Community Science

COMMENTARY

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**Key Points:**

- Community science—new knowledge co-produced by researchers and community members—has the potential to enrich science through broadening our research perspectives, help communities respond to their pressing challenges, increase equitable access to science, and increase the understanding of and support for science in society
- The grammar of science is important; while we currently focus mainly on nouns and verbs (i.e., our results and methods), we need to augment our grammatical treasure chest with prepositions (science "with" society, not "for" or "on"), prefixes (i.e., trans-disciplinary science is different from inter- and multi-disciplinary science), and adverbs describing how we work (e.g., collaboratively)

**Correspondence to:**

K. J. Noone,
kevin.noone@aces.su.se

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**Author Contributions:**

**Conceptualization:** Kevin J. Noone, Jean J. Schensul, Paula R. Buchanan
**Writing – original draft:** Kevin J. Noone, Jean J. Schensul, Paula R. Buchanan
**Writing – review & editing:** Kevin J. Noone, Jean J. Schensul, Paula R. Buchanan



# Augmenting the Grammar of Science—The Community Science Exchange

**Kevin J. Noone[1], Jean J. Schensul[2], and Paula R. Buchanan[3]**

[1]Department of Environmental Science, Stockholm University, Stockholm, Sweden, [2]Institute for Community Research, Hartford, CT, USA, [3]Disaster Resilience Leadership Academy, Tulane University, New Orleans, LA, USA

**Abstract** The expanding field of community science offers the possibility to augment the way science is done, making closer, two-way connections between researchers, communities, and community members. It enriches and improves science through broadening the scope of problem and hypothesis formulation to include practitioners who will use the results of scientific investigation. It enriches the communities involved through access to and participation in scientific investigations aimed at their own challenges. In this article, we describe a new facility—the *Community Science Exchange*—that offers venues for both researchers and community practitioners to publish and share their work to the benefit of both science and communities.

**Plain Language Summary** We are in a new epoch in which society needs to deal with "wicked" problems—such as sustainably producing healthy, nutritious, affordable, and attractive food for everyone on the planet while enhancing ecosystem resilience, dealing with climate change, transforming our energy and transport sectors, and ensuring just and equitable access to resources. Dealing with these sorts of problems challenge the research community to become more connected to society, and to more holistically involve communities and practitioners in the process of science. In this article, we describe a new facility that offers venues for publishing, promoting and rewarding science done with, not for, communities.

## 1. A New Social Contract for Science?

In her Presidential Address as incoming President of the American Association for the Advancement of Science in 1997, Jane Lubchenco threw down the gauntlet to the scientific community. She stated that since the magnitude of human impacts on the ecological systems of our planet has become so large and pervasive, and since there are intimate connections between these systems and things like human health, social and relational wellbeing, the economy, social justice, national security and many others, we need a new social contract for science. In this new contract, scientists would (a) address the most urgent needs of society, in proportion to their importance; (b) communicate their knowledge and understanding widely in order to inform decisions of individuals and institutions; and (c) exercise good judgment, wisdom, and humility (Lubchenco, 1998). While *science* is not explicitly defined in Lubchenco's article, she does hint at an inclusive interpretation of the term by mentioning space, medical, environmental, biogeochemical, and other kinds of research, as well as issues such as social justice, economy and national security. We share this broad interpretation of science.

The response from much of the scientific community at the time was essentially "Meh." Continuing to operate under the paradigm that "Scientific progress on a broad front results from the free play of free intellects, working on subjects of their own choice, in the manner dictated by their curiosity for exploration of the unknown" (Bush, 1945) was more comfortable than re-thinking a social contract.

In the decades since Dr. Lubchenco's speech, the need for a new social contract for science has become even clearer. While the kind of discovery science described in "Science: The Endless Frontier" (Bush, 1945) performs extraordinarily well for certain classes of questions or problems, it is not particularly well aligned with the kinds of "wicked" problems now facing us in the twenty-first century. Wicked problems are ones where we operate with multiple contributing factors, a large number of stakeholders with different views, incomplete or contradictory and rapidly changing information and with connections to many other problems (Churchman, 1967; Kreuter et al., 2004; Peters, 2017; Rittel & Webber, 1973). Issues of justice and equity are very often an integral part of wicked problems because of the power imbalances that can be present when diverse stakeholders interact in framing issues and their solutions. Science has the potential to contribute substantially to addressing these kinds of problems, but often it is either under-utilized or not used at all.

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There are many reasons for this lack of connection between science, societal issues, and solving wicked problems. One is because the current culture of science views maintaining the independence of the scientific endeavor as a primary consideration. Short-term political considerations or the current issue *du jour* should not influence what scientific questions are addressed or how science is performed. Another aspect of our current scientific culture stemming from the "Endless Frontier" report is that science should be left to the professionals; involving stakeholders in framing scientific questions or investigating scientific issues would inevitably decrease the rigor of these activities. A third is the notion that normative issues like justice, equity or values should not influence what kind of scientific questions are addressed or how science is performed. In the currently predominant paradigm, science and society need to coexist, but should be hermetically separated.

