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Urban youth and the environmental commons: rejuvenating civic engagement through civic science

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ABSTRACT

Civic-science integrates science knowledge with civic practice but differs from the citizen-science prototype by reframing science as a public good and citizens as both recipients of and actors in policy. We draw from our studies of a civic-science model in which adolescents (majority African-American) collaborate with teachers and community partners to mitigate an environmental problem in their urban community. Based on students' reflections on what they learn from these projects we have developed Environmental Commons theory, referring both to the natural resources on which life depends and the public spaces where people negotiate how they will care for those resources and for the communities they inhabit. We contend that, to solve twenty-first century environmental and climate challenges, it is myopic to rely on elite groups of scientific experts and policymakers. Instead, a civic science skill set should be part of the preparation of younger generations to be informed citizens and youth from urban ethnic minority communities should be a high priority. From an eco-justice standpoint, these groups bear a disproportionate share of the burdens of environmental pollution and climate change yet historically have been marginalized by the institution of science and, until recently, relatively neglected by environmental movements.

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Public education in the U.S. was founded with a mission to prepare younger generations for participation in the civic lives of their society (Civic Mission of Schools 2011). Based on the current state of research on civic education, the most effective way to achieve that goal is for students to engage in actions on issues that are relevant to them (Ballard, Cohen, and Littenberg-Tobias 2016). According to the National Action Civics Collaborative elements of so-called *action civics* programs include youths' collective action, voice/agency, and reflection (Gingold 2013). Insofar as youth are not as knowledgeable or connected to civic life as adults are, scholars also have pointed to the need for intergenerational civic connections (Ballard, Cohen, and Littenberg-Tobias 2016; McIntosh, Hart, and

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Youniss 2007; Zeldin, Christens, and Powers 2013). However, opportunities to engage in action civics practices vary along racial/ethnic and social class lines (Kahne, Chi, and Middaugh 2006).

In this paper we present *civic science* as an action civics model with potential to address these civic opportunity gaps as well as similar gaps in environmental and STEM education. We synthesize results from the past seven years of our research-practice collaboration with the Southeast Michigan Stewardship Coalition (SEMIS), a regional coalition of educators dedicated to place-based education (PBE). SEMIS facilitates partnerships between teachers and adults from community-based organizations who work with classes of students to address environmental problems in their community. In these partnerships students work alongside teachers and community partners as fellow community-scientists. They collect and analyze data on environmental issues, take actions to mitigate problems, and communicate results in public forums. The questions that drive projects relate to local health and safety and often raise issues of environmental justice. Through a series of studies using multiple methods, we have been documenting consistent practices in these projects which, in this paper, we argue reflect core elements of civic science. These elements parallel several of the characteristics identified in Elinor Ostrom's (2012, 2015) work as features of groups that are effective in stewarding their common pool resources.

Our paper begins with a definition of civic science followed by a critique of the narrow framing of the relationship between humans and nature that, historically, has been the foundation for the environmental movement and environmental education. The paradigm of humans in pristine wilderness, apart from cities excludes communities of color and is partly responsible for the underrepresentation of people of color in environmental and STEM (Science, Technology, Engineering, Math) fields. Following that critique, we discuss an alternative ecojustice paradigm led by people of color and based on the intersections of environmental, economic, and health issues in their communities. Building on these intersectional foundations, we then discuss our program of work and the core elements of the civic science model distilled from our studies. We end with a discussion of *Environmental Commons* theory that we have been developing as we analyze students' reflections on what they learn from engaging in the civic science projects.

Civic science

Civic science refers to science as a public good and emphasizes citizens' capacities to use scientific knowledge and methods to make informed decisions for the common good of their community (Bäckstrand 2003; Pykett et al. 2018). Although it fits under the umbrella of citizen science, civic science differs from models where trained scientists crowdsource data collection. Since science is iterative and experts don't have all the answers, such expert driven approaches will not revitalize science for the public good (Garlick and Levine 2017). In civic science citizens define problems, collect and interpret data, propose action steps and policy solutions. The emphasis is on *doing science together* – in collaboration with fellow citizens for the benefit of one's community. Thus, it reframes how we think about the purpose of science and raises fundamental questions about whose knowledge and insights are relevant for civic action and public policy (Dillon, Stevenson, and Wals 2016).

