“Science That Matters”
Teaching Science With a Commitment to Community

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The Next Generation Science Standards (NGSS Lead States 2013) require middle school science teachers to provide connected and meaningful engagement with science ideas and practices. These standards challenge educators to think about how the middle school science curriculum matters to the current and future lives of all students in ways that connect to both potential career aspirations and their future experiences as citizens. Despite understanding that this is an important goal, the question remains: How do we achieve this?

In this article, we describe our work with middle grade students (and their teachers) in both afterschool and classroom science learning experiences. Our goals are for students to see science as consequential to their lives as well as how their existing expertise and knowledge of their communities can be important to learning science and taking action.

The middle school youth we worked with over time have something to contribute to the conversation about connected and meaningful science learning through a term they coined: “science that matters.” Science that matters occurs when youth have opportunities to bridge their science knowledge/practices with a commitment to their community. As one youth, Caitlyn, expressed: “We talk about a lot of stuff in school, but we never consider how it matters here.” Instead of science presented as decontextualized from where they live and who they care about, science presented with a commitment to community involves using the knowledge and practices of science to make a difference through taking action on a community-related phenomenon. This is more than grounding an investigation in an area of interest to youth or a familiar place. As we describe next, it means experiences of youth in their community are central to the investigation in ways that engage community members toward real and consequential action-taking on issues that matter.

These definitions of science that matters by youth hold potential to impact science learning experiences in classrooms (Birmingham et al. 2017). However, we found that a vital voice when determining what these experiences might look like is often missing—that of students. The inclusion of youths’ voice is vital to defining, designing, and enacting meaningful science learning opportunities. The voices of those who are often marginalized in science (females, youth of color, youth from low-income backgrounds) are especially important to consider as they work to navigate barriers that often prevent their full participation (Bang et al. 2016).

In this article, we introduce a framework for bringing science with a commitment to community into middle school science classrooms. We follow with an example from a partner teacher’s science classroom that highlights this framework in a classroom context.
Framework for science with a commitment to community teaching

Science with a commitment to community involves teaching science in ways that:

- are contextualized to issues or phenomenon present in local communities,
- involve action-taking to improve local conditions, and
- engage community members in local science-related issues through youth-designed, youth-led experiences.

This stance reflects science learning as vital to the present lives of students and their communities, as well as the long-term efforts to develop knowledge and practices over time that are necessary for future endeavors. The youth we work with want to see how what they are learning matters to where they live. They want to be able to share that with others in their community in ways that can lead to making a difference.

Working with these youth, we have identified pedagogical practices that support bringing similar learning experiences into your classroom, as well as the intended outcomes of these types of experiences.

**Pedagogical practice #1: Recognize and legitimize youth expertise, experience, and wonders.** For science to be authentically bridged with community, teachers must understand that their students bring a wealth of expertise with them to the classroom that is integral to the learning process. What youth know about their community can serve as:

- a drive to understand science concepts and practices to impact their community in positive ways, and
- a catalyst to shift what types of knowledge and practice are central to participating and taking action with science.

Teachers can offer opportunities for students to share their experiences through class discussions, surveys, or activities that are intended to not only elicit student experience, but also serve as a foundation for investigation and intended actions. A few examples of issues our students have shared with us include worries over a school budget crisis (investigated through an energy audit), access to healthy food (addressed through GIS community mapping activity and engineering hanging gardens), concerns about a lack of “fun” in school (addressed through designing a light-up limbo stick and a social contract for when and how it could be used to increase fun during the day), and the need for a safe space for area teens to hang out (examined with LEED/green building design solutions). A key idea here is for teachers to not only provide space for sharing areas of expertise, but also position those areas of expertise as important to how the class proceeds with their investigation.

**Pedagogical practice #2: Sharing power between teacher and students.** Making science relevant for students is often something that youth have little say in. While educators might be well-intentioned, the design of the curriculum often leaves teachers deciding what is meaningful to the lives of their students. The youth we work with propose to incorporate student voice/experience through their inclusion in conversations and/or activities around the questions as a regular part of instruction. What issues or phenomenon are important in our community? How do we address those issues? What do we need to know and be able to do to take action? How can we communicate what we know? These conversations can take place as a part of classroom dialogues, with small groups of students during “lunch time with teacher,” or other free times during the school day.