## 2. Science in the Twenty-First Century

While the "Endless Frontier" paradigm has produced astounding scientific advances, and even tremendous societal benefit, it is misaligned with too many of the critical issues facing society today. Human-induced climate change is causing increasingly significant negative impacts on society, and the pace of these changes is rapid and increasing. Human influence on the stability and resilience of ecosystems upon which our society and economy are entirely dependent is pervasive, and rapidly increasing. The COVID-19 pandemic has clearly shown the impacts of the kinds of intimate connections between things like ecological systems and human health, the economy, social justice, and national security that Jane Lubchenco wrote about in 1997. Science needs to take a mammoth step forward in terms of contributing to solutions for these wicked problems facing us today.

In recent decades there have been some advances in this direction. As early as the mid-1990s the United States Environmental Protection Agency recognized the importance of multi-stakeholder research and action to address complex environmental and pollution related problems (Johnston, 2010). Anthropologists, Earth scientists, and public health researchers have made significant strides in linking with local populations and indigenous communities around the globe to learn from and address the issues that are arising as a result of climate change. Community Based Participatory Research and Participatory Action Research offer approaches and methods to build partnerships between scientists/scholars and communities to solve local problems often stemming from inequitable distribution of resources and exploitative policies. The practice of *citizen science*, which directly addresses the engagement of scientists and community residents to solve science and community problems, has become sufficiently developed that it now has its own Association and journal (*Citizen Science: Theory and Practice*). Still, we remain a long way from meeting Jane Lubchenko's challenge.

Recognizing this need, six large international scientific societies—the American Anthropological Association (*AAA*), American Geophysical Union (*AGU*), American Meteorological Society (*AMS*), American Public Health Association (*APHA*), Citizen Science Association (*CSA*), and the UninóGeofsicaíMexicana (*UGM*)—have come together to form a new platform for supporting, publishing, and promoting *community science*. Community science starts with community knowledge, ends with community impacts and centers equity and justice. Community science is the equitable collaboration of all forms of science with communities primarily aimed at outcomes for the benefit of communities. Community science partners stakeholders with scientists and other experts to create resilient communities, drawing from science including the social sciences, community values, and local knowledge to solve Anthropocene challenges. It enriches both communities and science. The platform is called the Community Science Exchange.

The new platform includes a journal, *Community Science*, as well as a related *Knowledge Exchange Hub*, a portal for sharing diverse materials connected to community science. The journal will provide a home for open-access, peer-reviewed transdisciplinary research involving community stakeholders that at present may not fit painlessly into more disciplinary-oriented journals. While the journal will focus on research articles and commentaries, the *Knowledge Exchange Hub* will welcome a wide-range of media types including short-form written pieces, teaching and learning materials, videos, blogs, artistic representations, pointers to other content, and—in the future—dynamic discussions among community science stakeholders. *Community Science Exchange* is focused on supporting truly transdisciplinary research work in which multiple scientific disciplines and non-academic stakeholders work together to co-create new solutions-oriented knowledge. The combination of a peer-reviewed journal and a new Knowledge Exchange portal recognizes the need for having outlets that expose and reward both the researchers and stakeholders involved in the work.

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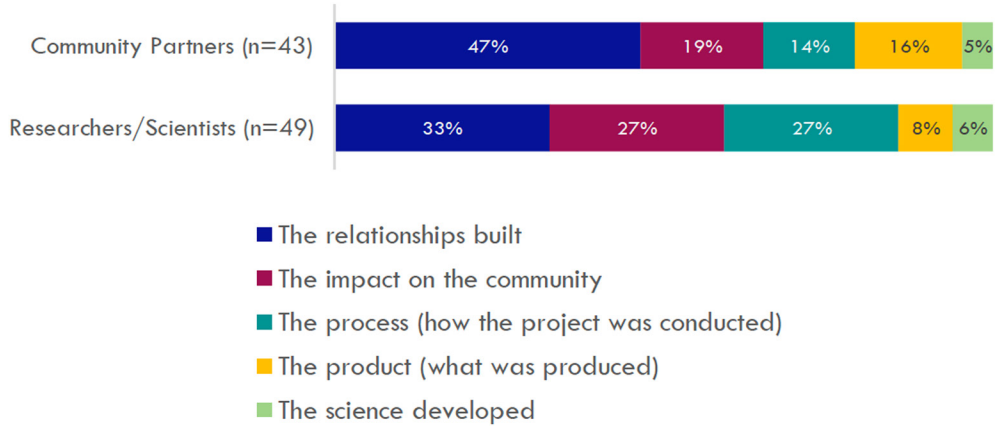


