



Engaging Diverse Communities in a Community Science Fair

Justin Hougham,¹ Brad Bessler,² Joey Zoher³, and Walter Sams⁴

Abstract

Prioritizing alternative ways to encourage student interest in STEM is necessary to increase the number of students that choose a career in STEM. The traditional classroom setting that includes direct instruction may inspire some students, but when there is a significant discrepancy of students from historically marginalized populations in STEM careers, determining what can be done differently and how it can be done differently, may be the questions that result in more representation from minoritized communities.

Origins of Science Strikes Back

Educators, administrators, and all-around nerds met in the fall of 2016 to begin planning a “Science Fair for All” with a Community Advisory group associated with a public charter school in Milwaukee, WI. Wouldn’t it be cool for people to be able to engage in a science fair outside of educational affiliation? The original thought was to get a lot of likeminded organizations together to throw an event that would increase engagement with science and have an all-around good time. It wasn’t long before conversations about the decline of science were on the table. Talking heads on TV “debunking” climate change, pundits taking hard lines against almost every branch of science to engage their base, get voters out of the woodwork, and increase their political clout were loudly present on many cable networks and social media websites. The idea of science seemed to be under attack. The title of Science Strikes Back came quickly and you could feel in the room that it was a hit.



The logo for Science Strikes Back (SSB) tells a story all its own. First is the obvious call back to a classic sci-fi film in which the main character has his hand cut off in an epic confrontation. Looking a little deeper though, there is a lot of significance in the title and logo choice. The hand holding an Erlenmeyer flask with an active reaction happening inside it is a direct reference to how some of the founders felt at that initial meeting. The immense potential transformative power of science work was being cut off at the wrist by counter-information and social media dissonance. The logo also brings a touch of taboo to the table by showing the exposed bone of a disembodied hand. Those of us around that table saw this chance to “strike back” against these forces to give students and other community members a reason to trust in science: relevance to their own lives and their own participation in the process.

After an hour or so of conversation, the skeleton was assembled. Folks from University of Wisconsin-Madison would spread out to different schools and organizations all over the Milwaukee area with lessons to engage groups in possible science fair projects. The host school, Escuela Verde, would drum up interest amongst their Project Based Learners and host the event with space assistance from their neighbors: The Urban Ecology Center and Velobhan Coffee. A late winter/early spring go time would be a fast turnaround, but it was certainly going to happen!

Full listing of authors and contacts can be found at the end of this article.



Published by the Hoosier Association of Science Teachers, Inc. (<https://hasti.org/>) ISSN 2475-451x

© Hougham, Bessler, Zoher, & Sams, 2023. **Open Access** This journal is distributed under the terms of the Creative Commons Attribution NonCommercial NonDerivative 4.0 International License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits unrestricted use, distribution, and reproduction without revision in any non-commercial medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license.

We decided early on that our focus would be on diversity and environmentalism. All of the organizations involved were already in the trenches of anti-racism and environmental justice, so the fit was easy. This helped us know where to focus our recruitment efforts.

Science Strikes Back is different in a lot of ways, but it also leans on many of the conventions of traditional science fairs. We had categories to enter and prizes for winners. Our goal was to attract participants from all over the city, but we ended up with heavy participation from a few schools. We also wanted to keep it open to any age of participant- though we do most commonly see students in grades 6-12. Escuela Verde, being the host and having several staff members heavily involved, ended up providing the bulk of the participants. Since they are a Project Based Learning (PBL) school, this was a great fit. Seniors at Escuela Verde are required to submit a Youth Participatory Ecojustice Action Project (YPEAR). Many seniors would submit parts of their YPEAR capstones as SSB projects.

Science Fairs as a STEM Learning Venue

Prioritizing alternative ways to encourage student interest in STEM is necessary to increase the number of students that choose a career in STEM. The traditional classroom setting that includes direct instruction may inspire some students, but when there is a significant discrepancy of students from historically marginalized populations in STEM careers, determining what and how it can be done differently, may be the questions that result in more representation from minoritized communities. Recent data shows that 59% of White students received a Bachelor degree in STEM, while only 15% of Hispanic students and 9% of African American students received a degree (NCES, 2018).