With respect to educating youth, scholars of youth civic engagement contend that the integration of science with civic action is essential preparation that younger generations will need to address twenty-first century challenges (Hart and Youniss 2018). And in light of the disproportionate environmental burdens their communities face and their marginalization from the institution of science (Bang et al. 2012), students of color should be top of that agenda. In fact, there are particular benefits of civic science for youth whose scientific insights have been ignored and whose voices have been muted in conventional educational practice. Consistent with culturally responsive teaching practices (Aronson and Laughter 2016; Ladson-Billings 2014), students' voices and the contributions they make to their community count in civic science work. Likewise, as in place-based education (Smith and Sobel 2010; Theobald 2006), the local community figures: (a) as a source of knowledge that informs students' insights and (b) as a society to which students belong and contribute. Students are not just studying but are *doing* science and using it to make a palpable contribution to their community. The focus on urban youth of color engaging in environmental work also augments the possibilities for environmental education to focus on human-nature relationships in urban ecologies and expands the meaning of and routes to developing an environmental identity (Gallay, Pykett, and Flanagan 2021).

Historical foundations of the U.S. environmental movement

The U.S. environmental movement was based on a settler-colonial narrative of domination, both of nature and people (Purdy 2015a; Martusewicz, Edmundson, and Lupinacci 2015). During the late nineteenth and early twentieth centuries, lawmakers defined the legitimate uses of nature in what became known as the conservation movement, effectively enclosing what had been a shared commons. Native Americans were forcibly removed from their ancestral lands and access to 'wild spaces' was restricted to the privileged few (Purdy 2015b). Later, even landmark environmental legislation such as the *Clean Air* and *Clean Water Acts*, lauded by environmental groups, were not written with vulnerable populations in mind (Purdy 2015b).

What are the consequences of this legacy today? For one, the dominant picture of primarily White middle-class people communing with nature apart from urban spaces constrains our ideas about the groups of people who care about the natural environment and could be mobilized to sustain it (Finney 2014). Potential solutions to environmental problems also suffer from a kind of myopia such as environmental education focused primarily on individual acts of conservation. Although critical, changes in conservation and consumption are insufficient and have allowed the fossil fuel industry to greenwash its image but do nothing to curb its own impact. For example, the petrochemical giant BP, the first to promote the idea of an individual's 'carbon footprint' (Doyle 2010) was so successful that carbon footprint calculators are now common in environmental education, despite the fact that everyone living in the fossil-fuel powered U.S. has an unsustainable footprint (Chandler 2008).

Environmental education

The dominant paradigm in environmental education also has emphasized nature as wilderness apart from the city. Scholars have criticized these reductionist and White

representations and called for a re-imagining of Black space in environmental education that would respond to the uneven inheritances and increasingly uncertain ecological futures that children of color experience (Nxumalo and ross 2019). In general, students of color, especially in low-income communities, have not been at the forefront of environmental education, despite the disproportionate environmental burdens their communities bear with brownfields and toxic manufacturing typically located in low-income communities (Commission on Racial Justice 1987; Taylor 2014). And, although contact with nature promotes human health, lower income communities are less likely to have access to clean/safe outdoor space, more likely to experience food deserts, heat islands, and flooding and to suffer from asthma, diabetes, and lead poisoning. These inequities result from political choices. For example, organizing efforts in Detroit, Michigan show how high rates of asthma are related to the political decision to locate large trash incinerators in those communities (Gallay 2016).

