9TH GRADE INTEGRATED SCIENCE: ENERGY AND MATTER ACROSS DISCIPLINES

*Note: this summary document refers to a **video** of students engaging in a performance task. Because the video is an edited snapshot and not easily annotated, this document does not include a complete evaluation of the task—instead, the task is included to show a different kind of assessment example.*

Introduction:

This task is a classroom-embedded transfer task focused on energy and matter flows in life and physical science systems. Prior to the class time recorded here, students had been considering energy within life science systems. To elicit evidence of how students' understanding of energy and matter flow is evolving, this task asks students to transfer that understanding between life and physical science contexts by working with a group to 1) create and describe the mechanisms underlying their design of a Rube Goldberg machine, and 2) connect ideas and observations from both science domains to construct an argument for which organism is the most efficient source of energy for a human and why (connected back to the organism's role within its ecosystem). The task includes both individual and group artifacts of student thinking.

STANDARDS:

This task is intended to assess NGSS Performance Expectations:

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Note: students are building toward the knowledge and skills that would allow them to demonstrate the PEs and targeted elements of each of the dimensions, which are end of 12th grade goals—as a result, the embedded performance assessment(s) are intended to elicit a range of student responses, some of which may be at the MS level.

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

Student interest and ideas are identified by the teacher as driving factor for the context of the task.

The task scenario—particularly the component that asks students to use the understanding they developed during their study of energy transfers in physical science to make a claim about efficient organisms in life science—**requires sense-making using multiple dimensions.**

Sense-making grounded in DCIs, SEPs, and CCCs is heavily foregrounded by emphasizing reasoning based on the three dimensions, including:

- When students are asked to make a supported claim about which organism is the most efficient for humans, they have to use MS and HS aspects of SEPs (engaging in argumentation from evidence, communicating information), DCIs (HS.PS.3.A, 3.D, 2.B) and CCCs (energy and matter, cause and effect).
- Throughout the video, students share ideas and claims with the teacher as well as peers, and they are routinely pressed to share their evidence and reasoning, rather than being told their ideas is right or wrong.

! OPPORTUNITIES FOR IMPROVEMENT

While the task emphasizes eliciting student understanding, it is **not clear what feedback every student receives about their understanding and progress,** and how this is connected to further learning opportunities. Because this is a 9th grade task and students are expected to be building toward the HS expectations without fully meeting them yet, it is especially important that the users of the task be clear on 1) which aspects of the HS expectations are being met at the HS level and which need to continue or be cultivated, and 2) how to both interpret that information from student responses as well as provide feedback about that progress to students.

The **purpose of the task, and how the resulting information would be used formatively or summatively, is unclear.**

While the Rube Goldberg Machine component of the task was developed in response to student interest, it should be noted that this walks the line of an activity that seems fun and interesting, but **may not be engaging to all students unless it is intentionally designed to do so.**

✓ STRENGTHS

This task **uniquely focuses on the crosscutting concepts (CCCs)** in a number of ways, including:

- Providing CCC language directly in student prompts. We see this in how the task is set up, how the teacher facilitates the conversation, and in students' discourse with their peers.
- Asking students to use their understanding of energy and matter flow within systems and across disciplines in uncertain contexts (e.g., when considering efficiency, something students have not explored yet).
- Leveraging classroom culture that emphasizes respectful discourse, with a focus on reasoning grounded in ideas about systems.

The task **integrates science and engineering** DCIs and SEPs together as students design their Rube Goldberg machine, and make connections between observations during that process and new ideas about efficiency.

The task routinely provides students with opportunities to **make choices and to make their own ideas an important part of completing the task successfully.** Some examples include:

- Designing the Rube Goldberg.
- Individual organism designs and justifications for efficiency.
- Group and class share-outs that focus on reasoning, not just the answer.

Peer- and teacher-feedback opportunities are embedded throughout the task.

The task encourages students to **make their thinking visible in a variety of ways,** including:

- Discourse and collaborative work with peers and with the teacher.
- Written descriptions, diagrams, pictures.
- Physical models.
- Formal presentations.

How does this task support all students?

✓ This classroom embedded task includes a number of features that make it supportive for a wide range of students. Students are routinely given opportunities to meaningfully engage with the task and make their own ideas an important part of completing the task, including the design of the task itself as well as the range of ways students respond to the task. Students have multiple ways to show what they know, including written/drawn artifacts, small group conversations, one-on-one interactions, and large group presentations. Students were able to use multiple modalities to make their thinking visible, including discourse, written artifacts, and physical models. Importantly, the task prioritizes student thinking, decision-making, and choice, providing an avenue for students to develop confidence and interest in science.

What are the major takeaways?

SUMMARY POINTS:

- Overall, this task requires meaningful sense-making using the three dimensions.
- The task includes engineering ideas and practices as an integrated aspect of the task.
- The task elevates and prioritizes student ideas, choice, and multiple ways of making their thinking visible.

SUGGESTED IMPROVEMENTS

The task would be improved if:

1. The feedback loops for students and other stakeholders were made clearer.
2. The DCIs targeted, and student progress toward them, was clearer.
3. The relevance and authenticity of the task was made clearer to all students, including why this matters and why it is worth figuring out.

How should this task be used?

This task can be used as a classroom-embedded transfer task intended to surface student understanding and ability to use the targeted three-dimensions—one benefit of this task is that it can be used to surface a range of sophistication of ideas and practices while allowing students at different points in the progression to fully participate. Educators should ensure that this task is used in conjunction with other tasks designed to more deeply monitor student progress toward specific targets.

Some features educators should note as they use this task:

- This task is highly contextualized by the interests of the students in this classroom and the classroom culture established previously.
- While this example provides a meaningful way to use something like the Rube Goldberg machine in a science classroom—by explicitly asking students to describe the energy transfers (transfer task from their prior physical science learning) and connect it to a life science context (transfer of understanding of energy transfer from physical to life science)—very frequently, Rube Goldberg machines are used as a “fun” activity with very little meaningful science learning or performance across all three dimensions.
- Consider supplementing the task with a clear rubric such that students can better reflect on their own progress as well as to facilitate peer- and teacher-feedback processes.