Participation in a school event that can provide the opportunity for students to demonstrate their learning presents a unique opportunity that is not universally available to all schools. The “science fair” has become ubiquitous with what a school-related event may look like, but this opportunity is often limited to schools with bigger budgets and higher levels of funding (Grinnell, 2022). A recent longitudinal study indicated about 5% of 23,500 high school students surveyed participated in science competitions during high school (NCES, 2020). This data indicates that there remains an untapped opportunity for schools to consider when deciding if a STEM fair is purposeful or not, though recent research would suggest the former. Establishing a STEM fair within a school community has the ability to inspire

student interest in STEM fields (Dabney, 2012; Grinnell, 2022; Koomen, 2021). STEM fairs also give students the chance to apply what they learn in their classrooms to a community setting by empowering them to share their scientific knowledge and passions with others. This participation in science activities outside of school hours more than once per year also increases the likelihood of students choosing a STEM-related career (Dabney, 2012). With more consideration being made to how the science event is structured, the more effective they may be in becoming equitable to diverse populations.

Historically, science fairs are student-focused with varying levels of support from families, teachers, experts, or mentors. A recent study by Grinnell et al. (2022) that surveyed students from populations underrepresented in STEM on their views of science and engineering fairs showed that the level of support from teachers, families, and science experts had an impact on STEM aspirations, but these supports differed greatly amongst different ethnicities. For example, when Black students participated in science and engineering competitions, their reports demonstrated that they were most likely to receive no help from parents, teachers, or scientists in comparison to students that identified as White, Hispanic, Asian and other (Grinnell et al., 2022). To make our community science fair more accessible and to fight back against these disparities we put several supports in place.

What Makes a Community Science Fair?

Participants can find any number of resources online for help in planning and performing a science fair project. We had the fortunate support of UW Extension and Upham Woods that would send out crews of educators to host project starting workshops for classrooms or after school groups. Many local schools also already host science fairs, so giving those students an opportunity to fine tune their earlier experience and bring it to another show is also a draw for participants. Some of the most unique and interesting projects, though, were those from families looking for a way to do something fun together. I remember a family whose project aimed to discover the best pancake recipe. What a fun way to spend a weekend with your kids! All while learning about how science works and getting the chance to share that research with people from all over the city!

How do you Judge a community science fair? That was a question to ponder. On one hand, you want there to be high stakes to drive participation, but in many



	Formative		Developing		Mature		Exemplary	
	1	2	3	4	5	6	7	8
Collaboration Mark Description: Team worked in a collaborative, mutually beneficial way that helped address community needs.	-Project is determined and implemented with little involvement from community partners. -A shared vision and collaborative partnership has not been established or maintained.		-Partnerships are few in number, weak, or non-existent. - Project reflects a partial shared vision with minimal collaborative work between the partners. -Service is not reciprocal or of mutual benefit.		-Some communication and ongoing interaction with community partners is central to the project. -More opportunities could be provided to encourage the team to see community members as collaborative partners and resources, and not just recipients of service.		- Partnerships engage in frequent and regular communication, establish a shared vision and set common goals, and collaboratively worked on the project. -Partners share knowledge and understanding of community assets and needs, and view each other as valued resources.	
Voice Mark Description: Team has a strong, original voice in planning and executing their project.	-Project has very limited original team input.		-Project is a spin-off of an already completed project. -One adult teammate offered strong guidance in organizing and completing project tasks.		-Project is original -Team works collaboratively to develop project plan and takes leadership in carrying out tasks.		-The team is engaged in generating ideas, identifying learning outcomes, and decision-making during planning, implementation, and evaluation of the project. -Project works with adults to create an environment that supports trust and open expression of ideas.	
Meaningful Mark Description: The team presented knowledge in such a way that was exciting, meaningful and understandable to the community.	-Project demonstrates little evidence of new learning. -Little connection to the community. -Questions can not be readily answered.		-Project demonstrates some evidence of learning. -The action taken or research has little impact on the community. -Some of the questions can be answered.		-Project is exciting and demonstrates evidence of learning. -The action taken or research has an impact on the community. -Most questions can be answered with ease.		-Project is exciting and demonstrates clear evidence of learning. -The action taken or research has a meaningful and clear impact on the community. -All questions from review committee can be answered with ease.	
Quality Mark Description: Product and methodology is a high quality.	-Poor product. -Information is disorganized. -Diagrams, illustrations or models are not accurate OR do not add to the reader's understanding of the topic. - Independent and dependent variables were not clear.		-OK product. -Information is organized - Diagrams, illustrations or models are neat and accurate and sometimes add to the reader's understanding of the topic. - Independent and dependent variables were mentioned.		-Good quality product. -Information is organized - Diagrams, illustrations or models are accurate and add to the reader's understanding of the topic. - Independent and dependent variables were clear.		-Professional quality product. -Information is very organized. -Diagrams, illustrations or models. - Independent and dependent variables were clear throughout.	
Total points								

