

Developing Meaningful Science Assessments | Understanding Standards

Authors: Sara Cooper, Katie Van Horne, Dawn Novak, Aneesha Badrinarayan

Ensuring high-quality science assessments requires that assessment developers interpret the learning goals in ways that are consistent with the intent of *A Framework for K-12 Science Education* and state standards that are based on it. One common and major barrier to effective science assessments is an underdeveloped understanding of what knowledge, skills, and abilities are actually needed to meet the vision of the *Framework* or standards like the Next Generation Science Standards (NGSS). More intentional “unpacking” of science learning goals can help science assessment developers build better assessments by ensuring that assessments actually surface what learners are expected to know and be able to do.

Why is unpacking important?

Complex standards like the NGSS and similar standards based on the *Framework* are built on learning progressions that increase in depth and complexity across the grade bands. Understanding grade level learning goals—in order to provide appropriately challenging and equitable learning experiences for all learners—requires an understanding of how the dimensions progress to see where learners have been, where they should be, and where they are going.

What does effective unpacking look like?

While there are many protocols for unpacking, they share the same goal: to fully articulate the knowledge, skills, and abilities learners should be supported in developing and demonstrating through instruction and assessment. Meaningful unpacking requires 1) analyzing the progressions for each dimension to understand what is distinct at each grade band, 2) analyzing the individual elements that comprise a 3D standard to understand the specific components of learner performance, and 3) understanding how those elements work together to provide learners with opportunities to demonstrate rich and complex understandings of science. In order to really understand what it looks like for learners to demonstrate meeting standards like the NGSS, it is important to examine learning targets in the following ways:

For each dimension of multidimensional learning and assessment targets...

- ✓ What is distinct about each DCI, SEP, and CCC element at the targeted grade-band?
- ✓ What does it mean and look like for learners to understand and use each targeted DCI, SEP, and CCC element?
- ✓ How do related DCIs, SEPs, and CCCs inform what learner performance should look like?
- ✓ What prior knowledge from learners’ lived experiences can be used to help learners learn or demonstrate the targeted ideas?
- ✓ What does it look like for learners to develop and use this target over time?

Once developers have a clear understanding of each dimension, it is important to consider how learners would use those dimensions together.

Across dimensions for multidimensional learning and assessment targets...

-
- ✓ What does it look like for learners to use the targeted elements together in grade-band-appropriate ways?
 - ✓ How does the sophistication of the targeted performance change when the dimensions are integrated? How can this be modulated to allow a range of learners to make their thinking visible while maintaining high standards for all learners?
 - ✓ In what ways can learners' cultural funds of knowledge be leveraged to support their learning?

What are the highest leverage unpacking strategies?

- Engage in individual thinking and collaborative sense-making
- Use available tools and resources (e.g. NGSS Appendices, the *Framework*) linked in the unpacking template to dig deeper
- Consider the purpose and audience
 - Match grain size of unpacking to the unpacking purpose (e.g. for an instructional purpose, unpack to a level that clearly shows the essential components needed for lesson-by-lesson incremental learning. For assessment, a 'concept' level is appropriate.)
 - Document the thinking process in a level of detail that is appropriate for the intended audience (e.g. if this is your personal work, short hand and abbreviated notes to cue your thinking are appropriate. If communicating to others, you may need to record more detailed information to make your thinking visible.)
- When possible, build on the work of others rather than starting from scratch—making sense of someone else's unpacking can be an effective and efficient way to understand the standards for some purposes.
- Keep vocabulary words in context. Identify key science terms by describing how learners will use the words to make their thinking visible.
- Revisit your unpacking overtime and revise your work as your thinking and understanding deepens and grows

Target PE or 3D Standard
Target:
What does this PE/3D standard mean in your own words?

After you have completed unpacking the targeted elements, describe what it looks like for learners to use the targeted elements together in grade-band-appropriate ways. *Think about: What would kids say that would represent their use of the ideas in context of a phenomenon? How will these elements be used together to explain a phenomenon, not just a mechanism (ie: where would we see carbon being cycled)?*

How does the **sophistication** of the targeted performance change when the dimensions are integrated? How can this be modulated to allow a range of learners to make their thinking visible while maintaining high standards for all learners?

Target DCI Progression ([ESS](#), [LS](#), [PS](#), [ETS](#))

- Identify the targeted **DCI**(s).
- Copy and paste all element(s) for the targeted **DCI**(s).
- **BOLD** the element(s) from the foundation box aligned to the PE/target for your grade band.
- **BOLD** an element that is similar to the targeted element for above and below grade bands.

[Target DCI]

[Component Idea (e.g. LS1.A)]

K-2

3-5

6-8

9-12

Step 1: What are the overarching themes in my grade band?

- Look at other **DCIs** [within the grade band](#). Start with those in the same topic or DCI bundle. How would you **characterize the science ideas** learners are making sense of in this grade band?
- What themes or patterns do you notice?

Step 2: How does this core idea progress? Analyze the DCI progression:

- Look at the targeted **DCI** [across](#) grade bands. What **similarities and differences** do you notice?
- How are we building upon what learners have learned in **previous** grades? (Notice conceptual versus concrete/procedural understanding present)
- Which aspects of the DCI are developed in **later** grades?
 - Notice what concepts remain in a 'black box'—meaning learners are introduced to the concept without fully understanding all of the hidden mechanisms.



