

**Advancing Knowledge, Action, and Literacy
Among Underrepresented Minority Youth and Families
Through Community Science**

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Paper Prepared for the Citizen's Ambassador Program Conference
Havana Cuba, December 1-6, 2024

UCSD Statement About Kumeyaay Stewardship

The UC San Diego community holds great respect for the land and the original people of the area where our campus is located. Today, the Kumeyaay people continue to maintain their political sovereignty and cultural traditions as vital members of the San Diego Community. We acknowledge their tremendous contributions to our region and thank them for their stewardship.

Introduction

We propose that students benefit when they encounter authentic, hands-on activities in their science courses and scientific investigations. Students attending San Diego Unified schools in Southeastern San Diego (an ethnically diverse and economically depressed neighborhood) benefit from after-school and “*Summer Science Academies*” that augment in-class instruction with authentic hands-on activities conducted at the “EarthLab.” The EarthLab—a 4-acre outdoor “Community Station” operated jointly by Groundwork-San Diego and UC San Diego—facilitates a reflexive relationship between in-school and outdoor instruction. For purposes of illustration, we will give examples of both types of instruction: Ones that begin in the classroom at Millennial Tech Middle School (MTM) and continue at Groundwork’s EarthLab and examples of activities that start on the EarthLab and finish in the classroom. In both instantiations, students, often referred to as “young scientists,” are taught how scientists work: i. e., reasoning using evidence. Confronted with genuine problems, the students are asked to propose questions, gather data, compare observations to predictions, and compose research reports.

The conventional approach to solving social problems using science has two steps: (1) professional *researchers* conduct basic research (2) a second group of *practitioners* apply that knowledge. Information gathered as part of a conventional research project may be strong in that it meets social science standards, but it may not be relevant for the problems faced by the community. Therefore, the Groundwork-UCSD Partnership employs a “Community Science” approach (England et al 2024; Wandersman 2023) that includes community members, educators, and scientists. *And we include students* in problem posing, data gathering, and analysis to ensure the project is useful to the community when confronting significant social problems such as climate change. Collaborations include the design and execution of research projects, After School and Summer Science Academies, and community-based programs that give students ample opportunities for authentic reading, writing, and scientific investigations.

The project’s teacher-student interaction is informed by socio-cultural theories of human development, which treat learning as a dynamic process wherein learners (“apprentices”) actively construct theories of the world around them through interactions with more capable peers (“experts”) (Vygotsky, 1978; Cole 1996; Wertsch, 1985). Topics in Groundwork’s portfolio (some to be discussed below) include alternative energy, water conservation, and healthy food production, complemented by activities offered at Groundwork’s Earthlab, local museums, aquariums, and parks. Youngsters and their families engage in community science learning by collecting data in their neighborhoods, reading, writing, and acting on it.

By offering Science Academies after school and during Summer sessions, learning time is extended. By using hands-on, inquiry-based informal learning experiences, we help close the achievement gap, motivate students toward STEM courses and careers, and provide opportunities to discuss and write about authentic events.

The Partnership

A noted research university (UCSD) and an educationally motivated community service organization (Groundwork San Diego-Chollas Creek) are collaborating with inner-city public schools (notably Millennial Tech Middle School) to serve as a model for Community Science instruction and research.

Groundwork San Diego founded in 2006, has worked in Southeastern San Diego-Chollas Creek (See **MAP** in the Appendix) ever since to address the challenges of inequitable zoning measures, historic disinvestment in community services and unchecked development. Groundwork’s mission is to improve the environment, economy, and quality of life for residents in the Chollas Creek Watershed through new approaches to education and responsible community development; to link energy, economic, and health equity with environmental justice by improving water quality; developing alternative forms of energy; and increasing the capacity of low-income communities to lead climate action.

The UCSD Center on Global Justice (CGJ) was launched in 2012 to advance interdisciplinary research on poverty and the environmental crisis especially in the San Diego-Tijuana region. The CGJ is home to initiatives such as *Bending the Curve*, focused on global ethics, cooperation, and real-world intervention at local scale. The Center has helped advance the UCSD Community Stations, a network of field hubs located in low-income neighborhoods on both sides of the San Diego-Tijuana border, where teaching and research are designed, funded, and conducted collaboratively between UCSD, grassroots organizations such as Groundwork, and local schools.

Millennial Tech Middle School (MTM): is a historically low performing middle school with 84.3% Socioeconomically Disadvantaged, 31.3% English Language Learners, 0.2% Foster Youth, 21.6% Homeless, 24.9% Students with Disabilities; 64.9% Hispanic, 20.4% African American, 6.5% Asian, 3.7% two or more races, 0.7% Filipino, 0.7% Pacific Islander and 2% White students. As of 2019, MTM's suspension rate was 20.2% and chronic absenteeism rate was 22.4%. Students underperform in Math and English Language Arts.