Figure 1. Customized Scoring Rubric

ways this event was designed as an anti-science fair. What parts do you embrace and what parts do you “Strike Back” against. Ultimately, we settled some of this in the rubric. Our rubric awarded points for diversity and cooperation amongst your team. If you were submitting a project on your own, you were at a disadvantage. The hope was that this would encourage people to get even more people involved. Though a great driver, the prestige aspect of winning the science fair was at odds with our hopes to bring down the ivory tower. Adding these non-academic rubric criteria was our way of saying there’s more to this science fair than equations, science background knowledge, and academic clout. To give you a sense of the range of submissions, here are some example titles of project submissions in the past:

- “Testing How Clothing Choices Impact the Behavior of Others Around Us”
- “Who Stole the Cookies”
- “The Benefits of BMX”
- “Kombucha Krew”
- “Pavement vs Grass”
- “Light Pollution and Bats!”
- “SLIME.411- Recipes”
- “Are your Menorgs or Your Disorgs Winning?”

Judges ended up being a healthy mix of fun folks from all over the city. Education students looking to connect with schools, educators and staff from partnering organizations, and people who were just interested in the fair who may eventually enter in subsequent years. All judges met to go over the rubric to calibrate and make sure we were doing our best to be fair and impartial. This was actually a difficult task since the participants ranged from 3rd grade to professionals or PhD candidates. Once the rubric was covered, each judge was handed an iPad and a schedule to ensure that projects got equal coverage. Their rubrics were Google forms so that the results would be populated into a spreadsheet for easy scoring.

We had some hiccups the first year. There were submissions that didn’t show up, or projects that changed their titles or set up in the wrong spot making it impossible for judges to find the correct groups to score. It was very helpful to have a few people dedicated to supporting the judges and the participants to make sure they had everything they needed and that things went as smoothly as possible. Behind the scenes we needed a person watching the rubrics as they were submitted in case something seemed off. We didn’t want a project to



get an improper score due to user error or a mis-clicked prompt.

Judges then gather in a room to hammer out ties, agree on a best in show and in general discuss what they saw. At this time judges were having a Science Strikes Back experience of their own. What began as an opportunity to volunteer your time became an opportunity to be in touch with science, youth, and education. People were actually networking at this event. It became a way to connect with local orgs and each other. Some judges came back year after year.

This rubric was built over the years based on the curricular evaluation framework generated and co-created with the education team at Escuela Verde. They began with existing frameworks in PBL, specifically the EdVisions models. That team was also well versed in the YPAR and YPEAR research work by Joella Zocher mentioned above. This framework aligns very well with the goals of Science Strikes Back as it proposes that the inequities in education are not solely based on outside factors but instead are baked into the system of education, necessitating action to change the paradigm.

The 40 point rubric aims to offer opportunities for a project to succeed in a number of ways that a more traditional academic rubric might ignore. The five scoring categories are Collaboration, Voice, Meaningful, Quality, and one specific to the category the group submitted for. This has changed over the years, but an 8 point scale allows for two points of delineation for each indicator. Another challenge was lowering the entry point for judges. We didn't want a rubric that required an education background to understand because not all of our judges were educators. Throughout the years we've made changes and had tons of opportunities for judges to express their thoughts about scoring and the rubric. Every year we have and continue to make changes.

The specific aim of Science Strikes Back is to increase environmental literacy and agency among urban populations. Anecdotal feedback points to positive growth toward this goal, though the long-term impacts have yet to be measured (Zocher and Hougham, 2020). But the feeling in the room during this event speaks volumes. Observers, participants, and judges are buzzing with excitement, surprised and enlightened by projects created across a range of diverse presenters.

Lessons Learned

Can a similar science fair work for you? I would say emphatically: Yes! This project is moldable to suit so many potential fields, areas, and scales. Every year, as planning commences the folks behind Science Strikes Back think about growth and ways to reach out and make it bigger. There's also value in keeping it small, though. Whatever your desired scope, here are 9 things to do to get you started engaging your community in a similar event. Pick and choose the things that make sense to you and run with it!

