Michigan Assessment Consortium
Learning Point

Disciplinary literacy and student-centered assessment in the secondary science classroom

Every time we apprentice learners into a discipline, we draw on disciplinary literacy. Within the literacies of science and engineering, learners come to understand both the content and the practices of these fields. As educators, our job is to identify and enact those literacies in ways that prepare students to make science-based decisions — and to meet the learning standards we have legislated.

Built on *A Framework for K-12 Science Education* (NAP, 2012), the Next Generation Science Standards (NGSS, 2015) define science learning as three-dimensional: Disciplinary Core Ideas (DCIs), Science and Engineering Practices (SEPs), and Crosscutting Concepts (CCCs). DCIs are likely familiar — the gas laws, atomic structure, energy transfer. What the SEPs and CCCs add is equally important: they shift instruction away from memorization and toward the thinking tools scientists and engineers actually use to investigate the world and communicate their findings.

What students need to think like scientists

The SEPs and CCCs are the foundations of "figuring out" scientifically. Each of the eight SEPs and seven CCCs provides a toolbox that supports the generation of questions, exploration to help answer them, and processes for sharing ideas with others.

Some educators who have focused on literacy as reading, writing, speaking and listening in science have conveniently attached the tag of Disciplinary Literacy to the SEP, "obtaining, evaluating, and communicating information." While it is true that this practice demands the use of text in a traditional sense, it is insufficient to apprenticeship into science and engineering as disciplines. When we begin to take a wider view of literacy in science and engineering for the purposes of apprenticing learners into the discipline, we come to appreciate the value of *all* the SEPs and CCCs as guidance to frame science and engineering as disciplines.

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Disciplinary literacy illustrated through investigation

For example, the SEP of "planning and carrying out an investigation" (not necessarily a controlled experiment) helps us define experiences and learning that are essential to apprenticing novices into the discipline and are foundational to the doing of science. The implementation of this SEP develops learners' understanding of how the discipline of science builds an evidence base from which to make claims.

When learners use this practice, we expect that they will both plan and carry out investigations including testing design, determining and manipulating variables, and organizing data. The details of this practice show that the literacies of science and engineering have expanded and moved beyond following a set procedure and collecting data on a table provided. We are asking learners to scientifically consider questions and use the literacies of science to investigate them.

The CCCs deepen this further. The CCC of "systems and system models," for example, asks students to analyze complex phenomena through a systems lens and to revise their models as new evidence emerges. This kind of thinking is iterative — it develops across a unit, across a school year, across grade levels. A sketch of a model completed once in a notebook does not capture it. Authentic assessment of this practice

must account for how students' thinking evolves over time.

Disciplinary literacy helps focus teaching, learning and assessing

The Disciplinary Literacy Essentials (DLE)[1] include 10 literacy essentials that help focus teaching and learning for all students. Essential 8 is critical for educators to support their assessment of student learning, using the SEPs and CCCs as part of the criteria of what counts as success in science and engineering.

Essential 8 asks teachers to engage in "Ongoing observation and assessment of students' academic language and literacy development that informs their education." It is the crossroads of literacy and assessment that we find in this essential that helps us build assessment strategies that play out over time and inform educators and learners about their academic success. Through definition of expectations for students at various grades/ages, and a commitment to using the SEPs and CCCs over time, we begin to blend the DLE with assessment.

Planning and clear success criteria are key

Teasing apart the language of this essential, we notice that it calls on us to have an ongoing observation and assessment of students' literacy development. Ongoing also implies planned. To do this well, we need to know the expectations we are to have for students, including expectations for knowing and using the SEPs and CCCs. When we have a vision for how students in different classes and at different ages can use the SEPs and CCCs as part of their learning, then we can create an ongoing assessment system that elevates these dimensions to the same level as the DCIs.

For example, returning to the SEP "planning and carrying out an investigation," ongoing assessment of how well students can participate in this practice requires more than knowing if they can write a step-by-step investigation plan. At the high school level, they would also need to know why the plan would work or fail, and how the plan helps them answer the question or gather evidence to support or refute a claim. Can the student explain why a given design would succeed or fail? Does their plan account for appropriate variables? Will the data they collect actually allow them to answer their driving question or evaluate a claim? These are the questions a formative assessment system must address.

Formative assessment practices illustrated

Using formative assessment requires educators to widen high-quality assessment beyond the multiple-choice test or seeing a table of data to include direct mechanisms by which we are observing students' use of SEPs and CCCs. In assessing "planning and carrying out an investigation," educators would need thoughtful strategies for identifying students' progression throughout a unit or school year.

Daily, educators work to become attuned to the language of the SEP so that they can hear and see learners' use of the practice. Formative assessment strategies must be specific enough to assess the details of the practice and how the details develop over time. In the illustration shared, educators will take notice if planned investigations have ill-defined variables, if learners' investigation plans will capture appropriate data, and if learners have created ways of documenting data that will support later analysis.

Bringing it all together

To meet the goals of the DLE through assessment systems, educators and leaders need to allocate time to these instructional goals. Coaches and teacher leaders will work at developing a broader view of what counts as literacy in science and engineering and how we define student success. This process will be time-consuming, but it can be supported by the adoption of high-quality instructional materials (HQIM), which are currently being developed and published. All HQIM should be committed to having a transparent three-dimensional (DCI, SEP and CCC) assessment plan. By unpacking this plan, educators can more readily blend disciplinary literacy and assessment of SEPs and CCCs.

References

National Research Council. (2012). A *Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: The National Academies Press.

National Research Council. (2015). *Guide to Implementing the Next Generation Science Standards*. Washington, DC: The National Academies Press.

TO LEARN MORE

Essential Instructional Practices for Disciplinary Literacy in the Secondary Classroom: Grades 6 to 12, Michigan Association of Intermediate School Administrators, General Education Leadership Network (2023)
qr.link/4DldnN

Components of an Equitable Assessment System, Michigan Assessment Consortium (2024)
qr.link/gLVbaw

Guide to Implementing the Next Generation Science Standards
www.nextgenscience.org

Disciplinary Core Ideas in NGSS (handout)
qr.link/OolZuL

Michigan Math & Science Leadership Network, for HQIM Resources
mmsln.org/programs/openscied

[1] *Developed by the Disciplinary Task Force of the Michigan Association of Intermediate School Administrators (MAISA), General Education Leadership Network (GELN)*