5D... 5 Years Later – Chapter 11 Progress and Next Steps, or: How 5D Science Learning Can Support Equity & Justice

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A FRAMEWORK FOR K-12 SCIENCE EDUCATION

Practices, Crosscutting Concepts, and Core Ideas

NATIONAL RESEARCH COUNCIL OF THE NATIONAL ACADEMIES





Equity in science education: The work continues...

"Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science."

— NRC Framework, p. 28



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Attending to Learner and Community Interests

"[A] major goal for science education should be to provide all students with the background to systematically investigate issues related to their personal and community priorities. They should be able to frame scientific questions pertinent to their interests, conduct investigations and seek out relevant scientific arguments and data, review and apply those arguments to the situation at hand, and communicate their scientific understanding and arguments to others."

— NRC Framework, (Ch. 11) p. 278

6 Strands of Science Learning

Learners in science learning environments...

- 1: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.
- 2: Come to generate, understand, remember, and use concepts, explanations, arguments, models and facts related to science.
- 3: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world







- 4: Reflect on science as a way of knowing; on processes, concepts, and institutions of science, and on their own process of learning about phenomena.
- 5: Participate in scientific activities and learning practices with others, using scientific language and tools.
- 6: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science.







SCIENCE

Putting Research to Wo

Equity & Diversity (NRC Framework Chapter 11)

- Equalizing opportunities to learn
- Inclusive science instruction
 - Science Learning as Cultural Accomplishment
 - Relating Youth Discourses to
 Scientific Discourses
 - Building on Prior Interest & Identity
 - Leveraging Students' Cultural
 Funds of Knowledge
- Making diversity visible
- Value multiple modes of expression





APPENDIX D

"ALL STANDARDS, ALL STUDENTS": MAKING THE NEXT GENERATION SCIENCE STANDARDS ACCESSIBLE TO ALL STUDENTS

Appendix D Case Studies

These seven case studies of diverse student groups accompany <u>Appendix</u> \underline{D} and provide examples of strategies classroom teachers can use to ensure that the NGSS are accessible to all students:

Case Study 1: Economically Disadvantaged

Case Study 2: Race and Ethnicity

Case Study 3: Students with Disabilities

Case Study 4: English Language Learners

Case Study 5: Girls

Case Study 6: Alternative Education

Case Study 7: Gifted and Talented Students





Teaching STEM In Ways that Respect and Build Upon Indigenous Peoples' Rights



Implementing Meaningful STEM Education with Indigenous Students & Families





3D Learning is Powerful



Students learn to 'figure out' how to explain and model phenomena—and to design solutions







Free PDFs available at nap.edu

The National Academies of SCIENCES • ENGINEERING • MEDICINE

CONSENSUS STUDY REPORT

English Learners in STEM Subjects TRANSFORMING CLASSROOMS, SCHOOLS, and LIVES



MARÍA SANTOS, MARTHA CASTELLÓN PALACIOS, TINA CHEUK, REBECCA GREENE, DIANA MERCADO-GARCIA, LISA ZERKEL, KENJI HAKUTA, and RENAE SKARIN

Foreword by Michael Fullan

PREPARING ENGLISH LEARNERS for COLLEGE and CAREER

Understanding Language | Language

Lessons from Successful High Schools

TOWARD WHAT JUSTICE?

Describing Diverse Dreams of Justice in Education

Edited by Eve Tuck and K. Wayne Yang



Equity Projects

Abolition: abolishing institutions of unfreedom

Decolonization:

promoting rematriation of Indigenous life, cultural resurgence

The Possibilities of Community-Driven Science Investigations

- CONCLUSION 1: Citizen science projects investigate a range of phenomena using scientific practices across varied social, cultural, and geographical contexts and activities. Citizen science allows people with <u>diverse motivations and</u> intentions to participate in science.
- CONCLUSION 2: Because citizen science <u>broadens the</u> <u>scope of who can contribute to science</u>, it can be a pathway for introducing new processes, observations, data, and epistemologies to science.
- CONCLUSION 10: <u>Community participation</u> in citizen science activities can support the development of <u>community</u> <u>science literacy</u>.
- CONCLUSION 11: Citizen science can create opportunities for communities, especially communities who have been marginalized, neglected, or even exploited by scientists, to <u>collaborate with scientists and the science community</u>.



Classes of Anchor Phenomena Support Specific Equity Goals

Kind of Phenomenon	Example	Equity Goals
Culturally Significant	BackPacks: Ancestral Story	 Focus learning on youth & community purposes Increase representation & participation in STEM (Increased student achievement in science)
Contemporary Scientific	SSWD: Evolution & Climate	 Increase representation & participation in STEM Increased student achievement in science
Societally Relevant	SSWD: Nature-Culture Relations	 Focus learning on youth & community purposes Problematize the privileged forms of science Leverage science in justice movements
Everyday Phenomena	Microbes & Me	 Focus learning on youth & community purposes Problematize the privileged forms of science (Increase representation & participation in STEM) (Increased student achievement in science)

Selected Equity Initiatives with Future Potential

There are others!

1	Culture-based pedagogies	
2	Supporting Diverse Sense-Making	
3	Disrupting Ableism / Promoting Universal Design	
4	Promote Learning in Places (field STEM, across settings, place / land based pedagogy)	
5	Centering Cultural & Racial Diversity	
6	Promote Cross-age, Family & Community Science Learning	
7	Course Sequences Using a Mix of Meaningful Phenomena	

Equity & Justice Goals for Science & STEM Ed

Increased representation & broadened participation in STEM

Increased student achievement in science—often starts & sometimes ends with opportunity & access when we need belonging & identification, perhaps uses logic of 'sameness' when culture-based pedagogy is needed

Problematize the privileged forms of science—work to expand 'what counts as science,' 'who does science,' 'when is science'; support diverse sense-making

Focus science learning on youth & community purposes—youth & community agency is centered; accountability shifts to personal & community goal attainment

Leverage science in social and multi-species justice movements—prioritizes science as a tool in community organizing and social movements, requires critical view of historical inequity

Adapted from Philip & Azevedo, Science Education, 2017 by Philip Bell

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New Consensus Reports from the National Academy of Sciences



Free PDFs available at nap.edu