

Integrating Science Practices Into Assessment Tasks

The Next Generation Science Standards call for the development of “three-dimensional science proficiency,” that is, students’ integrated understanding of disciplinary core ideas, science and engineering practices, and crosscutting concepts. Assess three-dimensional science proficiency requires *multicomponent tasks* (National Research Council, 2014). These are a set of prompts linked by a common scenario, phenomenon, or engineering design challenge.

Developing three-dimensional science assessments is challenging. Most current assessments focus on testing students’ knowledge of science facts. Few focus on having students apply their understanding of disciplinary core ideas in the context of engaging in a science or engineering practice. Fewer still make connections to crosscutting concepts.

The “task format” templates included in this document are tools to help teachers and district leaders design three-dimensional assessment tasks. They are based

on the language of *A Framework for K-12 Science Education* and the NGSS Evidence Statements, focusing on all eight science practices and two engineering practices. These task formats represent different ways that assessment tasks can be written to engage students in science practice. They do not specify precisely which disciplinary core ideas are to be integrated into tasks, which would be determined by the team designing the assessments.

The different formats get at different aspects of a given science and engineering practice. Some formats are likely to be more demanding cognitively for students than others. The idea of presenting multiple formats is to give task developers a sense of the range of tasks that can be written. A good “test” of a student’s grasp of a particular practice, in the context of a disciplinary core idea and crosscutting concept, would be comprised of multiple tasks and draw on multiple formats.

How to Read a Template Task

Scenario presented to students

Format	Task Requirements for Students
1	<p>Present students with a textual description of an investigation of an observable phenomenon, <i>then</i></p> <p>Ask students to formulate a scientific question relevant to Investigating that phenomenon.</p>

Task(s) for students to complete

Potential Task Formats: Analyzing and Interpreting Data

Relevant definitions

- A *pattern of evidence* from data is what the data say (“The population of white-colored moths disappeared in cities,” or “The birds’ tail feathers are whiter in the mountains than in the city”)

Format	Task Requirements for Students
1	Describe an engineering design problem, a solution to the problem and a set of data from a test of the solution, <i>then</i> Ask students to evaluate which design solution best addresses the problem and constraints.
2	Present students with a scenario that describes an investigation, the phenomenon under investigation, and one or more recorded observations from the investigation directly relevant to explaining the phenomenon, <i>then</i> Ask students to make a prediction and compare it to the observations given, Ask students to organize the data and describe how this organization helps them analyze, Ask students to use tables or graphical displays to identify and describe the patterns they see in the organized data, <i>and</i> Ask students to student to describe how the patterns of evidence in the data help to explain the phenomenon.
3	Present students with a scenario that describes an investigation, the phenomenon under investigation, and multiple recorded observations from the investigation, only some of which are relevant to explaining the phenomenon <i>and</i> Ask students to describe which data are relevant to explaining the phenomenon under investigation, Ask students to analyze the relevant data using mathematics or logical reasoning, <i>and</i> Ask students to interpret the analysis as evidence for explaining the phenomenon.
4	Describe an investigation, the phenomenon under investigation, and one or more recorded observations from the investigation, <i>then</i> Ask students to organize, represent, and analyze the data in at least two different ways, <i>and</i> Ask students to compare how the representations and analyses help them to identify patterns in the data.
5	Present students with a scenario that describes an investigation, the phenomenon under investigation, and one or more recorded observations from the investigation, <i>then</i> Ask students to construct graphical displays of data and identify relationships in data sets, Ask students to use grade-level appropriate mathematics and/or statistics to analyze the data including mean, median, mode, and variability, <i>and</i> Ask students to draw conclusions supported by their mathematical analysis, Ask students to describe the limitations in data analysis and in relation to the methods for data collection.
6	Present students with a scenario that describes a hypothesis and a phenomenon under investigation, <i>then</i> Ask students to create a data set that would support the hypothesis, <i>and</i> Ask students say how the pattern of evidence from the data would support the hypothesis.

7	<p>Present students with a scenario that describes tests of engineering design solutions and gives students the relevant data from those tests, <i>then</i></p> <p>Ask students to analyze the data to evaluate and propose refinements to the design solutions, <i>and</i></p> <p>Ask students to compare the analyzed data to criteria for success and then define an optimal operational range for the design solution (an object, tool, process, or system).</p>
8	<p>Present students with a scenario that describes an investigation, the phenomenon under investigation, and one or more recorded observations from the investigation, <i>then</i></p> <p>Ask students to organize, represent, and analyze the data in at least two different ways,</p> <p>Ask students to use tools (digital tools, if appropriate), technologies, or models and apply concepts of statistics and probability (e.g., functions that fit the data, slope, intercept, and correlation coefficient) to analyze the data,</p> <p>Ask students to compare how the representations and analyses help them to identify patterns in the data,</p> <p>Ask students to make a valid and reliable scientific claim using their analyses as evidence, <i>and</i></p> <p>Ask students to consider the limitations of their data analysis.</p>
9	<p>Present students with a scenario that describes an investigation, the phenomenon under investigation, multiple recorded observations from the investigation, and the results of analyses <i>then</i></p> <p>Ask students to use the results to explain the phenomenon.</p>
10	<p>Present students with a scenario that describes an investigation, the phenomenon under investigation, and multiple datasets including a large data set, an archival data set, data generated from a model or self generated, or data presented in graphical format, <i>then</i></p> <p>Ask students to identify relationships in the data including temporal and spatial relationships,</p> <p>Ask students to compare the datasets for consistency of measurements and observations,</p> <p>Ask students to analyze the datasets using mathematics, as appropriate, <i>and</i></p> <p>Ask students to use the results from multiple datasets to explain the phenomenon.</p>
11	<p>Present students with a scenario that describes an investigation, the phenomenon under investigation, one or more recorded observations from the investigation, the results of analyses, and an interpretation of the data <i>then</i></p> <p>Ask students to assess whether the interpretation is consistent with the data and the analysis, <i>or</i></p> <p>Ask students to evaluate how the interpretation is affected by variation or uncertainty in the data.</p>
12	<p>Present students with a scenario that describes a phenomenon using text, images, video, and/or data, and a working explanation or a model of the system, and new data not included in the explanation or model, <i>then</i></p> <p>Ask students to evaluate the impact of new data in relation to the explanation or the model, <i>and</i></p> <p>Ask students to revise the explanation or model based on the new data, if appropriate.</p>