**Figure 1.** Perceived benefits of community science. Figure courtesy of Bolduc and Ristroph (2019).

## 3. Confronting Challenges in Community Science

Buzzwords like "co-creation," "transdisciplinarity," and "solutions science" are appearing increasingly in various strategy documents. While our myriad strategy documents state that we desire co-creative, solutions-oriented research activities that lead to positive societal outcomes, our current reward structure in both the research domain and civil society supports the opposite—working in silos. As Steven Kerr wrote in 1975 in his article "On the Folly of Rewarding A, While Hoping for B" (Kerr, 1975),

> "Nevertheless, numerous examples exist of reward systems that are fouled up in that behaviors which are rewarded are those which the rewarder is trying to discourage, while the behavior he desires is not being rewarded at all."

Unfortunately, progress in better aligning reward structures with desired outcomes has been rather limited in the nearly five decades since Kerr's article was published. *Community Science Exchange* will enhance our reward structure by providing a peer-reviewed academic outlet and a community norms-changing portal through which stakeholders and scientists can use to shine a light on the products and the processes of community science.

At a time when trust in science (and institutions in general) is ebbing across the globe, transdisciplinary community science produces a much needed increase in trust for science in society. In an independent review of 87 community science projects carried out by the Thriving Earth Exchange, 78% of the community participants strongly agreed that "your interactions with your matched scientist-partner(s) were positive," 15% mostly agreed, and none disagreed (Bolduc & Ristroph, 2019). Furthermore, 50% of the community participants strongly agreed with the notion that they were more confident using science after the project, with an additional 33% mostly agreeing with the statement.

Building trust in science (especially in science—hesitant communities) requires establishing trusting relationships between scientists and community partners and stakeholders, from which useful, actionable science results. The aforementioned review shed a light on these central perceived benefits of community science by both the community partners and the researchers, shown in Figure 1.

The greatest benefits were perceived to be the relationships built, the impact on the community, and the process itself. Having structures in place like *Community Science Exchange* that provide incentives for building relationships and having community impacts will help better align the desired outcomes of our work with what is actually rewarded. For both the community and research partners, the "scientific" products produced in the interactions represented only a small fraction of the perceived benefits perhaps because the focus is on the utility of the results.

## 4. Adding to the Grammar of Science

Up to this point, the grammar of science has been essentially been focused on nouns (our results), and to some extent verbs (our methods). While nouns and verbs are critical elements of any grammar, *Community Science Exchange* will augment them by including elements like prepositions, prefixes, adverbs, and conjunctions.

As an example, transdisciplinary community science rests on the preposition "with." Community science research is not done "on," "in," or "for" a community, but "with" the communities. It focuses on and rewards the adverb "collaboratively." Prefixes are very important in community science. *Multi*disciplinary science involves researchers from different disciplines collaborating without significantly integrating their disciplinary methods, *inter*disciplinary science happens when researchers from different disciplines combine methods and data and share a common problem formulation, while *trans*disciplinary science happens when multiple scientific disciplines and non-academic stakeholders work together to co-produce new knowledge (Bark et al., 2016). The *Community Science Exchange* will have a strong focus on the terms "with," "collaborative," and the "*trans*" prefix, which at this point is only sporadically used in our scientific grammar.

## 5. Changing the Culture of Science

In Roman mythology, Janus was the god of transitions. He was well suited to the task, having one face oriented toward the past and one toward the future. One of the sponsors of the *Community Science Exchange*—the *American Geophysical Union*—recently published a new strategic plan. The plan outlines a strategy for transitioning from the century of tradition and expertise *AGU* has developed in support of discovery in *Earth and Space Science*, and plots out a course for the future that would ensure that *AGU*'s science is relevant for twenty-first century challenges. Combining discovery *and* solutions, co-creating new knowledge through sustainable partnerships, promoting inclusion, building trust—all these elements of the plan resonate extremely well with the vision and mission of the *Community Science Exchange*. The conjunction "and" is critically important in this regard; grammar matters. Goal one of the strategic plan is to "Catalyze discovery and solutions to scientific and societal challenges." The word "and" appears twice in this sentence. The need for and value of discovery science and scientific advancement is not diminished in this strategy. Rather, these needs are augmented by the need for and value of solutions to societal challenges.

## 6. The Time Is now

It is not too late for the scientific community to pick up the gauntlet thrown down by Jane Lubchenco in 1997. In fact, there is probably no more timely moment for the research community to rise to the challenge. The truly wicked problems of the Anthropocene cannot be resolved in a post-truth environment. Doing science *with* communities can help move society at large away from alternative facts and back into an evidence-based existence. We look forward to the *Community Science Exchange* being an important element in creating a new social contract for science, and allow science to better contribute to helping solve the "wicked" problems of the twenty-first century. We look forward to your help in generating content for our knowledge hub and journal, and more importantly, solutions to our wicked problems.

## Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

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