Assessing three-dimensional performance: crosscutting concepts

CCCs | SENSE-MAKING

Crosscutting concepts (CCCs) are an integral component of the Framework and the NGSS, representing ways that scientists and engineers advance their thinking. The CCCs should be used by students to deepen their understanding of a scenario at hand through a range of applications, including:

- Making connections across multiple science experiences, phenomena, and problems
- Probing a novel phenomenon or problem to support new questions, predictions, explanations, and solutions
- Using different CCCs as lenses to reveal further information about a scenario.

Throughout the Task Annotation Project in Science (TAPS), examples of different ways CCCs are addressed in tasks are surfaced, supporting better conversations about what it means to assess the CCCs.

What we've learned about crosscutting concepts in science assessments:

There are **three ways CCCs** are frequently identified in assessments:

IMPLICIT	Tasks 1) mention concepts related to the CCCs, 2) are inherently connected to a CCC, and/or 3) offer students an implicit way to practice or develop using the CCCs. However, **students did not need to bring an understanding of CCC elements to the table to respond to the task**.	! **This does not provide evidence of students' understanding and ability to use the CCCs**
SPECIFIC	Tasks elicit understanding of a specific CCC by prompting students to think about a specific CCC target, and **understanding that specific CCC element is necessary to respond to the task.**	✓ **This provides evidence of students understanding and use of a specific CCC.**
FLEXIBLE REASONING	Tasks require **deep reasoning about highly uncertain or ambiguous**(from the student perspective) situations. In these cases, some kind of CCC understanding is needed to propose a mechanism, question, hypothesis, or solution. Students may bring several different CCCs to the foreground, depending on their ideas, perspectives, and prior experiences.	✓ **This provides evidence of students understanding and ability to use the CCCs flexibly to sense-make.**

In order to make claims about whether students are meeting the standards, tasks must require students to bring their understanding of CCC elements to the table as they sense-make.

Implications for educators and developers

Both **educators and developers** should emphasize tasks that require authentic sense-making—these are the tasks that are most likely to require students to use the CCCs.

Educators and developers should beware of "explicit" red herrings: questions that use the CCCs in prompts or in tasks, but do not require students to bring that understanding to the table. Instead, think about "necessary"—is it necessary for students to understand a grade-appropriate CCC to respond to the task, or can they complete the task successfully without understanding the CCC?

Developers should be clear about how tasks require students to engage with the CCC—and be clear about how student responses should be interpreted and used.

! Assessments should look less like...	✓ Assessments should look more like...
CCC ideas are implicitly part of the task or prompt, but not something students need to bring to the table	Asking students to engage in sense-making that requires the use of CCCs
Scenarios that require students to use a superficial understanding of the CCC (e.g., asking for simple pattern identification on a high school final exam)	Scenarios that require students to use grade-appropriate elements of the CCCs (e.g., asking HS students to propose a mechanism for a phenomenon based on evidence from multiple data sets at different scales).
Phenomena and problems that students can completely address using their expected SEP and DCI understanding.	Phenomena and problems that involve enough uncertainty from the student perspective that DCIs and SEPs are necessary, but not sufficient, for a complete response—bringing the CCC to the forefront.

Some examples of what assessing MS-level CCCs could look like include...

Patterns. Use identified patterns in data to predict future outcomes in specific scenarios that students are unlikely to fully be able to explain with the grade-band DCIs (to distinguish from DCI application), or anticipate additional data to better understand a phenomenon or solve a problem.

Cause and Effect. Critique the conclusion of an experiment by distinguishing between situations that provide correlational rather than causal relationships between variables.

Scale, Proportion, and Quantity. Use observations and mechanisms at a microscopic scale to predict macroscopic events or solve macroscopic problems.

Systems and System Models. Given an observation, propose a mechanism for how a series of events in a different subsystem may account for the observed phenomenon or problem.

Energy and Matter. Analyze the flow of energy through a system to predict what may occur if the system changes. (This example combines two CCCs, if engaged appropriately: energy and matter, and systems and system models.)

Structure and Function. Evaluate the potential uses of a new material based on its molecular structure.

Stability and Change. Given a system in dynamic equilibrium (stable due to a balance between continuing processes) that has become destabilized due to a change, determine which feedback loops can be used to re-stabilize the system.