There are some signs of progress in current policy: Senator Heinrich's bill to improve access to natural spaces for underserved youth nationwide (Thompson 2021) would not only expand the health-promoting benefits of nature but would open new possibilities for place-based environmental education in low-income communities. Signs of change also can be seen in the increased awareness and political pivots of prominent 'big green' environmental organizations. In response to the Black Lives Matter movement, most have made public statements about policy changes and, in some cases, such as the Sierra Club, a frank reckoning with their racist past. Perhaps the most wide-reaching recent change is the fact that the Biden Administration has put environmental justice at the forefront of policy, promising to consider it in all decision-making and to direct 40 percent of environment – and climate-related federal investments to communities that have borne the brunt of past environmental harms (Hersher 2021).

Environmental justice work

While not prominent in media narratives, there is a long history of people of color in the U.S. engaged with nature (Chesney 2007; Smith 2007) and leading environmental justice work (Bullard and Johnson 2000). In the late 1970s, environmental justice emerged in the U.S. as a response to environmental racism, particularly around toxic waste and pollution. People of color and Indigenous groups have continued to fight for environmental justice in local communities, sovereign tribal lands, and at the systemic level (Bullard 1993; Copeny 2018; Ducre 2018). As one example, The First National People of Color Environmental Leadership Summit in 1991 brought together people working for environmental justice (Bullard and Johnson 2000). Delegates adopted 17 principles to guide the movement including: recognizing the interdependence of all living things and the rights to be free from ecological destruction; rights of all human communities to resources that enable them to participate in environmental decision-making; responsibilities for education in order to ensure a healthy planet for future generations.

Contemporary movements and studies point to the salience of environmental justice as a political issue for people of color. Surveys show that, compared to their White counterparts, African American and Latinx respondents, are more concerned about environmental issues and more willing to convince elected officials to take action (Leiserowitz et al. 2019). And, as Quiroz-Martinez, Pei Wu, and Zimmerman (2005) point out,

when ethnic minority youth engage in environmental action, they are often motivated by an awareness of the intersections of class and racial inequities in environmental and human health. In fact, it is young people who have developed the new term *intersectional environmentalism,* asserting that their generation brings a new viewpoint to what the environment is and who can be an environmentalist (Oglesby 2021). To illustrate the kinds of environmental education that is responsive to the lived experiences of urban youth of color, we turn now to our studies of civic science projects in urban schools.

Urban youth and the environmental commons

As noted, for the past seven years we have engaged in a research-practice partnership with the Southeast Michigan Stewardship (SEMIS) Coalition. With respect to our study sites, all projects take place in urban schools in southeast Michigan where over half of the state's population resides. Like other parts of the Industrial Heartland of the U.S., this region has been impacted by economic restructuring, deindustrialization, globalization, white flight, and the cumulative concentration of poverty. For over a decade the SEMIS has recruited teachers and adult community partners to engage students in learning about and acting to mitigate local environmental problems. Although the coalition includes teachers from any discipline and grade level, our studies have focused primarily on 4th–12th grade students in science and math classes. Further, although schools serving middle-class, White students are part of the coalition, our studies have focused on schools serving students in working-class and lower-income communities of color. Nearly 80% of the students in our studies identify as African American or Latinx and 14% of mixed race/ethnicity; 55% are female, 45% male. Quotes in this paper are primarily from high school (ages 15–18) and middle school students (ages 12–14) with a few from upper elementary students (ages 9–11).

We have used multiple methods to understand the content of projects, group dynamics within them, and outcomes for students. Methods have included classroom and field-based observations, interviews with teachers and community partners, pre–post surveys of students prior to and after engaging in projects, focus groups, and short reflective essays about what students learned in projects. In this paper we have drawn from interviews with community partners and students' short essay responses to an open-ended prompt (that varied slightly from year to year): 'What did you learn in your stewardship project?' and 'Was there anything you learned in the project that you could use to help your community (or people in your community)?' In analyzing students' responses, we employed an iterative process of deductive and inductive coding to identify emergent themes (See Flanagan et al. 2019 for additional details).

