Stackable, Instructionally-embedded Portable Science (SIPS) Assessments Project

SIPS Assessments Complexity Framework

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The Stackable, Instructionally-embedded, Portable Science (SIPS) Assessments Complexity Framework (see Exhibit 1) describes four components of complexity that support the principled design and evaluation of prompts, tasks, and assessments that elicit evidence about the degree to which students can "demonstrate proficiency in integrating Scientific and Engineering Practices with important Disciplinary Core Ideas and Crosscutting Concepts to scientifically investigate and understand natural phenomena and solve important science and engineering design problems" (SIPS Overarching Claim). Adapted from the Cambridge Alignment Methodology (Forte, et al., 2022) and informed by aspects of Achieve's Framework to Evaluate Cognitive Complexity in Science Assessments (Achieve, 2019), the SIPS Assessments Complexity Framework (hereafter referred to as *The Framework*) is grounded in sense-making and students' ability to flexibly apply knowledge through the integration of the **same and new/different combinations of dimensions** within the Next Generation Science Standards (NGSS Lead States, 2013) performance expectations (PEs) from a unit topic bundle, in the context of a phenomenon or phenomenon-rooted design problem based on the focal DCIs.

The sophistication of students' ability to demonstrate sense-making is characterized by their ability to (a) use disciplinary core ideas (DCIs), scientific and engineering practices (SEPs), and crosscutting concepts (CCCs) together in the service of sense-making about a phenomenon or problem, and (b) engage with and respond to prompts and tasks designed using variable features[1] representing combinations of Low, Moderate, and High complexity designations.

The SIPS Complexity Framework's four components relate to:
- the **degree and nature of sense-making about phenomena or problems**
- the **complexity of the presentation**
- the **cognitive demand of response development**
- the **cognitive demand of response production**

Uses of The Framework

Performance Level Descriptors
The Framework serves as the basis for articulating general definitions of complexity within the policy and unit-specific range performance level descriptors (PLDs). These general definitions of complexity are shared across units. For example, how SIPS defines complexity for a level 3 performance in one unit is the same as how a level 3 performance is defined in another unit. Within the unit-specific range PLDs, these commonly defined levels are further contextualized with the specific DCIs, SEPs, and CCCs in focus for the unit.

Design Patterns and Task Specifications
The Framework and PLDs inform the development of variable task features within the End-of-Unit (EOU) assessment design patterns and task specifications. Variable features describe aspects or features of the tasks and prompts that may be varied to shift the difficulty or focus (e.g., complexity of scientific concepts to be modeled; use of domain-specific vocabulary and provided definitions; phenomena addressed in the scenario; number of data points to graph). These variable features address the

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[1] Aspects of assessment situations that can be varied to shift complexity or focus.

components of The Framework by representing characteristics of varying degrees of low, moderate, and high complexity that inform the design of tasks and prompts.

Student Profiles
Unit-specific student profiles describe students' ability to integrate the dimensions of the DCIs, SEPs, and CCCs represented in the PEs within the unit bundle to reason and sense-make about phenomena and design problems. Collectively, the four student profiles at each grade describe expectations of learning for students as they progress toward achievement of end-of-year (EOY) learning outcomes. The complexity components of The Framework serve as a resource to articulate how these expectations of student learning can be characterized as higher degrees of sophistication and application of sense-making in the student profiles from unit to unit.

Thus, The Framework is a means to characterize designations of low, medium, and high complexity across the four components, which in turn inform the design of a coherent system of assessments along a year-long instructional pathway. The EOU assessments and the nature and types of learning investigations students engage in during a unit of instruction, in terms of low, moderate, and high complexity, are intentionally varied to ensure that all students can make their thinking visible while maintaining the rigor and expectations of the PEs within the unit of study. Just as the units across the year focus on learning opportunities that contribute to higher order thinking and reasoning skills, so too do the SIPS EOU assessments.

Exhibit 1. SIPS Assessments Complexity Framework

Component	Complexity		
	Low	**Moderate**	**High**
Connections to Curriculum and Instruction — **A.1 Degree and nature of sense-making about phenomena or problems**	• Requires one or two dimensions • One dimension may have a greater degree of emphasis than another • Requires previously learned ideas or concepts	• Requires integration of two dimensions in the service of sense-making • Requires integration of same or different combinations of dimensions as represented in the PE bundle • Requires a combination of previously learned ideas or concepts and newly presented information	• Requires integration of three dimensions in the service of sense-making • Requires integration of same or different combinations of dimensions as represented in the PE bundle • Requires a combination of previously learned ideas or concepts and newly presented information
Characteristics of the Tasks — **B.1 Complexity of the presentation**	• The amount and type of information provided in the scenario supports limited simple connections among ideas or concepts • Provides few, simple graphics/data/models • Includes definitions or examples • Phenomenon or problem presented in a concrete way with high level of certainty	• The amount and type of information provided in the scenario supports multiple evident connections among ideas or concepts • Provides graphics/data/models • Limited use of definitions or examples • Phenomenon or problem presented with some level of uncertainty	• The amount and type of information provided in the scenario supports multiple and varied complex connections among ideas or concepts • Provides complex graphics/data/models • Phenomenon or problem presented with high-degree of uncertainty
B.2 Cognitive demand of response development	• Requires well-defined set of actions or procedures • Requires a connection or retrieval of factual information	• Requires application of ideas and practices given cues and guidance	• Requires selection and application of multiple complex ideas and practices

	• Response requires a low level of sophistication with routinely encountered well-practiced applications	• Requires drawing relationships and connecting ideas and practices • Response requires a moderate level of sophistication with typical but relatively complex representation of ideas and application of skills	• Requires high degree of sense-making, reasoning, and/or transfer • Response requires a high level of sophistication with non-routine or abstract representation of ideas and application of skills
B.3 Cognitive demand of response production	• Responses include selection from a small set of options presented as text (e.g., word, short phrase) or other formats (e.g., or a simple graphic or process)	• Responses include one or more sentences or a paragraph, a moderately complex graphic, or multiple steps in a simple or moderately complex process	• Responses include multiple paragraphs, multiple graphics of at least moderate complexity, or multiple steps in a complex process

References

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