1. Identify Partner Organizations - this can bring the person power and help drive your theming. Our partners were all environmental orgs so that was our driver. These can be organizations you are already working with, but it's also important to broaden your horizons and reach outside of your normal connections. You may want to engage some organizations to offer prizes for winners or gift bags for participants.
2. Get schools involved - if you have a school or two that will adopt this as a part of their curriculum that will guarantee participants and probably help with finding a host site. We rely on schools to provide the academic and safety context for their students leading up to the event.
3. Start gathering volunteer judges - reach out in as many ways as you can to get people interested. These folks may end up being interested in stepping up in deeper ways as well (see number 7)
4. Have organizations help with public submissions - some are already running studies that can be turned into science projects and some are looking for an easy way to do something like this.
5. Pick a date and find a venue - In our case we were linked to a school with a neighboring coffee shop and community center. This was perfect as it allowed us to spread out and with 3 host organizations it automatically expanded the reach we had.
6. Start working on a schedule - There should be ample time for judges (and public visitors) to check out the projects and allow for a bit of pageantry at the end to award prizes. We award top prizes for each category and overall best in show.

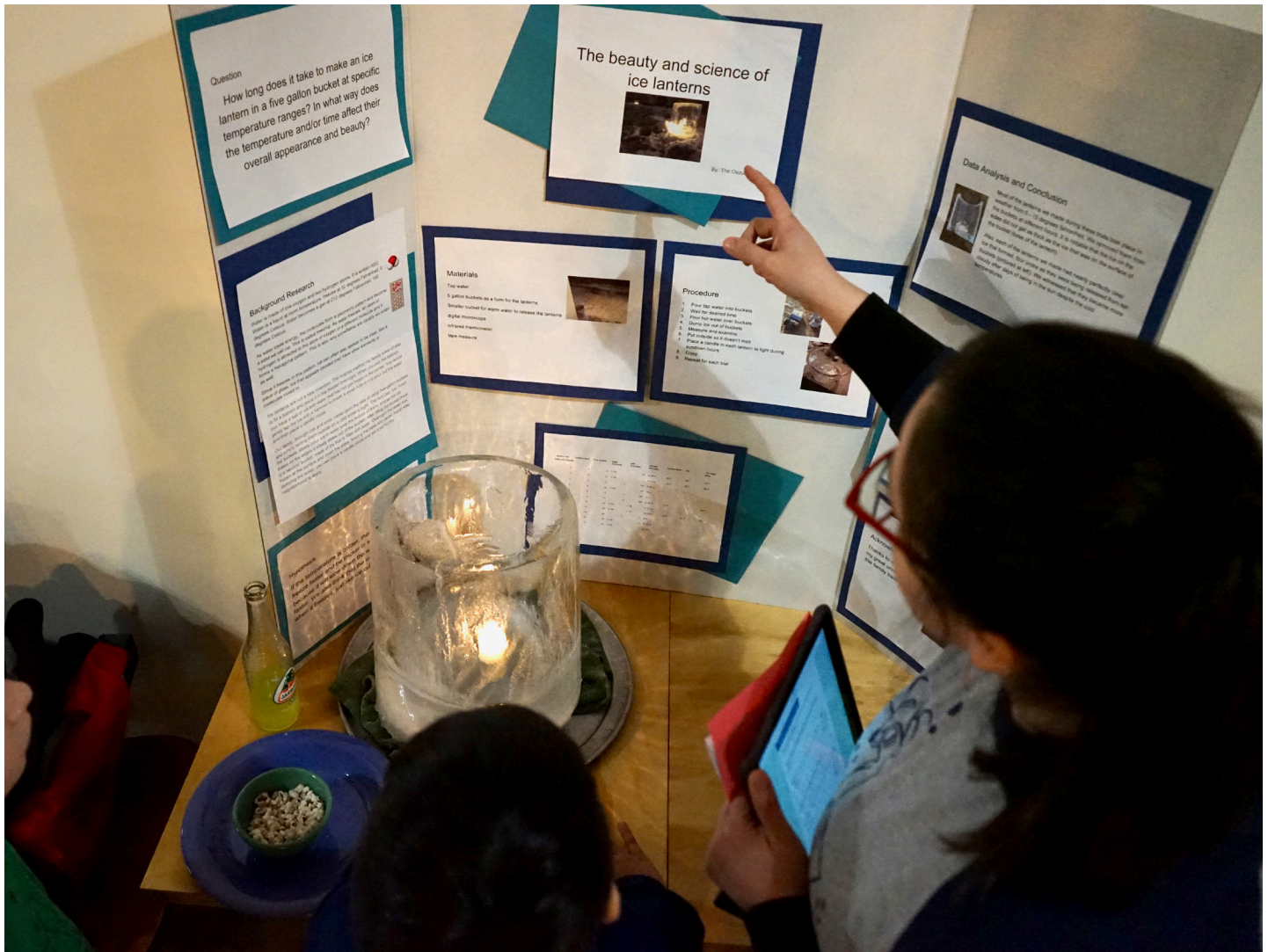


Fig. 2. Participant explaining her research

7. Establish a team with deliverable goals - Who is responsible for marketing the idea on social media? Who will manage participant entries? A few dedicated folks can make this event happen if you've got a good plan in place. We recommend placing someone in charge of the following elements: School/participant recruitment, social media and outreach, judge recruitment and judging, and someone with general oversight to make connections and host regular check-ins.
8. Decide what else you'd like going on during your event - Do you want to invite food vendors? Would local colleges like to have recruitment tables? There are all sorts of extra engagements you can add to an event like this. During COVID for example, we had to

also navigate our own risk management and safety framework for holding the event in person. This was rolled up into our waiver for participation. We also have a photo release for the media we collect on the day-of.

9. To merch, or not to merch? With a name like Science Strikes Back, we decided a little bit of merch would go a long way to get the word out for subsequent years. T-shirts, mugs, journals, pins . . . it's an investment that hopes to increase interest next year and beyond.

