# Leveraging Student Resources in Science

## Purpose

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"[1] (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.

In chapter 3 of Helping Students Make Sense of the World Using the Next Generation Science and Engineering Practices[2], the authors emphasize that science and engineering have the potential to broaden sensemaking 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 sensemaking is crucial to equitable science learning.

## Definition of Student Resources

Student resources are the ways of speaking, knowing, acting, and valuing that students use to make sense of their 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 classrooms include "known-answer questions, taxonomic thinking, and strict turn-taking" as well as "explanations that are expository or definitional in nature[2]" (pg. 35).

  *Example of a traditionally valued student explanation of metabolic reactions: 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 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 [traditional] classroom science[2]" (pg. 35).

  *Example of a nontraditional student explanation of metabolic reactions: 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. 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 all 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[2]" (pg. 33).

Some additional examples of nontraditional student resources are listed below, along with implications for sensemaking and how teachers can best leverage student contributions to the discussions.

### Non-academic Language

| Resources for Student Sensemaking | How Teachers Can Leverage Student Contributions |
|---|---|
| • Students can use metaphors and stories to explain scientific phenomena<br>• Students use their everyday language and experiences to make sense of scientific phenomena | • Presume the ideas make sense to the student and ask the student to expand on their ideas (see Science Talk Moves for ideas)<br>• Work with the student to clarify their ideas<br>• Position the student as a thinker and holder of ideas worth discussing by valuing the everyday language they bring to the discussion. Academic vocabulary can come after students have a strong grasp of conceptual understanding. |

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### Gestures

| Resources for Student Sensemaking | How Teachers Can Leverage Student Contributions |
|---|---|
| • Students use gesturing to make their thinking visible and transparent to others.<br>• Gesturing helps others visualize interactions and mechanisms (including unobservable ones) that are difficult to picture from words alone. | • Students often gesture when they do not have an agreed-upon set of words to communicate (i.e. not knowing the vocabulary word), when words have multiple meanings, and/or if English is not their first language.<br>• Watch for gestures as students explain their ideas or restate the ideas of others. |

| Resources for Student Sensemaking | How Teachers Can Leverage Student Contributions |
|---|---|
| | • After a student gesture, emphasize that it was helpful to see what they were thinking and ask others if they have other ways of expressing the idea.<br><br>• Use gestures when you are checking to see if your restatement of a student's idea is what they meant. |

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## Multiple Modes of Expression

| Resources for Student Sensemaking | How Teachers Can Leverage Student Contributions |
|---|---|
| • Students can use metaphors and stories to explain scientific phenomena<br><br>• Students' models and mathematical expressions can be important ways for them to make sense of science. | • Presume the ideas make sense to the student and ask the student to tell you more (see Science Talk Moves for ideas)<br><br>• Have students share their multiple modes of expression with a small group and in a whole group.<br><br>• Place value on all modes of expression and not just on expository or definitional examples by highlighting what the student has brought to the discussion. |

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[1]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.

[2]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.