Core program elements of the civic science model

Place-based

First is the focus on the local community or *place* as implied in the acronym, place-based stewardship education, PBSE. In contrast to a view of nature as a pristine landscape apart from the city, these projects emphasize the interdependent relationships of humans and natural and built systems in the city as well as the civic potential of local residents

(including youth) to improve their urban ecologies. As in any model of place-based education, the local community is understood as a place from which students draw knowledge as well as a place of membership and belonging to which students contribute. Consequently, the questions that drive investigations are not drawn from textbooks but rather from the health and safety issues that affect everyday life in their community. And issues of environmental injustice come to the fore when students are encouraged to share what they witness. For example, one student observed,

> … when you on the freeway [there's] big signs for McDonalds & stuff. When you get there – [city boundary] then its smaller stuff. I want to know why ours are so much bigger. They're trying to get us to spend all our money on food. I don't know why. I want to know why.

Another noted, 'I observed that we don't have grocery stores like the stores in the suburbs. [They] also don't sale things they would in suburban area' (high school student).[1]

Students' knowledge of the issues that family members or neighbors face is relevant both to the definition of issues and solutions they imagine. For example, projects on local air quality were motivated by students' knowledge of friends and neighbors who suffer from asthma (a common health problem in poor urban areas). Daily measures of air quality and posting public alerts was a project chosen by one middle-school, as these students described:

> Something that could help the community is the PurpleAir quality chart. Mostly because then people in the neighborhood can know how the air quality is outside. Helping those in need of this information; those with asthma and other lung problems. This helps them know when it's dangerous to go outside and not breathe the outside air.

Another middle-schooler went further, linking people's health and air quality to the polluting practices of local industries:

> The air quality sensors are a good way to help the people in the community understand what the air quality is like here and the problems it can cause. I think that part of the problem with companies getting away with releasing [pollutants] into the air is people not knowing how this can affect them and what they can do about it.

Validating such concerns and respecting the insights and knowledge students bring to both the study and solution of environmental problems highlights what scholars have called a sense of *rightful presence* for students of color who all too often feel that they don't belong or have no role in science (Calabrese Barton and Tan 2019).

A focus on the local community also means that students can regularly monitor environmental changes and the impacts of their projects. For example, several rain garden and bioswale projects were motivated by students' awareness of urban flooding – on school grounds and in neighbors' basements. One reported

> The things we did in the community, I check up on it every time I leave school. The community is doing good people basements are not flooding no more. There are no more [floods] of water in front of peoples houses no more. So what we did for the community really worked. I thought at first it was not going to work but now I see it working. (high school student)

It is important to underscore the role of adult community partners in these projects. They are recruited from local government, non-government community-based organizations, and the private sector. Insofar as they work *alongside youth as fellow citizens,*

power asymmetries between adults and youth are minimized. The coalition also has been quite intentional in seeking partners who not only reflect the racial/ethnic backgrounds of the students but also are aware of the environmental injustices that their communities face. To illustrate we draw from the following self-description by a community partner who works for an urban community development and sustainability organization: 'I see myself not as an environmentalist but someone who supports social justice but happens to do that with a green lens'. Her approach reflects an intimate understanding of how poor urban residents' lack of economic and political clout impacts basic conditions of environmental and human health and how climate change is exacerbating those inequalities. Paraphrasing her comments, she shows with stark images how municipal water shut offs (a policy impacting residents of many urban areas in the United States) are connected to climate change:

> Consider a city with a combined-sewer overflow system. Every time there is a big storm, which happens more frequently due to climate change, the sewers overflow, flooding the streets and people's basements with raw sewage. Because fixing the infrastructure causing the problem takes money, the very people affected who pay city taxes will see an increase in their water bills. The end result is that city residents have flooded basements at the same time that they have their water shut off because they can no longer pay their water bills. (See also Dingell and Tlaib 2021, S.E. Michigan's Congressional Representatives, for a discussion of how pervasive municipal water shutoffs are and their critique of such practices especially during a pandemic)

Community contributions

Besides the knowledge of their communities that students bring to projects, they also use what they have learned to contribute to those communities. One student shared,

