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

STEM teaching tools

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STEMteachingtools.org/brief/41

Crosscutting Concept: Patterns

A Framework for K-12 Science Education description of **patterns:** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Ask after presenting students with data from an experimental study focused on isolating causal variables as part of the scenario:

- What patterns do you observe in the data presented above in the [table, chart, graph, model output]?

- Are there ways you can use mathematics to summarize the data that might help you see patterns in the data more clearly, to determine whether_____ causes _____?

- What does the pattern of data you see allow you to conclude from the experiment?

- Does the pattern in the data support the conclusion that _____ is caused by _____? Why or why not?

- Are there any other data that are needed to test whether _____ causes _____?

- How does the pattern of data at the _____ scale help you explain [phenomenon at different scale]?

Ask after presenting students with observational data as part of the scenario:

- What patterns do you observe in the data presented above in the [table, chart, graph, model output]?

- What does the pattern of data you see allow you to conclude about _____?

- Does the pattern in the data support the conclusion that _____ is related to _____? Why or why not?

- What mathematical representations of the data could help you identify patterns in the data?

- What observations could you ask next, to help explain the pattern in the data?

- What kind of mathematical function best fits the pattern of data you see?

- For bivariate data: How strong is the correlation between x and y? (Calculate correlation coefficient)

Ask when time is a variable:

- How is_____ changing over time?

- What do you predict will happen to [variable] in the future? Use the pattern you see in the data to justify your answer.

- How is the rate of change changing over time? How could you represent that rate of change mathematically?

Ask when asking students to classify (e.g., physical objects, organisms) presented as part of the scenario:

- What are some similarities and differences among the _____ above?

- What is one way you could classify or group these _____, to create groups of _____that are similar to each other? Describe the attributes (characteristics) you are using to classify the _____.

- Follow up question: To which of your groups would a _____ with the following characteristics belong: _____, _____, and _____.
- How similar or different are [objects or organisms that are similar at macroscopic scale] at the microscopic scale?
- How similar or different are [objects or organisms that are similar at microscopic scale] at the macroscopic scale?

After presenting students with data on performance of a designed object or system:

- What patterns do you observe in the data presented above in the [table, chart, graph, model output]?
- Are there mathematical summaries of the data that could help you describe more clearly the success or failure of the designed system?
- What does the pattern of data you see allow you to conclude from the test of the system?
- *If the pattern of data is indicative of failure:* On the basis of the patterns you see, what appears to be the cause of failure in the system?