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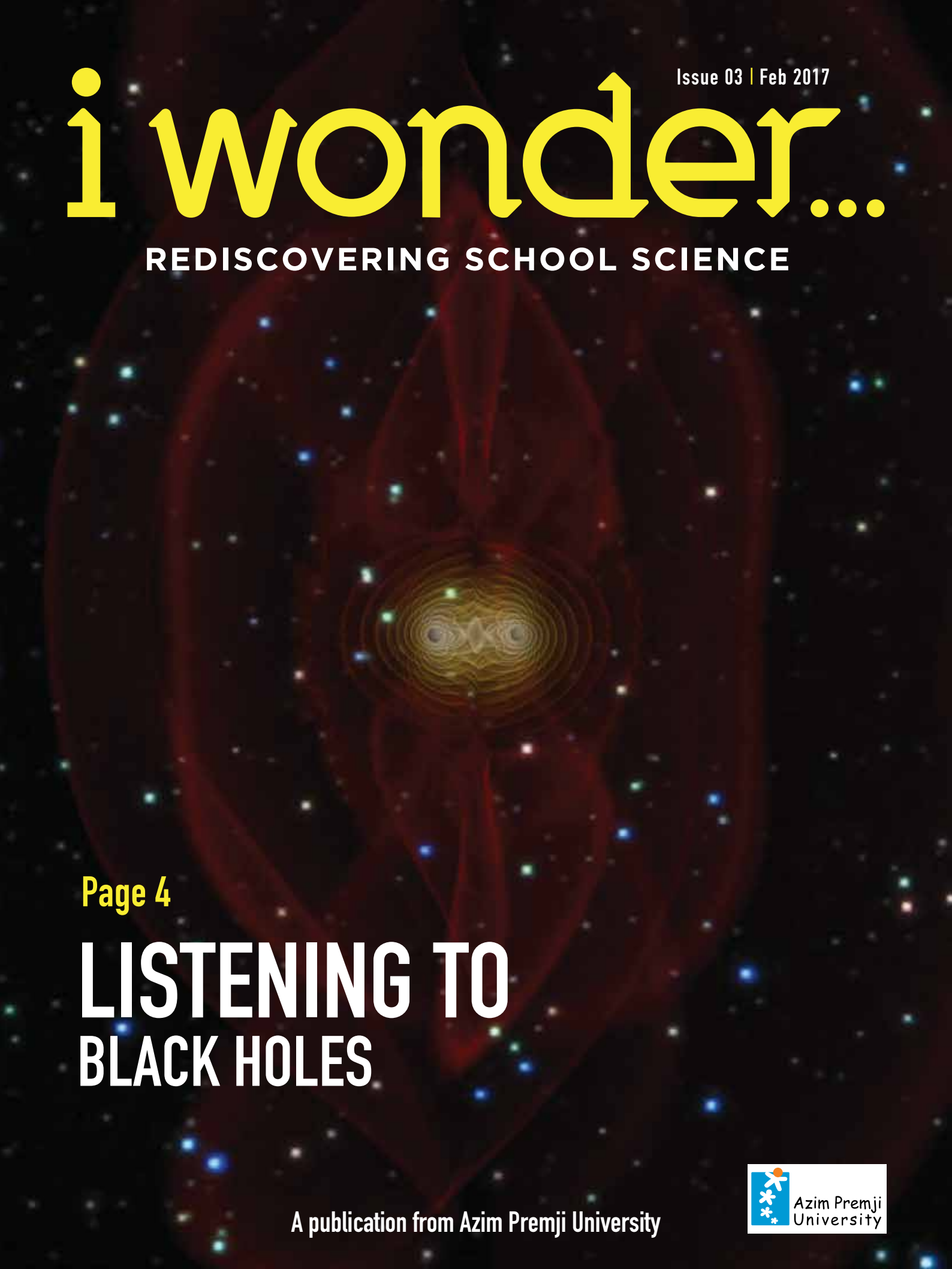
REDISCOVERING SCHOOL SCIENCE



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LISTENING TO BLACK HOLES

A publication from Azim Premji University

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WHY SCIENCE TEACHERS SHOULD CARE ABOUT SOCIAL JUSTICE

DAY GREENBERG

This article explores the need for social justice teaching in science education, and what it can accomplish, especially for students who come from communities that have been excluded from science learning and careers. It also presents important lessons learned from one case of science teaching for social justice.

"There is a need to prepare teachers and students for the new roles that they must play... Our vision of schooling, and by extension science education, is more aligned with participatory democracy where citizens actively collaborate... for future generations."
– Mike Mueller.

"I used to probably think, well I thought that, um, school wasn't that important, but then this program made me feel that I belonged in the school, that I made a change, so I had to go to school, cause it helped me and it helped the school, a lot."
– Fatima, an elementary student who did "action research" in school.