> The work I did in learning about community gardens was important because it was brought to my attention how much of a food desert our city is and how creating something like a community garden can combat it. Through this learning [experience] I learned that fresh (healthy) produce isn't something [city] is known for or even remotely close to something like that, and how there are few organizations that have already implemented their strategies to [combat] the food desert within [city]. (high school student)

The sense of collective agency that students gain through their civic contributions may be especially empowering for youth in urban areas who have been marginalized from the mainstream. As one high-school student said that he learned from participating in a community mural project honoring past generations of local African-Americans: 'The mural brought everyone together. Once there's togetherness, there's power. Once there's power, there's change, once there's change, there's evolution'. A student from another project said: 'Yes, I learned that you should use your voice in order to do what's right. When a company is compromising the health of others, it becomes a problem. Use your voice. Pull up information to back up your claim and don't give up to do right' (middle school student).

Students' reflections on what they learned were replete with such examples of speaking up and taking a stand. In light of the stereotypes about their communities that have dominated in media, we suggest that participating in these projects offers an opportunity to challenge negative narratives and reclaim their community's identity (Ginwright and Cammarota 2007). In the following, the first student points to a change in the public's

perceptions of youth from the local high school after the students finished their public mural project:

> It's almost like a transformation how even just being a kid going to [this high school], who has a certain kind of reputation, like I don't know how we got it but we were just, you know, they're from [this city], there must be something wrong over there, but um, and now we got in the community and they see us like, 'Oh! These are the kids from [city]. These golden kids that help paint a mural, they go out to work out there. They are really involved'. I like that feeling. It like erases all of the bad feelings and everything and all the bad vibes and it's just replaced with all these great vibes. (high school student)

The second student links improvements in the community to his own decision to be an agent of change:

> It was important for me to work and be a member of the [environmental group] because it helped me believe in my community. At first I really didn't care about my surrounding but working with the [group] made me realize I need to do something about it. … Also my community changed [a lot] because it looked better than it was before I started being in the community. (high school student)

These students are echoing what scholars of place-based education contend should be the purpose of education, i.e. to teach young people how to re-inhabit communities, to restore their relationships to other people and to the land (Gruenewald and Smith 2008).

Teamwork

Across generations or within peer groups – is the third core element. Whereas mainstream conservation arguments have typically relied on personal responsibility as the mechanism for saving the planet, the team orientation of these civic science projects sends a message that 'we're all in this together' as illustrated in the following students' quotes: 'I learned to collaborate with your community cause they have a say in it too' (high school student). In response to what it would take to address an environmental issue in her community, another high-school student noted: 'It takes teamwork. Teamwork from your community, your peers, your families: teamwork makes the dream work'.

Bear in mind that these are teenagers who are still determining the groups with whom they identify, the values they want to live by, and the purpose for their lives going forward. Thus, there is a benefit of the team format with respect to nurturing their environmental identities. According to social movement theorists, to mobilize a broad and dedicated environmental movement, we need constituents who identify with the large goals of environmentalism (Hahn and Barnett-Loro 2019). Toward that end, every effort should be made to connect youth with organizations dedicated to environmental work where they can get to know people from other generations who share their goals. Based on our observations of the teamwork in their projects, we believe that students are developing the kinds of skills that are needed for working with others, even those with whom they might disagree, toward a common purpose. In their own words, students showed that they were aware of group processes at play in their projects:

> Like if you have something that you want to get done, so and you just want people to like come together, you gotta get the people that you don't like or you don't get along with

> to participate because it can make a difference and like, so I want to give an example because that was what I went through but people just coming together and the people that you don't like can have an effect on the thing you're trying to accomplish. (high school student)

And another:

> Of course being in a group or a team you don't like all the people at first you're going to have some issues, some problems, some obstacles but you know at the end of the day you're all trying to do one thing, that's make this school, this environment you know better so you know you better kick your problems to the side and get your stuff done. (high school student)

In contrast with a liberal or thin version of democracy that stresses the rights of citizens to live independent lives, to determine *on their own* how they want to live, these quotes reflect what the philosopher, Michael Sandel (1996) refers to as a republican interpretation of liberty which holds that citizens can only guarantee their liberty by participating in communities where they deliberate with others.