Conclusion

Our experience with Science Strikes Back has been overwhelmingly positive. Over the past 6 years the event has continued to invite people who would not have thought to enter a science competition into the doors of organizations that have been able to establish new relationships with the science process. The event even survived the pandemic pivoting to a virtual model when presenting in public was not an option. Organizations keep coming back because they value the time and the payoff. On top of that, every year we get even more solid presentations from a diverse group of participants. By connecting multiple organizations' reach and participant base we are able to reach many more individuals than any one organization or school. This also means more meaningful new connections between participants (including judges, hosts and visitors/observers) that in our case has resulted in an increase in high quality connections. Engaging the community in the sciences is a great cause worth the time and effort. As we continue to see science's credibility being brought to task in a battle for social media clicks and network airtime, we need all of the resistance we can muster.

References

- Dabney, K. P., Tai, R. H., Almarode, J., Miller-Friedmann, J., Sonnert, G., Sadler, P. M., & Hazari, Z. (2012). [Out-of-School Time Science Activities and Their Association with Career Interest in STEM](#). *International Journal of Science Education*, 2(1), 63–79.
- Grinnell, F., Dalley, S., & Reisch, J. S. (2022). [High school science fair: Ethnicity trends in student participation and experience](#). *PLOS ONE*, 17(3).
- Koomen, M. H., Hedenstrom, M., & Moran, M. A. (2021). [Rubbing elbows with them: Building capacity in STEM through science and engineering fairs](#). *Science Education*, 105(3), 541–579.
- National Center for Education Statistics. (n.d.). [High School Longitudinal Study of 2009 \(HSL:09\) - Overview](#).
- S&E Degrees, [By Race/Ethnicity of Recipients](#) | NCSES | NSF. (n.d.).
- Zocher, J. L., & Hougham, R. J. (2020). [Implementing Ecopedagogy as an Experiential Approach to Decolonizing Science Education](#). *Journal of Experiential Education*, 43(3), 232–247.

Authors

¹Justin Hougham (justin.hougham@wisc.edu) is a Professor and Environmental Education State Specialist in the Division of Extension, University of Wisconsin-Madison, Madison, WI, USA.

²Brad Bessler (besslerb@uwm.edu) is a Student in the School of Education at the University of Wisconsin-Milwaukee, WI, USA.

³Joey Zocher (joey@transcenterforyouth.org) is the Executive Director for the Transcenter for Youth, Milwaukee, WI, USA.

⁴Walter Sams (wsams@wisc.edu) is a Science teacher at Indian Community School, Milwaukee, WI, USA.