Project Rationale

Many students served by Groundwork have voiced feelings of exclusion, of not belonging, when visiting dominant science institutions and organizations. For instance, while heading towards the Birch Aquarium in La Jolla, an affluent coastal town, a Hispanic youth exclaimed, "This is where rich white kids go." While on a tour of UCSD, a young African-American youth turned towards the educator accompanying the group and whispered, "Ms. P, this is not a school for Black people. There's no one like me here."

Both vignettes reflect a deep rooted and systemic problem confronting historically marginalized underrepresented minority youth entering prominent universities and STEM fields. They have had little or no exposure to these spaces growing up and *do not see themselves* in these spaces. They therefore have difficulty imagining possibilities for themselves in them. Though improvements are visible in some realms of society, most dominant cultural narratives—those over-learned stories communicated through mass media or social institutions--continue to undervalue women and historically marginalized underrepresented minority students in STEM fields.

The pressing need to develop effective instructional models to help close the undisputed fact of the achievement gap and provide youngsters with authentic reading and writing activities motivate this project.

The Need to Develop Effective Instructional Models to Close the Achievement Gap

Most historically marginalized students from low-income neighborhood schools do not do as well academically as their well-to-do contemporaries. This disparity is evident on most measures of academic performance: standardized tests, grades, high school completion, and college enrollment (Chetty et al. 2023; Fensterwald & Willis, 2023; CDE, 2023; NAEP 2025). Historically marginalized students regularly confront barriers to learning associated with poverty and second-language acquisition that are not easily overcome within the time constraints of the regular school day and year. The achievement gap is exacerbated by long summer breaks (Castleman & Page 2014; CDC 2023) accelerated extensively by the COVID Pandemic (Fensterwald, & Willis. 2023).

Project Design: A Paradigm for Environmental Research, Literacy, and Action

Community Stations: A University-Community Collaboration to Actualize Community Science

The UCSD-Groundwork Partnership deploys "Community Stations," a unique model of community-university collaboration and reciprocal knowledge production to actualize Community Science goals. Community Stations (Duster et al. 1990; Mehan et al 2010; Quartz et al. 2017; Forman & Cruz 2019) are field-based hubs located in disadvantaged neighborhoods. They exemplify Community Science

by conducting collaborative research and teaching. Each Community Station operates as a civic classroom and research station that is designed, funded, and programmed collaboratively between the partners and often community groups.

The EarthLab Community Station circulates university youths, faculty, and researchers onto the EarthLab and local youth, residents, and community members onto the UCSD campus. YounAg people are invited to participate in special UCSD mentorship programs providing access to higher education, career pathways and quality jobs, which are intended to prepare the next generation of thinkers and activists in the green economy.

Developing a STEAM Identity: “Learning to Be a Scientist”

While youngsters participating in our projects will be mastering the content of STEAM academic disciplines, they will also be involved in an identity shift, for example seeing themselves as a “science person.” “Learning to be” a science person means going beyond “learning about” the facts, concepts, relationships, formulas of a discipline. “Learning to be” involves acquiring the practices and norms of established practitioners in that field, that is, acculturating into a community of practice (Gee 2007; Lankshear 2011:12). Learning to be a science person also means developing and applying practices that are embedded in the identities, tools, technologies, and worldviews of disciplines as varied as medicine, carpentry, and physics.

Learning to be a scientist requires immersion in social practice. This involves engaging students in science-based practices that enable knowledge, identities, and critical literacy skill to develop iteratively. Sharpening students’ tools for critical reading and writing involves transforming their relationships to texts—some that they have written. Inviting students to “act like scientists” involves providing them opportunities to think about, critique, and write about the content and active investigations of scientific claims to knowledge.

This is not a question of facts and knowledge *versus* identity because knowledge and identity are intertwined. Students need content to employ thinking and writing skills; they can hardly learn facts without thinking and writing about them. Therefore, interventions and resources encouraging STEM pathways need to be prioritized to engage and capture the imagination of young people from kindergarten to 12th grade. For these reasons, tracing the elements that influence the development of participating students’ sense of self in relation to doing science and writing about authentic science activities is a priority of our work.