Public presentations

The final core element of these civic science projects concerns various ways in which the youth present their work in public. As noted in earlier quotes, several classes painted public murals of past civic leaders on the barber shops and beauty salons in their town. For other projects, permanent signage has been installed – at the public park or the entrance to a trail, or next to a rain garden at a school – recognizing the work and the legacy left by the teams of students whose efforts resulted in these community contributions. These placards recognize the class of students, the school they attended and their year of graduation and serve a role similar to the signage in state and national parks in the U.S., commemorating the work of the Civilian Conservation Corps during the presidency of FDR.

A final form of public presentation is the annual end of year forum in which students present to parents, teachers, community members, and fellow students from different schools. Their reflections on the day suggest that the event nurtures an awareness that their projects and work are part of a larger collective environmental effort. As students put it: 'Coming together from different schools like this makes me feel like that everyone can work together and really take things to another level' (high school student). Another described the experience as 'empowering, knowing that even though we're children, there are people out there willing to listen to us, and respect our opinion' (upper elementary student), and another, 'I really enjoyed spreading info about the work I was able to do. To create exponential change with a group across cities and building bonds, new stories, and exchanging these experiences meant a lot. Felt like I learned, felt like I taught, networked' (high school student).

Some student teams present their work in other public venues: at local events organized by NGOs, to elected municipal or county officials. In projects that included advocacy efforts, students see their influence on policy and practice and their capacities to influence those in power. They recognize the importance of having a voice in their community, in order to create change, as illustrated by these middle-schoolers who commented, 'speaking up can really stop things. Such as the incinerator closing down. It [took] a long time, but it finally shut down' and another who wrote, 'I learned that if there is a problem,

speaking up about it can go a long way, with this knowledge and enough people on my side, I would have the potential to tackle some big issues'.

Public presentations also take place within the school, with a variety of stakeholder audiences, including professionals in fields related to the students' projects (students presenting about their rain garden to landscape architects and environmental engineers), those directly affected by the projects (students advocating for green roofs to school district facilities supervisors) and even to their families, to showcase their learning and the benefits of using environmental science to help their communities. One student mentioned: 'I applied what I learned to influence the grounds keepers at my school, and presented a PowerPoint on the benefits the trees would give' (high school student).

The team action to improve the community's environment at the core of these projects is a form of civic engagement that may continue into adulthood. National longitudinal studies indicate that compared to other forms of extracurricular activities, involvement in community service, political action, and public performance in adolescence predicts voting, volunteering, and joining community organizations in adulthood (McFarland and Thomas 2006). The authors point to the *public* quality of these activities, echoing Arendt's discussion of the public realm – where one's activities gain meaning because they are seen and heard by everyone. Arendt (1958) provides several mechanisms whereby activity in the public realm may nurture a commitment to the environmental commons. First, insofar as the public realm is the common world that gathers people together, activity in that realm helps people to realize their personal stake in the common good and motivates them to act in the interests of the whole. Second, the inclusive nature of the public realm should expand ideas about the 'others' who are part of one's community as well as the range of potential solutions to public problems. Although people will choose different ways to live their private lives, it is in the public realm that a wide range of beliefs on how best to live together in a civil society can be aired.

With respect to tackling the environmental issues they will face as adults, these youth are becoming aware that they are part of a movement with a larger purpose, that, with respect to meeting environmental challenges, they are not alone. In contrast to the individual conservation behavior approach, these young people should have more confidence that by working together they can manage the climate crisis. This is critical insofar as research on climate change has shown that individuals have a low sense of personal efficacy, given the magnitude of the problem (Kerr and Kaufman-Gilliland 1997; Pickard, Bowman, and Arya 2020). However, leveraging the social context in which people make decisions and emphasizing the power of the group to effect change is a more effective strategy (Roser-Renouf et al. 2014). In short, when they identify with the group and its shared goal people can be hopeful that their actions will achieve change.

