HS CHEMISTRY: CONSERVATION OF MATTER

Introduction:

This task asks students to describe why, when a certain amount of iron wool is burned, the resulting substance has more mass that the iron wool did in the first place. This task is intended to be used as an assessment of student understanding of an unpacked "part" (learning performance) of a performance expectation (PE).

STANDARDS:

This task is intended to assess a learning performance (LP) that was derived from the following NGSS PEs:

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

LP: Students construct a model using mathematics and computational thinking to demonstrate that atoms are conserved during a chemical reaction.

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.

✓ STRENGTHS

The **task focuses on a specific, intriguing observation that has been problematized**. This gives students something to figure out, allowing them the opportunity to use multiple dimensions to sense-make.

The task scenario **uses multiple modalities (text, photographs) and a limited reading load** to convey the relevant and salient aspects of the phenomenon, supporting students who may struggle with reading.

The task **scaffolds students' explanation of the phenomenon** first asking them to balance the equation and draw a molecular-level picture of the products of the reaction, before asking them to use that thinking as reasoning for why there was more mass in the product of the reaction than the steel wool starting material. This gives students **multiple ways (equations, drawings, written descriptions) to show their understanding of conservation of matter.**

The task **includes a clear assessment target (LP) and surfaces student understanding of that target**, building toward the targeted PE.

Throughout the task, students have to **use mathematical thinking (SEP) and their understanding of the conservation of matter (DCI) to make sense of the phenomenon.**

! OPPORTUNITIES FOR IMPROVEMENT

The task focuses on relatively simple use of mathematical and computational thinking as well as an understanding of the DCI that is more closely connected to middle school expectations. This in and of itself is not a weakness, as these are important steps to build toward the HS expectations—however, it would be helpful if they were **specifically identified as below-grade-level SEPs and DCIs, to help support appropriate interpretation of student responses.**

Because students are given so much information about the products and the reactants between the scenario and questions A and B, **deep conceptual understanding of conservation of matter might be conflated with a simplistic counting exercise.**

Throughout the task, the **SEPs are present but often backgrounded** (below grade-level, representations rather than sense-making) **and are used in service of making student understanding of the DCI really apparent.** To fully meet the learning performance and provide more evidence of students' understanding and use of the SEPs, it would be helpful if the SEPs were foregrounded more frequently.

How does this task support all students?

✓ The task includes several features that support a wide range of learners. This includes a clearly and simply worded phenomenon-based scenario; many opportunities for students to make their thinking visible in different ways, including equations, representations, and written explanations; clear scaffolding throughout the task; and and language that can help students understand what is being investigated and why.

What are the major takeaways?

SUMMARY POINTS:

Overall, this task focuses on surfacing student understanding related to the targeted DCIs via the SEPs to explain the phenomenon, an important step toward eliciting information about student proficiency with the targeted PE. The task offers students opportunities to practice parts of many SEPs as they make their thinking visible.

SUGGESTED IMPROVEMENTS

This task would be improved if:

1. The task was modified to require more meaningful engagement of the SEPs and CCCs—this would likely require the scenario to shift and include more complex information such that students have to use the SEPs and CCCs, along with the DCIs, in service of sense-making.
2. The task more clearly identified when student thinking is being elicited at the MS-level, to support clearer interpretation of student progress.

How should this task be used?

This task can be used as a helpful check on student understanding of parts of the DCIs related to conservation of matter during or after instruction, but should not be used in isolation to make inferences about students' ability to use the SEPs and CCCs, engage in grade-appropriate three-dimensional performances in service of making sense of phenomena, or as evidence of student proficiency on the performance expectation. The task could certainly be used as part of a larger assessment instrument, with this part of the assessment being used to elicit evidence of DCI and some SEP use.