Step 3: What's distinct in my grade band? (Analyze the DCI progression, the clarification statement(s), and the assessment boundary.)

- Notice how we are building upon what learners have learned in **previous** grades.
- Notice which aspects of the DCI are developed in **later** grades.

Step 4: What does it mean for learners to understand and use this DCI element? ([Framework](#) & Clarification Statements)

- What ideas, concepts, sub-concepts, and vocabulary will learners need to show you to make it clear that they understand the DCI target?
 - When identifying vocabulary, clarify the term and explain why learners need to know it (e.g. learners need to know 'photosynthesis' to explain how matter and energy move in plant systems or learners need to know 'decomposer' to describe the organisms responsible for breaking down dead organisms and recycling matter in an ecosystem).

Step 5: What everyday experiences or knowledge from outside of school could we connect to help learners understand the target ideas?

- How can learners use these ideas to **explain real-world phenomena or solve real-world problems**?
- What **ideas might learners already have** about these ideas?
- What **questions** may learners have related to these ideas about how the world works?
- What **scaffolding** might my learners need to fully engage in this particular **DCI** element?

Step 6: What cultural assets will your learners bring related to this **DCI**?

- In what ways is this topic particularly relevant from cultural perspectives?
- What scientific terms may have cultural connections?
- How might you leverage learners' cultural funds of knowledge to support this learning?

Target SEP Progression

- Identify the targeted **SEP**.
- Copy and paste all element(s) for the targeted **SEP**.
- **BOLD** the element from the foundation box aligned to the PE/target for your grade band.
- **BOLD** an element that is similar to the targeted element for above and below grade bands.

[Target SEP]

Description

Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
Introductory text			

Step 1: What are the overarching themes in my grade band?

- Look at other **SEPs** within the grade band. How would you **characterize the ways learners engage in practices** to make sense of science ideas in this grade band?
- What themes or patterns do you notice?

Step 2: How does this practice progress: Analyze the **SEP** progression.

- Read the **introductory text** for the targeted **SEP** across grade levels. What similarities and differences do you notice?
- Read **all of the elements** for the targeted **SEP** across grade bands. What themes or patterns do you notice?

Step 3: What's distinct in my grade band? ([SEP](#) Progression, Assessment Boundaries, & [Framework](#))

- Notice how we are building upon what learners have learned in **previous** grades.
- Notice how the [SEP](#) develops in **later** grades.

Step 4: What does it mean for learners to understand and use this practice to figure something out? ([Framework](#) & clarification statement)

- Read the **description** for the targeted [SEP](#). What does it mean for learners to understand and use this [SEP](#) **in general**?
- What does it look like for learners to use this **particular element** in the context of this 3D standard?
- What **related SEPs are embedded** in the element (e.g., [asking questions](#) to [explain](#))?

Step 5: What everyday experiences or knowledge from other content areas might learners bring to help them develop this target practice?

- Where are learners using and experiencing the practice outside of the science classroom?
- How might I use these experiences or knowledge to support learners in using this **particular element** in the context of this 3D standard?

Step 6: What cultural assets will your learners bring related to this [SEP](#)?

- How might cultural values affect the ways learners engage with the SEPs? (e.g. How is active questioning viewed by your learners' cultural communities? What types of evidence—empirical or storytelling and narratives—are valued by your learners and their communities?)
- How might you leverage learners' cultural funds of knowledge to support this learning?

Target CCC Progression

- Identify the targeted **CCC**.
- Copy and paste all element(s) for the targeted **CCC**.
- **BOLD** the element from the foundation box aligned to the PE/target for your grade band.
- **BOLD** an element that is similar to the targeted element for above and below grade bands.

Target CCC:

Description

Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12

Step 1: What are the overarching themes in my grade band?

- Look at other **CCCs** within the grade band. How would you **characterize the ways learners use these concepts** to make sense of science ideas in this grade band?
- What themes or patterns do you notice?

--

Step 2: Analyze the CCC Progression.

- Read **all of the elements** for the targeted **CCC** across grade bands. What themes or patterns do you notice?

--



Step 3: What's distinct in my grade band? (CCC Progression, Assessment Boundaries, & [Framework](#))

- Notice how we are building upon what learners have learned in **previous** grades.
- Notice how the **CCC** develops in **later** grades.

Step 4: What does it mean for learners to understand and use this crosscutting concept to figure something out? ([Framework](#) & clarification statement)

- Read the **description** for the targeted **CCC**. What does it look like for learners to use this crosscutting concept **in general**?
- What does it look like for learners to use this **particular element** in the context of this 3D standard?
- What other **related CCCs** are embedded in the targeted elements? (e.g. Patterns can be used to identify cause-and-effect relationships.)

Step 5: What everyday experiences or knowledge from other content areas might learners bring that could help them understand and use the target **CCC**?

- How do we expect learners to already use this **CCC**?
- How might I use these experiences or knowledge to support learners in using this **particular element** in the context of this 3D standard?

Step 6: What cultural assets will your learners bring related to this **CCC**?

- How might different cultural ways of knowing inform the ways learners understand and use **CCCs**? (e.g.
- How might you leverage learners' cultural funds of knowledge to support this learning?



Check with the Framework

What does the Framework have to say about your grade band?

- Read [Chapter 2](#), pages 33-34, Progressions Across K-12

Provide a summary here.

