Prompts for Integrating Crosscutting Concepts Into Assessment and Instruction

The new vision for science education features a three dimensional view of learning that involves: science and engineering practices, crosscutting concepts, and disciplinary core ideas. Many educators already incorporate crosscutting concepts into their teaching, but may still be looking for ways to amplify these concepts or to make them more explicit for their students, including in their classroom assessments.

This set of prompts is intended to help teachers elicit student understanding of crosscutting concepts in the context of investigating phenomena or solving problems.

These prompts should be used as part of a multi-component extended task. They should not be used in isolation, and the blanks provided are intended to be filled using the content of the scenario presented at the beginning of the multi-component task. The prompts can be open-ended, as shown below. They can also be turned into multiple-choice questions. These prompts were developed using the Framework for K-12 Science Education and Appendix G of the Next Generation Science Standards, along with relevant learning sciences research.

These prompts are currently being tested or evaluated in the field. We request you send feedback and information about how you have used the prompt to william dot penuel at colorado dot edu.

Please note that some prompts may not be suitable for students in early grades, while others may be low-level for high school students. Designers should consult the learning progressions in Appendix G of the NGSS to choose a prompt that is appropriate for different grade level bands.

Our team has also created a similar tool to help educators create tasks that incorporate the science and engineering practices into their teaching, found at stemteachingtools.org/brief/30. You can learn how to develop 3D formative assessments here: http://tinyurl.com/3Dassessmentdevelopment

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Crosscutting Concept: Scale, Proportion, and Quantity

A Framework for K-12 Science Education description of **scale, proportion, and quantity**: In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

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*When eliciting understanding of **quantity and proportion** presented as data in the scenario, ask students:*

- How long is ________?
- How much does ________ weigh?
- What is the temperature of ________?
- What is the volume of ________?
- How could you compare how much of [property or characteristic] these two different ______ presented in the scenario have?
- What would make a good measure of [property, characteristic, or process] to investigate the phenomenon presented in the scenario? Why is that a good measure?
- What is the ratio of ________ and ________ in the data presented?
- How do the ratios of ________ and ________ at [Time 1/Sample 1] and [Time 2/Sample 2] compare?
- What is the proportion of ________ that are ________?
- How do the proportion of ________ that are ________at [Time 1/Sample 1] and [Time 2/Sample 2] compare?
- Is the relationship between ________ and ________ linear or exponential, or something altogether different? How does the pattern in the data support your conclusion?
- What equation could be written to express the relationship between quantities of ________ and quantities of ________? Explain your answer.
- On the basis of the data you have, what do you predict would be the effect of a change in ________ on ________?

*When eliciting students' understanding of **scale**, ask students:*

- Is the model presented at a [smaller/larger/the same] scale than the phenomenon as you might observe it directly?

Does the model describe processes that are [faster/slower/the same speed*]* than the phenomenon as you might observe it directly?

- What scale should be used to investigate the mechanisms at work in this system? Why is that the right scale for this system?
- What scale of a model would allow you to gain insight into ________?
- What scale of a model would allow you to test the design of ________ in the classroom?

*When eliciting students' ability to **change scales** to investigate phenomena that are too large or small to see, or too long or short to observe directly, ask students:*

- Why could [people in the scenario] see ________ when they observed it [under a microscope/with a telescope], but not when they looked just with their eyes?
- How could we test whether ________ is changing, even though it looks like it is not?
- Which of the patterns presented in the scenario do you think could be observed at a [faster/slower, smaller/larger] scale? Why?