Louisiana STUDENT STANDARDS SCIENCE

Science:
Educator Resource

Leveraging Student Resources in Science

The Framework for K-12 Science Education emphasizes the need for students to "learn science in large part through their active involvement in the practices of science" (pg. 283). When educators effectively support and encourage engagement with the practices, they provide an entry point for science learning and build agency for all students.

National Research Council. 2012. *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Washington, DC: The National Academies Press.https://doi.org/10.17226/13165.

In Chapter 3 of Helping Students Make Sense of the World Using Next Generation Science and Engineering Practices, Bang, Brown, Calabrese Barton, Rosebery & Warren assert that emphasis on science and engineering has the potential to broaden sense-making in science to include more "wide-ranging, intellectually powerful practices" (pg. 33). This means that a teacher's ability to recognize student contributions as connected to sense-making is crucial to equitable science learning. (pg. 33).

Definition of Student Resources

- Student resources are the ways of speaking, knowing, acting and valuing that students use to make sense of the world.
- Students develop these resources as they live their daily lives within their families and communities.

Examples of Student Resources

The two examples below, while different, are both quality examples of how students use their resources to make sense of phenomena.

- Resources traditionally valued in k-12 schools include "known-answer questions, taxonomic thinking, and strict turn-taking" as well as "explanations that are expository or definitional in nature." (p. 35)

  Metabolic Reactions initial student explanation - M'Kenna's stomach hurts, which is part of the digestive system. The digestive system is the organs in the body that break down food using physical reactions and chemical reactions so the body absorbs nutrients.

- Explanatory modes valued in other communities include "storytelling and uses of metaphor" are often not valued in classroom science (p. 35)

  Metabolic Reactions initial student explanation - The way the body works is like when I am baking with my grandma. If you mess one thing up, lots of other things can get messed up too. Like if you forget to put baking soda in cookies, they are hard and flat. It makes the other ingredients not work so well.

How do we notice and leverage student resources?

"By attending closely to what students actually say and do in science, teachers can expand the relationships that are possible among themselves, their students, and science. In this way, they can begin to create more equitable opportunities to learn in science for historically underserved students." (p. 33)

Bang, M., Brown, B., Calabrese Barton, A., Rosebery, A & Warren, B. (2017). *Toward more equitable learning in science: Expanding relationships among students, teachers and science practices.* In Schwarz, C., Passmore, C., Reiser, B.J. (Eds.). *Helping students make sense of the world using next generation science and engineering practices.* (pp. 205-228) Arlington, VA: National Science Teachers Association Press.

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Some additional examples of student resources are listed below along with implications for sense-making and for how teachers can respond to best leverage these resources.

Non-academic Language

Resources for Sensemaking

- Students can use metaphors and stories to explain scientific phenomena.
- Students use their everyday language and experiences to make sense of scientific phenomena

Pedagogical Implications

- Presume the ideas make sense to the student.
- Work with the student to clarify their ideas and position the students as thinkers and holders of ideas worth discussing. Value the everyday language students bring to the phenomena, rather than seeing the ideas as wrong, can help students access the learning.

Gesturing

Resources for Sensemaking

- Students use gesturing to make their thinking transparent to others when we do not have an agreed upon set of words to communicate and when words (e.g. scientific terminology) have multiple meanings.
- Gesturing helps others visualize interactions and mechanisms (including unobservable ones) that are difficult to picture from words alone.

Pedagogical Implications

- Watch for gestures as students explain their ideas or restate other ideas.
- After a student uses gestures, emphasize that it was helpful to see what they were thinking and ask others to use gestures.
- Use gestures yourself when you are checking to see if your restatement of a students' idea is what they meant.

Multiple Modes of Expression

Resources for Sensemaking

- Although schools tend to accord higher status to expository or definitional ways of expressing science, students can bring other models such as storytelling and metaphor.
- In addition to words, students' drawings and mathematical expressions can be important ways for them to make sense of science.

Pedagogical Implications

- Use open prompts that offer students multiple ways to represent and express their ideas.
- Have students go public with their different modes of expression in both small group and whole group structures.
- Value multiple modes of expression and not just expository or definitional examples.