As our world continues to change along multiple dimensions – socially, politically, ecologically, medically, digitally, and economically – it is increasingly important for science teachers to provide students with the skills, knowledge, and opportunities to apply their learning to the world around them. They should seek to empower their students with the agency and tools to confidently meet challenges of the present and the future. Far too often, however, teachers assume that their students are not capable of accomplishing big things as young people. This is especially true for students who come from communities that have been excluded from mainstream science learning and careers (e.g., students who are members of immigrant or ethnic minority communities, and students from low-resource schools and neighborhoods).

What is social justice science education?

Social justice (oriented) science education involves using science knowledge and skills to make the world a fairer and more just place for everyone. Integrating social justice into their classroom practice offers teachers the tools they need to accomplish this goal.

Science teachers who work for social justice use their classroom practice as a tool of social, political, and academic empowerment for their students. Students learn to question existing systems of power – systems that oppress students and their communities. Science teachers empower students by

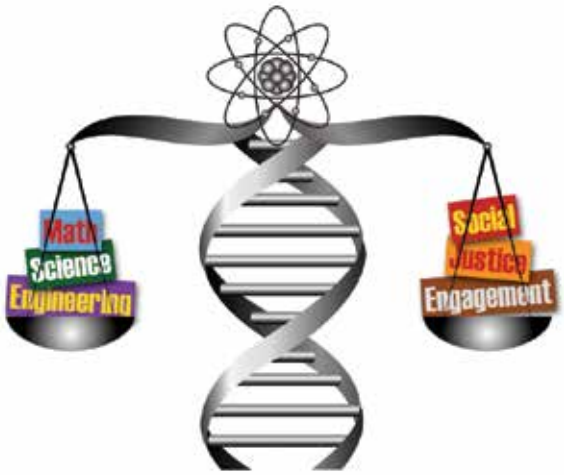

Fig. 1. Science and social justice – finding the balance!
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making their science classroom a place where students can build skills and use knowledge in ways that mirror and/or speak back to what the real world already asks of them (and will continue to ask of them in the future). They show their students how to navigate socio-scientific issues and challenges – issues that involve science knowledge and practices, and critically question/examine related social factors. They also build spaces that encourage their students to make change for themselves and their world, in partnership with others. Ultimately, such students learn to use science as a tool to act for positive change and greater justice, in partnership with others. This can benefit science learning, because the shared desire to make a specific positive change as a class can motivate students to reach related science learning goals. Then, students can activate their ownership of content (not just absorption) to take action themselves and/or convince others in positions of power to create positive change. For example, students who live in a flood zone could work towards physics learning goals to inform a student-organized public communications campaign to educate local community members on how to design stronger flood control structures. In this example, relevant physics content (e.g., energy, force, speed, weight, etc.), can become more directly important and meaningful when students recognize it as a tool to inform and protect their families and friends.

What does the research say?

How can science teachers make science matter for their students? How can they provide students with the tools to become leaders who take educated and meaningful action with science?

Educational researcher Alexandra Schindel Dimick studied a case of high school environmental science teaching that was organized around the goal of community action for greater social justice. Her study focused on science teacher Mr. Carson, who introduced social justice actions into his high school environmental science curriculum. He discussed local environmental problems with students, and allowed them to form three separate working groups to address these problems. His students learned about pollutants in their local waterway and conducted lab experiments related to water chemistry. They then created posters to educate the public on science topics related to water. Finally, they completed group action projects to solve problems in their local waterfront environment.

In her observations on the work done by the students, and her interviews with some of them (9 from a total of 24 students in the class), Alexandra found that students felt an increased sense of power when their learning was directed towards social justice. Mr. Carson explained:

... [the students] are feeling empowered to change something that affects them and they're not depending on other people to make the change. They're the ones who are being affected; they're the ones that are trying to make the change.

However, it should be noted that not all of Mr. Carson's students felt that the project was a complete success. Social justice science education must empower students socially, politically, and academically. Alexandra's study showed that the students noticed when one of these dimensions was missing, and they shared their disappointment in not receiving the support they needed to succeed as action-takers in science. It should also be noted that although Mr. Carson taught environmental science, **social justice action can be integrated into every type of science classroom**.

How can teachers become social justice science teachers?

What can we learn from this study about the successes and failures of implementing ideas of social justice in science classrooms? Here are three components that appear to be important to enact in order to successfully teach science for social justice:

Fig. 2. Participatory engagement in a classroom context.
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Guide 1: Support Student Leadership and Collaboration (The Social Component)

Mr. Carson had students divide themselves up into three separate groups after they voted to narrow down their ideas for taking action. He did not, however, provide group members with any specific strategies or guidelines for making group decisions and sharing discussion time. As a result, group dynamics affected individual actions, decreasing speed and efficiency.

How to implement: Allow students to choose their own working groups based on the topic, but provide them with tools to navigate group dynamics. Give them opportunities to practice healthy teamwork and compromise, within a supportive structure of group social rules that students can agree on together. Have students create a social contract together that dictates how to behave in groups and how to resolve conflicts. Empower your students to work well together by helping them create shared expectations and the tools to solve problems themselves.