Environmental Commons theory

Based on analyses of what students say they learn from participating in the civic science projects, we have been developing theory about the *Environmental Commons* which refers to: (a) the natural resources on which life depends (water, land, air) and (b) the public spaces (schools, town halls, Internet) where people determine together how to care for those resources and for the communities they inhabit (Bowers 2006). The term,

commons, is intentionally used to refer both to people's rights to resources and responsibilities to steward them.

Our theory also has been motivated by the work of Elinor Ostrom, who contested the so-called, 'Tragedy of the Commons' which held that ordinary people lack the capacity and rights to govern their common resources (Hardin 1968). Hardin used environmental sustainability arguments to justify racial discrimination and anti-immigration policies (McClennen 2019) which he embraced, including forced sterilization of women to reduce population, arguments against efforts to provide food to those in poverty, anti-immigration, and beliefs that certain groups had lower intelligence (Janssen et al. 2019). Notably, Hardin's 1968 paper remains one of the most assigned readings in environmental studies courses, sometimes presented without context or existing empirical work that refutes his claims (Janssen et al. 2019). Through their empirical studies Ostrom and her colleagues challenged both the thesis of the tragedy and the implications for democracy, i.e. that citizens should be passive observers in the design and implementation of public policy. Assuming that ordinary people would destroy their natural resources also ignores the evidence: Throughout the world community groups regularly engage in collective decision-making to sustain what Ostrom (2012, 2015) called, their *common pool resources* (CPRs), i.e. rivers, fisheries, forests, that provide benefits to everyone but can be depleted if abused.

We have used Ostrom's work as a lens for observing students' civic science projects and, while all of the elements for managing a commons don't apply, we point to three aspects of community groups that make them effective in stewarding CPRs and the parallel practices in civic science projects: (1) proximity to/knowledge of the CPR; (2) strength of members' identification with the group and its goal of preserving the CPR; and (3) group dynamics including mutual respect, responsibility and communication that enable members to know one another and build trust (Cardenas and Ostrom 2006). Concerning proximity, students' attention is drawn to the natural environment as it is affected by humans and policies in the *local place* where they live. Identification with the group and its goal is emphasized via the team structure of projects: not only do students work in peer teams, whole classes also partner with adults from community-based organizations. Finally, teams work over the course of a school year with reflective activities designed to build group dynamics – mutual respect, communication, shared responsibility, and trust.

Key differences between Ostrom's work and ours center on the stage in life and stakeholder status of the participants. Whereas most of Ostrom's studies focus on adults with a vested interest in preserving their CPRs, the adolescents in our studies are in a formative period, still determining the groups to which they belong and the issues in which they have a stake. For many, these civic science projects are the first time that they have focused on nature in their urban space and many come away from projects committed to the rights of all species to the natural resources that sustain life (Flanagan et al. 2019). The formative stage of youth also is relevant for the skills and identities they are forming. When reflecting on what they learned in projects, youth list civic skills (listening, respecting, negotiating) and the civic identities they are developing around shared goals of environmental stewardship and community contribution (Flanagan et al. 2019). The intergenerational teams with CBO partners also build awareness of organizations and adults committed to the environment and the community with whom they can continue

to network. Finally, it is important to point out that youth in general and youth from minoritized backgrounds in particular are not accustomed to having a voice in community affairs. The internal efficacy they gain and the external efficacy from public recognition of their work should motivate continued civic engagement work.

There are implications of our work for two current policy discussions. The first is President Biden's 'Build Back Better' agenda that connects plans for a renewable energy non fossil fuel economy to well-paying skilled and semi-skilled occupations. A recent Brookings policy brief spells out the potential of Biden's agenda not only to address the climate crisis but what the authors refer to as 'the nation's unacceptable opportunity divides' (Muro, Kane, and Tomer 2021). They conclude that 'in their variety, pay, and relative accessibility, clean energy jobs can advance equity and economic inclusion' due to the fact that almost half of those jobs do not require a college degree. Build Back Better policy is especially relevant for younger generations who are still imagining the kind of work they might do. Many in working-class and lower-income communities will not continue their education beyond high-school and for those in career and technical education, training for remunerative jobs in clean energy should be very attractive. At the same time, the fact that these jobs require more STEM-related skills and environmental awareness makes the civic science model outlined in this paper all the more relevant for educating future generations.

