ABSTRACT: This study examines the ways in which teachers provide students with written scaffolds in assessment tasks and the impact of these on students’ abilities to demonstrate a core disciplinary proficiency—constructing evidence-based explanations. Data include 76 assessment tasks designed by 33 science teachers and 707 samples of student work. We found five types of scaffolding embedded in assessments that allowed students to make their reasoning explicit: (a) using contextualized phenomena, (b) rubrics, (c) checklists, (d) sentence frames, and (e) encouraging students to draw explanatory models in combination with written explanation. Analyses showed that all five forms of scaffolding were significantly associated with the quality of student explanation even when controlling for teacher variance and student background. Providing contextualized phenomena had the greatest impact on the quality of student explanations, both by itself and in combination with other scaffolding. The results indicate that strategic combinations of scaffolds can prompt students across all achievement levels to more readily use what they know to produce evidence-based explanations, but that the scaffolding must be of high quality.


**Scaffolding With Sentence Frames.** (p. 13)

Two different forms of sentence frames appeared in the assessments: focusing versus connecting. Focusing sentence frames (Level 1) prompted students to draw their attention to the phenomena and explain them by providing linguistic lead-ins. For example, in the assessment about the gas laws using the phenomenon of changes in a balloon sitting on a table, students were prompted with a sentence frame like this: “What I saw was ______________,” “Inside [the balloon] the particles were ______________.” and “I know this because ______________.” In contrast to focusing sentence frames, connecting sentence frames (Level 2) prompted students to make deeper connections among key components of scientific explanation, such as evidence and reasoning. For example, in a cell membrane assessment (see Figure 2), the teacher provided the following prompt to support students’ use of evidence: Evidence for ______________ comes from the _____ [activity or reading]__ because_____________.

**Sentence Frames:**

*Guiding Disciplinarily Valid Ways of Thinking and Talking* (p. 27)

We conjecture that well-designed sentence frames support disciplinary and epistemic reasoning. They also help students express their thinking semantically. “Focusing” sentence frames (i.e., Level 1) usually took the form of “things happened because “ and provided a semantic structure to construct causal explanations about the focal event. Previous studies have shown that students often have difficulty addressing the main question or issue when prompted for explanations (e.g., Ruiz-Primo et al., 2010). By providing a “focusing” sentence frame, students are guided into the problem space. Furthermore, more sophisticated sentence frames, specifically “connecting” sentence frames, provided additional support for using epistemic structures for writing scientific
explanations. As demonstrated in the cell membrane assessment (Figure 2), sentence frames guided students to construct their explanation while examining the relationship between evidence and reasoning. Providing clear examples of appropriate language use for the performance of specific academic functions, such as the use of evidence, is a critical form of scaffolding (Walqui, 2006). It seems that well-designed sentence frames have potential to support the epistemic and semantic challenges of constructing evidence-based explanations. In our study, however, teachers used sentence frames infrequently ($n = 10, 13.1\%$), and upper level sentence frame were rarely used. More evidence is needed to understand the roles of different forms of sentence frames in supporting students’ productive disciplinary participation.

Figure 2. Cell membrane assessment: How does the paramecium get everything it needs to survive?