**Pedagogical practice #3: Opportunities for action-taking embedded in the learning processes.** School knowledge is often understood by students as disconnected from where they live,
which results in difficulty transferring what they learn in school to other contexts. The youth we worked with pointed this idea out urgently and repeatedly. Learning needed to extend beyond academic goals, as they wanted to translate their new understandings into practical actions that improved the lives of those around them. In response, science with a commitment to community has action-taking as a central part of the learning process. As experts of their communities, youth are often best positioned to know where or why certain actions might matter, but they may not know how to effectively leverage science to take action. Teachers, through drawing on their pedagogical and disciplinary expertise, can work with youth to co-define what these actions could be with the understanding that actions can range in size and impact—from addressing issues in school to others in the community. Examples of action-taking include using knowledge of sustainable communities to design classroom projects to promote positive classroom morale, youth co-producing raps to be shared with community members on how to support biodiversity in their backyards, and youth designing a community “green carnival” to showcase investigations into renewable sources of energy focused on both environmental and economic factors.

Outcome #1: More equitable learning opportunities. Youth of color and youth from low-income backgrounds often experience science as outsiders because of the ways the discipline has traditionally marginalized their existing culture, expertise, and experiences (Bang et al. 2012). As educators work toward valuing and legitimizing what these youth bring to classroom learning experiences and share power with their students, youth have more equitable opportunities to participate in science in ways that are inclusive of who they are and what they care about. These learning experiences can result in students seeing experiences, areas of expertise, and their cultures as assets when learning and doing science, resulting in the development of productive science identities for traditionally marginalized students. For example, youth coined the term “community science expert” to capture how they saw themselves when they were able to bridge science and community knowledge to solve problems they cared about.

Outcome #2: Expanded ideas of representing and communicating science learning. Through participating in more equitable learning experiences connected to their community, youth begin to see how science learning in school moves across the contexts of their lives, including their schools and the places in their community that matter to them. These types of learning experiences can reveal for students that science knowledge and practices can be represented and communicated in ways that extend beyond standard school measures (tests, quizzes). Instead, youth can show their understandings and abilities in connection to the action they take in their community. Figure 1 includes planning considerations to assist teachers in implementing this framework into their classrooms. We share an example of how one partner teacher used the science with a commitment to community framework to provide opportunities for her students to take action on issues that were important to them.

The Bank of Compliments

In a unit focused on developing engineering design practices, Ms. L challenged her students to engineer a design that would foster a “happy and healthy classroom environment,” drawing on what they had learned about energy transformations and sources, circuits, and sustainable communities, and using reusable materials from their classroom. Ms. L sought to learn more about students’ and their families’ expertise by helping them to design, administer, and analyze survey and interview data from the school community about classroom/school concerns that mattered to them (PP#1—valuing community voice). For a 5E design that includes teaching considerations during implementation, see 5E Lesson in
**FIGURE 1:** Science that matters planning and implementation ideas.