Illustrations of Reflexive In-School <->Outdoor Instruction

Our Community Science activities contain a reflexive loop between in-school and outdoor instruction. Instruction can start either in classrooms with text-based materials or outdoors with hands-on materials. For purposes of illustration, we will give examples of those two types of instruction: Ones that begin in the classroom at MTM and continue at Groundwork’s EarthLab and examples of activities that start on the EarthLab and finish in the classroom. In both instantiations, students, often referred to as “young scientists,” are taught how scientists work: i. e., reasoning using evidence. Confronted with genuine problems, the students are asked to propose questions, gather data, compare observations to predictions, and compose research reports.

Solving the Problem of the Day at the Hydroponics Learning Center and in the Classroom

A typical *Summer Session* day starts in the classroom with students assigned to small groups that are guided through thematic learning activities that result in proposing and solving the “Problem of the Day.” Next, the “young scientists” decamp to the EarthLab to engage in hands-on activities at the “Hydroponics Food Justice Farm.” While there, their Groundwork EarthLab Educators—often aided by UCSD students who serve as Teaching Assistants--reinforce, and extend concepts introduced during morning activities. For example, students at the Hydroponics Farm might report on the progress of their mini-experiments to

measure the amount and duration of water needed to grow lettuce, tomatoes, and radishes. Or, they might discuss one of the other pressing “topics of the day” recommended by the “National Farm to School Network (2022): Why grow plants hydroponically?” “What do plants need to grow and does water provide that?” “What are some of the basic growing techniques used in hydroponic growing systems?” “What are some of the ways that we can compare hydroponic growing systems with soil-based growing systems. After discussing one or more topics, students write their observations in their journals.



After engaging in discussions and composing journal entries connecting in-class lessons and EarthLab experiences, they head to lunch. After lunch, the group visits a climate change organization in San Diego. There, students are guided through learning experiences that are linked to their ongoing instruction. For instance, the “how do we increase lettuce productivity?” question might be explored on the day that the students visit the San Diego Botanic Garden.

At the close of the visit, Garden instructors debrief the day’s visitors about the availability of their produce. This combination of science and literacy activities gives students day-to-day experience in food production and sales, as well as knowledge about career possibilities in these fields. The preparation of menus, advertising, and sales materials give students opportunities for authentic writing and oral presentation experiences.

Project-Based Learning in the Classroom and at the EarthLab

In addition to Summer Academies that encourage students to explore problems in the classroom, at the EarthLab, and at a field trip site, the Groundwork Educators also bring hands-on, experiential learning to students during the school day through Project-Based Learning (Schmidt et al 2011). The principles of Project-Based Learning empower students to engage in inquiry to understand the world around them and to solve real world problems.

A representative project combines the mathematics lessons of proportional relationships to climate friendly recipes.



At the beginning of this project, many students initially picked vegan or vegetarian recipes to share with the community as “climate friendly.” The MTM teacher and Groundwork Educators led an interactive class outside at the EarthLab where students learned how food can be produced sustainably and how consumers can vote with their dollars to encourage sustainable farming practices and reduce their carbon footprint. Students asked questions about the problems of large-scale, monoculture farming and learned how even recipes with meat can still be considered climate friendly. The most important part of PBL projects is for students to think critically about their answers. While a meat-free or animal product-free diet is generally considered better for the climate, there are real issues around produce farming as well. Therefore, students were encouraged to devise solutions that they can support. Many students who chose vegan recipes admitted not wanting to try them. If the students, their families, and their community will not take part in the action, this attitude defeats the purpose of researching climate friendly recipes to reduce our impact on the environment.



After students began to really dig into what it means to have a climate friendly diet, they created a cookbook and calculated the proportional relationships within the recipe to feed 50, 100 or 200 people. Students were then invited into the Groundwork Culinary Lab at MTM to make one climate friendly recipe.

Summary

These examples illustrate how the UCSD-Groundwork instructional model is bringing classroom learning to life through outdoor and hands-on experiences and by contextualizing learning with relevant issues that pique students' interest. The Groundwork-UCSD approach to Community Science inflected instruction is also impacting the norms and practices of the broader informal climate science field by demonstrating the utility of: (1) forming a collaboration between a civic-minded non-profit organization and a university dedicated to research in the service of practice, community engagement, advancing social equity, and (2) serving as an exciting science learning enrichment program for young people.

The *After School* and *Summer Academies* offer a productive model of hands-on research integrated with classroom instruction. This socio-cultural motivated approach to learning contributes to a professional culture that encourages youth to experience the excitement and rigor of scientific investigation, facilitates inquiry, and improved understandings of scientific knowledge and processes.

By blurring the traditional lines, or walls, in a classroom to include outdoor learning experiences and hands-on activities in other environments, students begin to understand that “learning” happens throughout all aspects of life, and what you learn in school can help you advocate for a better environment and resilient community.

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Appendix

SESD Map (in preparation)