Achieve

SCIENCE TASK ANNOTATION

ANNOTATION KEY

EQUITY
Supporting a wide range of diverse students.

SCENARIOS
Information provided to elicit performances.

SEPs
Opportunities to demonstrate science and engineering practices.

DCIs
Opportunities to demonstrate understanding of disciplinary core ideas.

CCCs
Opportunities to demonstrate understanding of crosscutting concepts.

SENSE-MAKING
Opportunities for reasoning about phenomena and problems.

ASSESSMENT PURPOSE
Highlights how the task features connect to intended assessment use.

Next Generation Science Assessment

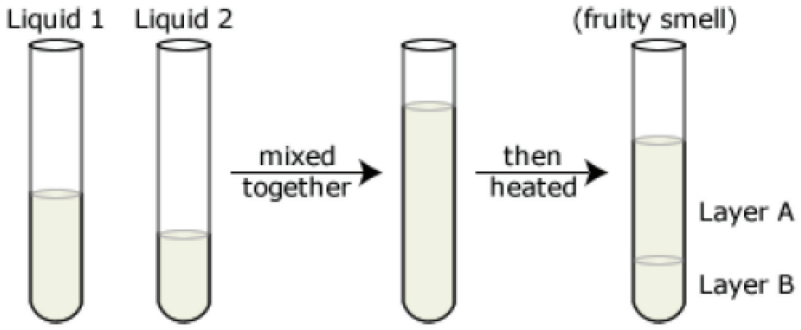
LAYERS IN A TEST TUBE

Miranda placed two liquids in a test tube. The two liquids were soluble in each other and mixed together. She then heated the test tube to see if the liquids would react. After heating the liquids, two separate layers formed — Layer A and Layer B.

The specific set of instances being explored in this task are the observations associated with heating a mixture of two liquids. The task scenario uses simple language, a well-labeled diagram, and a well-crafted data table to illustrate the experimental set up and outcomes in ways that are accessible to a wide range of students.

While this scenario is understandable for middle school students, it is not set up to be relevant to students. It is not made clear to students why this is a phenomenon worth investigating, or what uncertainty they need to use their scientific understanding to make sense of. As a result, the scenario drives a largely confirmatory task that focuses on eliciting DCI and SEP understanding with limited sense-making.

SCENARIOS EQUITY



LAYERS IN A TEST TUBE (CONTINUED)

Miranda tested and measured some properties of the liquids and layers and calculated the density of these substances, recording the data in Table 1.

Table 1. Data of sample **before** and **after** heating.

	Sample	Volume	Solubility on Water	Odor	Boiling Point	Density	Temperature
Before Heating	Liquid 1	0.45 cm^3	Yes	alcohol	78.4 ˚C	0.79 g/cm^3	25 ˚C
	Liquid 2	0.35 cm^3	Yes	vinegar	118.5 ˚C	1.05 g/cm^3	25 ˚C
After Heating	Layer A	0.40 cm^3	No	none	77.1 ˚C	0.90 g/cm^3	48 ˚C
	Layer B	0.30 cm^3	Yes	fruity	100.0 ˚C	1.00 g/cm^3	48 ˚C

The data in this table covers many different kinds of observations, but almost every observation follows the same pattern—that after heating, there was a change in the properties of the substances. Because the same pattern is consistently observed every time, students only need to know that chemical reactions occur when new substances form, and that new substances have different properties from the original substances—this makes it more likely that the DCI elicited will be at the 5th grade level, although the open-ended nature of the question allows students to show degrees of sophistication in their understanding.

DCIs SEPs

Use the data in Table 1 to answer the three questions below.

Next Generation Science Assessment

LAYERS IN A TEST TUBE (CONTINUED)

Question 1: State whether mixing and then heating Liquid 1 and Liquid 2 caused a chemical reaction to occur by relating the liquids **before** heating to the layers

Question 2: Describe what information from the data table you would use as evidence to support your claim and explain why you used it. after heating.

Question 3: Support your claim with evidence and reasoning using information in the data table.

In order to successfully answer all three questions, students must use their understanding that chemical reactions resulting in new substances with new properties are formed after mixing 2 (or more) substances to interpret the provided data in order to make and support a claim about the scenario. This most closely connects to:

- **grade 5 DCI element 5.PS1.B "When two or more different substances are mixed, a new substance with different properties may be formed".** These questions rely upon students understanding the general idea that chemical reactions can be identified by changes in properties—to reach middle school sophistication, the questions would need to also elicit a more sophisticated understanding of physical and chemical properties under given conditions. It should be noted, however, that the phrase "chemical reactions" is introduced in middle school, and connecting the 3-5 element to the idea of chemical reactions is one step on the way to MS-level understanding.
- **3-5 Analyzing and Interpreting Data element "analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation."** These questions require students to look at a data set, and make similar comparisons (before heating and after heating across liquid 1, liquid 2, layer A and layer B) several times to support the claim.
- **3-5 Constructing explanations element "use evidence to construct or support an explanation…".** These questions rely on students using a single source of data and a single set of observations to construct an explanation.
- **3-5 Patterns element "similarities and differences in patterns can be used to sort, classify, communicate…natural phenomena."** Students have to use a simple understanding of patterns to evaluate the data provided to support their ideas. While this is significantly overlapping with the data analysis, their understanding of patterns would likely help students work through the data and generate evidence.

DCIs SEPs CCCs SENSE-MAKING

Questions 1, 2, and 3 appear to be designed to scaffold students through a form of claim, evidence, and reasoning— Interpretations of student responses for each question and the task as a whole should take this into account (e.g., if students don't provide complete reasoning in Q3, it might be because they did not think to cite the evidence identified in Q2. This would provide a potential window into students' facility with SEP #6 Constructing Explanations.)

EQUITY CONNECTION TO ASSESSMENT PURPOSE

LAYERS IN A TEST TUBE (CONTINUED)

Question 1: State whether mixing and then heating Liquid 1 and Liquid 2 caused a chemical reaction to occur by relating the liquids **before** heating to the layers **after** heating.

Question 2: Describe what information from the data table you would use as evidence to support your claim and explain why you used it.

Question 3: Support your claim with evidence and reasoning using information in the data table.

Completion status

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