<table>
<thead>
<tr>
<th>Science that matters</th>
<th>Planning considerations</th>
<th>Potential teaching strategies</th>
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| Contextualized to issues or phenomenon in community | • What issues, questions, or concerns do my students have about their community?  
• What experiences in their community matter most to them?  
What aspects of their community are they most proud of or concerned about?  
• Have I planned activities that allow students to bring in their insider knowledge about their community? How will I recognize and value that knowledge?  
• What are the connections between the science I am teaching and my students’ experiences in the community? | • Science talk focused on eliciting student ideas about issues related to their community  
• Student–created community survey based on brainstormed issues  
• Interview activity where students create interview protocol and talk to three people in their community  
• Science notebook writing prompts meant to elicit ideas in connection to planning consideration questions |
| Involves action-taking to improve location conditions | • What kinds of action-taking are reasonable and possible in my classroom/school?  
• What kinds of action-taking build on students’ expert knowledge of their communities?  
• What kinds of action-taking align with the goals my students hope to achieve? | • Action-taking brainstorm activity where students explore and map potential actions in relation to stated goals  
• Peer review of planned action  
• Conferencing with project groups to talk through potential benefits and drawbacks of proposed action |
| Engages community members | • Have I asked my students who in their communities may know something about the topic we are investigating?  
• Have I planned for activities that might involve parents and community members in my classroom?  
• Have we as a class considered multiple and diverse community groups to include?  
• Have I sent an informational letter to parents soliciting their ideas, input, and participation? | • KWL chart to determine understanding of audience and their engagement with science ideas  
• Student–created letters [and invitations if applicable] explaining their projects to determined audience  
• Student–created community survey based on brainstormed issues  
• Student created event to communicate learning to their intended community audience |
Online Supplemental Materials.

From the data, one group of three girls identified bullying as an issue affecting many. They highlighted data indicating peer-to-peer bullying affected classroom morale. All three girls had a past history of bullying each other. Ms. L. agreed this was a powerful interpretation of their findings, encouraging the girls to consider how an engineering design might both heighten awareness and offer solutions to the bullying problem (PP #2—sharing power). Furthermore, bullying in K–12 schooling is most prevalent at the middle grades, and students from marginalized groups are most at risk, with significant negative physical and mental consequences (Hicks et al. 2018).

The girls leveraged their STEM and community expertise to take action on bullying (PP#3—action-taking). They designed and built the Bank of Compliments—a shoe box decorated with encouraging phrases that featured four LED lights in a parallel circuit powered by a handcrank generator and was filled with over 20 different compliments including “Your heart is filled with wonder” and “You shine bright like a diamond.” They described their innovation:

Our invention solves the problem we identified by making our peers feel good with compliments. Students can reach into the top of the box and get a compliment. They light up the box if they like the compliment they have. We used a parallel circuit to power four lights. Our energy source is a hand crank. Students can light up the box by turning the hand crank, transferring the energy to the LEDs.

While the school had a bullying reporting system, the girls critiqued that none of the available school tools addressed the emotional toll of being bullied, which was central to students’ ability to learn in school. The girls believed that their messages of compliments—a stance in opposition to the kinds of comments one receives from a bully—would be a source of comfort. This mattered also because they knew, from personal experience, that bullies often strike when they themselves are hurting. They knew that the current anti-bullying program had inadequate tools for students to utilize in healing relationships that have been ruptured throughout students’ school experiences. To learn how Ms. L connected the 5E learning experience with the framework, see Linking 5E Learning Plan in Online Supplemental Materials.

Ms. L. noted that the Bank of Compliments was a project that changed classroom culture, especially given that bullying in both the school and local community seemed to be growing worse in response to an emerging national political climate that legitimized bullying. As the girls sought to figure out how to build complex circuits while also determining how their box would function to address the bullying problem, their concurrent goal was to problematize and make visible their own, their peers’, and their community’s lived realities as a part of learning and doing science, even when those experiences challenged how they normally participate with science or what types of knowledge are normally legitimate in science. The injustices of bullying became a legitimate science-related issue. Ms. L. acknowledged the value of their experiences and supported them in mapping those individual experiences onto broader systemic structures. This made patterns of injustice something on which sixth graders could act.

**Conclusion**

Integrating learning experiences with a commitment to community into middle school science classrooms allows students to see how their voices and experience matter, and they can take action based on how they bridge their emerging science knowledge/abilities with their existing areas of expertise. This framework aligns with the NGSS commitment to bring connected and meaningful engagement into the classroom through involving youth in the process to ensure that the science they are learning matters.
REFERENCES

ONLINE SUPPLEMENTAL MATERIALS
5E Lesson—https://www.nsta.org/online-connections-science-scope
Linking 5E Learning Plan—https://www.nsta.org/online-connections-science-scope

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