The focus in the civic science work on youths' insights, voices, and actions also is relevant for the COP26 agenda. Young people have been taking advantage of NGO (YOUNGO, the official youth constituency of the United Nations Framework Convention on Climate Change, UNFCC) and platforms (Youth Climate Action) to get their message out and to build a broad constituency. In his address to the General Assembly, U.N. Secretary-General António Guterres articulated the frustrations of youth who do not feel heard by their governments and announced the creation of a new U.N. Youth Office (focused on ages 15–29) to bridge the generational divide (Ho 2021). Yet the official Parties to the Paris Agreement maintain the power in multilateral negotiations which ultimately will set the climate change goals. Such elite policy making stands in contrast to Environmental Commons theory and effective civic science strategies for sustaining the environment – namely dedicated groups in close proximity to the issue with the biggest stake in getting the solutions right. It is hard to imagine a more critical environmental commons issue than the climate crisis nor a group of stakeholders whose lives will be more impacted than youth.

Conclusion

In this paper, we start from the premise that those who experience the most harm from environmental issues should have the most say in the policies, programs and practices that seek to address those issues. In the United States, people of color and those in low-income areas bear much of this burden due to political decisions to locate toxic operations in their communities and to disinvestments in public infrastructure (e.g. municipal water systems, dams and levees, etc.) that impact environmental and human health. Although historically mainstream environmental organizations conceived of nature apart from the urban ecology, we argue that, to grow the environmental movement, more attention should be paid to the ways that youth experience the natural

environment in urban ecologies. Mainstream environmental organizations have focused disproportionately on protecting pristine wild spaces away from the communities experiencing significant harms from environmental degradation and have emphasized individual conservation behaviors. In a similar vein, traditional environmental education has focused on having young people experience 'nature' and learn in spaces away from cities, and on individuals adopting sustainable lifestyles.

While we are not arguing that conservation and individual behavior are unimportant in addressing climate change and mitigating environmental harm, we do argue for reimagined environmental movements, organizations, and education that center environmental justice and draw upon the rich history of people of color- and Indigenous-led environmental work, knowledge, and experiences. This shifting is important from a justice standpoint, but it is also critical for growing an environmental movement that can address the collective climate threats we face. As noted, there are examples of these shifts – in policy agendas, mainstream environmental organizations, and people of color and Indigenous environmental groups grounded in different narratives as they engage in environmental justice work. It is the younger generation whose lives will be profoundly impacted by the climate crisis. With that in mind, we have advocated for a place-based, civic science model that centers young people in urban communities and engages them as constituencies in environmental justice movements. Drawing from and contributing to emergent environmental commons theory, the four core elements of the model are: place-based focus, civic science community contribution, team or collective effort, and public presentations.

Students participating in these projects show how place based civic science learning and action for the environmental commons raises basic questions about justice in terms of the access, availability and use of natural systems and areas, unequal contributions to environmental degradation, and the burdens of the impact of human lifestyles. Consistent with a social justice framing of environmental issues, student responses point to an understanding of the intimate links between health, well-being, and relationships in a local area and stewardship of the commons that people in that area share. Perhaps even more importantly, the model provides an opportunity for young people to learn, practice and take action on environmental issues that affect the people and places in their own lives and do this collectively, alongside other youth and adults in their communities. In light of the history of environmental racism and the pressing need to address climate change, civic science is a means whereby young people can observe and monitor environmental conditions in their local place, insist on their rights to nature, and use both science and their voices to reclaim the narratives about their communities.

Note

1. Other than school level, descriptive information is withheld to insure individuals' anonymity. Demographic information is provided in the description of the sample.

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