values. This approach recognizes the need for scientists to exercise intellectual humility, as true engagement with stakeholders who have divergent opinions requires a degree of intellectual risk-taking. By respecting the legitimate concerns of all participants, scientists can facilitate building common ground among stakeholders who are not in agreement by helping participants acknowledge their shared commitments to open-minded dialogue.

**Building an inclusive dialogue on science issues-** The current political rhetoric swirling around science issues has made this a particularly compelling time to create a more inclusive public dialogue about these issues. Civic Science is responsive to this crisis in public civility by guiding students and citizens towards the intersection of intellectual understanding and personal meaning that grows out of the cross-pollination of ideas. Civic Science aims to create an environment for an exchange of ideas that connects science to daily choices and decisions we face. Institutions of higher education can contribute to this by teaching the conceptual frameworks and practical skills that build civic agency and collective empowerment that speak to our student's personal sense of civic, and moral responsibility (Saltmarsh & Hartlet, 2011). This requires a commitment to helping students reflect on the impact that science has on

understanding of other points of view. It creates an understanding that working towards finding common ground on divisive science issues does not mean that all participants must agree. Rather, we need to guide our students through conversations with people with whom they disagree by teaching to be intellectually humble while remaining committed to a position on which there may be persistent disagreement.

Civic Science offers a path forward by teaching that science issues are connected to students' core values and beliefs, including those that touch on race, gender, cultural heritage, identity and ethnicity. This supports the call for higher education to advance intercultural competence, diversity, equity, and community engagement initiatives that welcome groups that have been traditionally underrepresented in higher education (Sturm et al., 2011). This can be approached through pedagogy that promotes an inclusive classroom climate, in which a diverse spectrum of opinions and beliefs are respected in ways that inspire curiosity and empathy for other positions. Such inclusive dialogue asks students to reflect on and share questions that break down stereotypes and leads to a greater understanding of how individuals acquire particular perspectives on science issues. This happens when students ask questions of genuine curiosity that deepen understanding by encouraging others to elaborate on their formative, lived experiences in ways that builds mutual trust.

Inclusive dialogue guides us to bring out diverse points of view on science issues and to help individuals see commonality where they once saw difference and difference where they once saw commonality. Civic Science leverages this approach to fulfill our potential as public citizens, we must learn to grapple with science issues in ways that enhance

individual understanding, interpersonal connection and the capacity to contribute positively to society at large. This will help us understand that science is as much about understanding scientific process and facts as it about appreciating the humanizing principles that connect us.

**Building national and international agendas in Civic Science** - An exciting challenge facing Civic Science is to continue to formulate national and international agendas that can develop frameworks for educational initiatives, governmental funding, public education and evaluation, civic organizing and strategic thinking that advances its principles (Jewett, 2012). This includes building and energizing networks of federal science agencies to fund research projects at the interface of science and civics. Other agenda items include finding ways to support strategic communications about Civic Science to further help scientists become a trusted media source that can contribute to understanding the multifaceted institutional role of science within a democratic society. This requires identifying innovative projects that integrate research in civic agency, public engagement and science communication.

As we move forward, we need to frame science learning around real-world issues of personal relevance and challenge each other to find solutions to society's most daunting problems that exist at the nexus of science, technology and society. This will help us ask questions such as: What does it mean for a scientist to be an active citizen? Which aspects of science issues are authentically scientific as opposed to those that are

normative, involving values or ethical principles? How should science education be institutionally organized in relation to governance?

Civic Science offers ways to model civil, inclusive discourse on science-related, public issues within a safe and respectful environment. For example, in the United States, to accomplish this, Civic Science will need to integrate with the mission of other national organizations that strive for the same goals, such as SENCER (Science Education for New Civic Engagements and Responsibilities) and The National Institute for Civil Discourse, that work to bring science understanding, civic engagement and civility into our daily lives. By building open-minded dialogue, we can move ahead with humility and civility that can leave science dogmatism and polarization behind, as we work together to find compassion and common ground on issues we care about most. This is the quality of the national science conversation that we all need to share.

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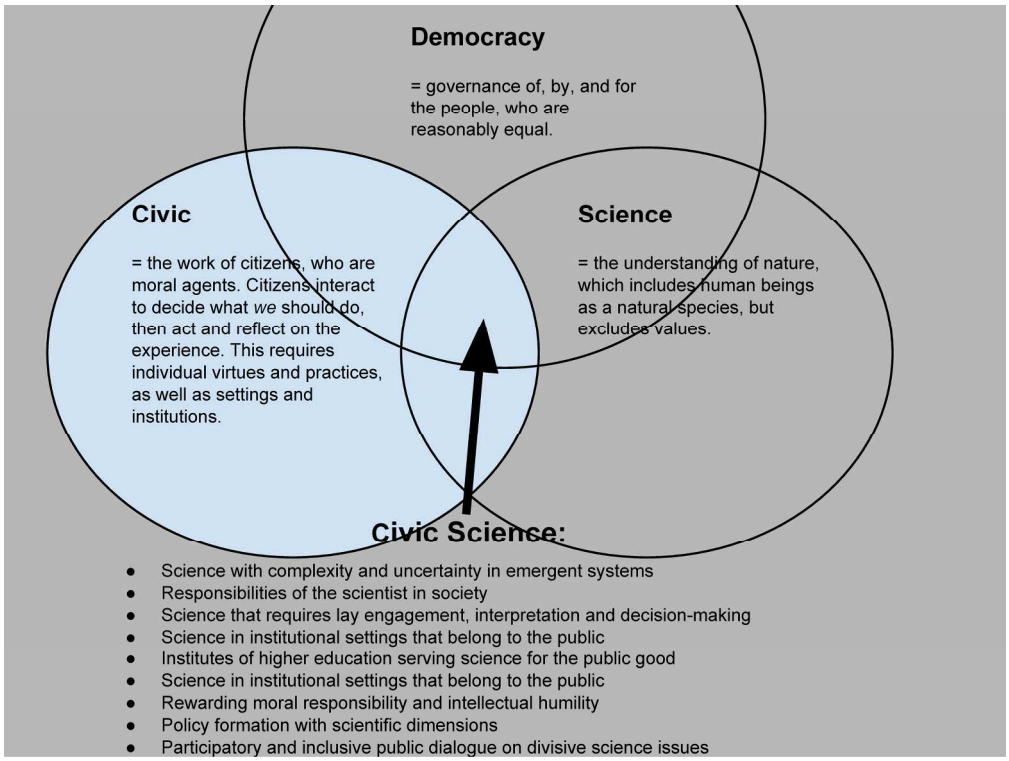
## TABLE 1: Cultural and Sociopolitical Impacts of GMOs in the Public Sphere

1. **Regulatory Issues-** Do we have regulatory and biosafety mechanisms to make sure that citizens are protected?
2. **Risks and Benefits**- Are people concerned about the distribution of risks and benefits among consumers, farmers, corporations and others?
3. **International Trade**- Should we invest in a technology that cannot be exported in some countries?
4. **Consumer Choice**- Is the labelling debate about consumers having the right to choose what they are eating?
5. **Effects on Rural and Developing Communities**- What will genetic modification technology mean for small-scale farmers?
6. **Nature Tampering**- Do we have the right to alter things that God has created in nature?

**Source**: Public Engagement on Genetically Modified Organisms: When Science and Citizens Connect- Workshop Summary, Roundtable on Public Interfaces of the Life Sciences, National Research Council, Washington, DC, 2015.

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