Recommended Articles to Learn More

1. Birmingham, D., & Calabrese Barton, A. (2014). Putting on a green carnival: Youth taking educated action on socioscientific issues. Journal of Research in Science Teaching, 51(3), 286–314. http://doi.org/10.1002/tea.21127
2. Vakil, S. (2014). A Critical Pedagogy Approach for Engaging Urban Youth in Mobile App Development in an After-School Program. Equity & Excellence in Education, 47(1), 31–45. http://doi.org/10.1080/10665684.2014.866869.

Guide 2: Prepare Students to Take Action (The Political Component)

Mr. Carson removed himself from classroom interactions after students formed groups. His students lacked the support they needed to transition from understanding action in terms of daily, personal responsibilities to understanding action in terms of larger, more transformative, active participation in change. As a result, some students came to a larger understanding of action with science themselves, but other students ended the project without knowing how to take further, larger, or more complex action for social justice with science.

How to implement: Be an active part of student interactions to make changes that matter to them and their community. Discuss the difference between individual action and collective action, and help students to critically question structures of power that cause pain to people or destruction to environmental systems. Help them discover the "root causes of problems" that often relate to social injustice but can also be better understood through scientific investigation. For example, science teachers could support their students in asking: How does a local school building's mold infestation relate to political debates on education budget proposals? How has genetics been used to marginalize existing populations? Who profits from the use of coal energy and mining? How have the contributions of women to computer science been neglected in histories of computing?

Fig. 3. The dove with an olive branch, a symbol of peace. Made from icons representative of science, flies against a word-cloud created from all the words in the Wikipedia page on "Social Justice." Credits: Photograph and Illustration by Punya Mishra, 2016. License: CC-BY-NC.

Guide 3: Help Students Use Knowledge as a Tool (The Academic Component)

Student empowerment can align with teaching and learning science education when social justice is the goal and science knowledge and practice is the tool. In order for students to feel empowered with scientific knowledge, teachers must actively facilitate experiences and provide supportive resources and information. It is not enough to give students the opportunity to lead – science teachers must also arm students with the scientific skills and knowledge to take the action that they desire.

How to implement: Each component of this model is important, but teachers must use all three to support social justice actions with science knowledge.

Help students learn about the ways in which actions they want to take can be supported with science learning and practice. Once they have a big goal in mind, help students break that down into smaller, accessible goals and have them lead a discussion together about what scientific information and skills they need to learn in order to reach each smaller goal. As they achieve the small goals, continually check in with them to discuss how their step-by-step progress is bringing them closer to their larger goal of big change (at the same time, help them see and feel proud about how their collection of knowledge and skills is growing in size and depth).

Conclusion

Science teachers must offer their students the resources and support to combine social, political, and academic growth in order to take action for social justice with science. When Mr. Carson did not combine and equally address all three components, his students were disappointed. They described their socially and politically informed actions as not being supported enough with academic knowledge and connections to their classroom learning. When, however, all three aspects work together, the results are positive. As Janis, a 13-year-old student in another social justice science teaching project explained:

"We know what we are doing. We know how to make a difference. We know how to save energy and how to convince other people of better ways to do things with electricity. That is one way that we are experts."

Teachers should empower their students with science, in ways that provide students with the tools to solve real problems that affect them and the people and surroundings they love and depend on. This requires more than simply giving student's permission to be powerful actors. It requires supporting students as they work to complete each step along the way towards addressing bigger and more complex issues, with scientific, social, and political knowledge and tools.

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References

1. Calabrese Barton, A., Birmingham, D., Sato, T., Tan, E., & Calabrese Barton, S. (2013). Youth As Community Science Experts in Green Energy Technology. After school Matters. Retrieved from http://eric.ed.gov/?id=EJ1016811.
2. Dimick, A. S. (2012). Student empowerment in an environmental science classroom: Toward a framework for social justice science education. Science Education, 96(6), 990–1012. Retrieved from http://doi.org/10.1002/sce.21035.
3. Langhout, R. D., Collins, C., & Ellison, E. R. (2014). Examining Relational Empowerment for Elementary School Students in a yPAR Program. American Journal of Community Psychology, 53(3-4), 369–381. Retrieved from http://doi.org/10.1007/s10464-013-9617-z.
4. Mueller, M., Tippins, D., Bryan, L. (2012). The Future of Citizen Science. Democracy & Education. 20(1), 1-12.
5. Shin, M., Calabrese Barton, A., Greenberg, D., Nazar, C.R., Tan, E. (2015, April). "Little Kids Can Do Ginormous Works": Youth's Engineering Design and Identity Work. In Division C 29.030. Equity-Focused Implementation of the Next Generation Science Standards: Exploring Models of Hope and Possibility. Structured poster session presented at the American Educational Research Association, Chicago, IL.

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