SECONDARY SCIENCE CASE STUDY

Engineering Science Standard HS-ESS3-4

What are the students learning?

Grade level standard: HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Example Learning Progression for Secondary Science

WA-AIM Access Points			Teacher adjusted	Grade Level Standard
Less Complex	**Intermediate**	**More Complex**	**Further Complexity**	**Grade Level Standard**
Student will use data to identify whether a technological solution reduces a human impact on natural systems.	Student will use data to refine a technological solution that reduces a human impact on natural systems and meets the given criteria and constraints.	Student will use data to refine a technological solution and describe how the refined solution reduces a human impact on natural systems and meets the given criteria and constraints.	Student will evaluate or refine a technological solution by comparing data from multiple trials to determine which version best reduces human impact on natural systems while meeting specific criteria and constraints.	HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Educator adapts instruction to meet the needs of students and deepen learning toward grade level standard

How could I teach this standard in general education to all students?

Phase 1: Planning for Engagement with a Phenomenon

A teacher may start with an **Anchoring Phenomenon,** a complex, real-world problem that requires a technological fix.

- **The Phenomenon: "The Urban Heat Island."** Show students thermal satellite imagery of a nearby city compared to a neighboring rural area. On a 90°F day, the city pavement is 140°F, while the park is 85°F.
- **The Big Idea:** Human construction (concrete/asphalt) creates "heat islands" that impact energy use and human health. We can use technology (green roofs, cool pavements) to mitigate this, but every solution has trade-offs.

Phase 2: Eliciting Student Ideas

The teacher identifies the "assets" students bring regarding how heat and materials interact.

- **Initial Models:** Students draw a model explaining *why* the city stays hot at night while the forest cools down. They must show the movement of energy (sunlight/heat) and how it interacts with different surfaces.

- **The Science Practice (Evaluating Solutions):** Present three existing "solutions":
  1) Painting all roofs white,
  2) Planting 10,000 trees, or
  3) Installing permeable "cool" pavement.
- **Student Questions:** "Which one is the cheapest?" "How much does the temperature actually drop?" "Does the white paint get dirty and stop working?".

Phase 3: Supporting Ongoing Changes in Thinking

This is the **inquiry and evidence-gathering phase** where students test the technology.

- **The Activity (Investigation):** Students build "Model Cities" using cardboard boxes. They test different "technological solutions" (e.g., covering a box in white foil vs. adding a "green roof" of damp moss) under heat lamps.
- **The Summary Table:** The class tracks data across all groups.

Solution Tested	Temperature Drop	Cost Estimate	Trade Offs
White reflective Roof	5° C	Low	High glare for neighbors
Green (plant) roof	8° C	High	Heavy, needs water/maintenance

Phase 4: Pressing for Evidence-Based Explanations

Students return to the phenomenon to **evaluate and refine** their chosen solution based on their lab data.

- **The Evaluation:** Students are given a "Constraint Profile" for a specific city building (e.g., "The roof is old and cannot hold much weight"). They must **evaluate** the three solutions and choose the best fit based on their data.
- **The Refinement:** Students must propose a "Version 2.0" of their solution. For example: "*The white paint worked best for the budget, but to refine it, we should add a textured coating so it doesn't cause glare for the buildings next door.*"
- **Evidence-Based Argument:** Using the Claim, Evidence, Reasoning (CER) framework, students write a proposal to the City Council justifying their refined solution using the data from their model city tests.

How could I measure understanding of the standard for students with significant cognitive disabilities?

Start with how you measure student understanding for all students and adapt from there. For example, if you assigned the whole class an engineering task given various constraint profiles, you could do the same for a student who has significant cognitive disabilities. For students who might need alternatives to individual completion of the engineering task, their task may involve use of if/then cards (e.g., “If the roof is too heavy, then we should use lighter soil and plants.”) or thumbs up/thumbs down icons to respond in a solution matrix to show the proposed technology fits with the constraints (e.g., budget).

One important consideration, especially for a complex engineering task, is a student’s communication modality. The purpose of engineering is to authentically engage in problem-solving and solution generation. This could require creative problem-solving to ensure that students have authentic opportunities to engage in learning tasks and assignments using various means.

If the student requires scaffolds to support their engagement, you might give them fewer tasks altogether and use the WA-AIM Access Point Framework to design scaffolded supports and prompts. If a student needs scaffolds at a certain Access Point for one standard, don't assume they will need this level of scaffolding for every other standard.

Further Complexity towards the Grade Standard

It is important to give the student an opportunity to demonstrate their understanding of the grade level standard. It is possible a student may be able to do more than the WA-AIM Most Complex Access Point. It is essential to challenge them to reach toward the grade level content standard.

However, it is likely they will require some accommodations and possibly modifications in how it is assessed. In this case, two options might be appropriate.

- Increase the amount of scaffolding or accommodations that most students already get on the assessment (e.g., multimodal assessment that includes flexibility in response options, for example, picture response versus written), and/or
- Provide the student an opportunity to demonstrate skills in the grade-level standard with a focus on the essential components and greater instructional scaffolding.

With this standard, the student may be able to identify whether a solution might work, use data to suggest a change, and with scaffolding, evaluate the effectiveness of that change against specific constraints like cost or safety.

If the student requires additional scaffolding, consider the More Complex Access Point.

More Complex (WA-AIM Access Point)

To measure the student's more complex demonstration of the standard, the Access Point states assessing their ability to **use data to refine a technological solution and describe how that refined solution reduces a human impact and meets given criteria and constraints.** An example of this would be a student looking at data from a "Cool Roof" experiment, noticing the temperature didn't drop enough, and suggesting a change in material (refinement) while explaining how that change fits the school's budget.

If the student requires additional scaffolding, consider the Intermediate Access Point.

Intermediate (WA-AIM Access Point)

To measure the student's Intermediate Access Point, the student should **use data to refine a technological solution that reduces a human impact on natural systems and meets given criteria and constraints.**

Given accommodations and communication support, a graphic organizer may look something like this:

The Data Says...	The Problem Is...	The Change (Refinement) I will make:
Temperature is High	The roof is still too hot.	*Paint it White*
High Cost	The plants are too expensive.	*Use different seeds*

If the student requires additional scaffolding, consider the Less Complex Access Point.

Less Complex (WA-AIM Access Point)

The Less Complex Access Point for this standard is to **use data to identify whether a technological solution reduces a human impact on natural systems.** An example of this could be presenting a student with a graph showing plastic waste levels before and after a "Plastic Ban" was implemented in a cafeteria. The student would identify if the "solution" (the ban) actually worked to reduce the impact (the waste) by pointing to the "Before" and "After" data points or sorting icons into "Working" and "Not Working" categories.

Reducing Barriers for Learners who have Significant Cognitive Disabilities in Large Group Lessons

Make reducing barriers an ongoing practice embedded in the instructional process - take a few minutes to think about your process! Is there a barrier related to:

- **Interest or engagement?** To enhance engagement, connect the topic to students' cultural backgrounds and communities. For example, discuss urban issues that are relevant to their own neighborhoods, or invite local experts to share their insights into the impact of urban heat islands. *Example*: Create a project where students can research how heat island effects manifest in their own community, presenting it through stories or presentations that reflect their personal experiences.
- **Background knowledge?** Support multiple ways to perceive information. To support learners with significant cognitive disabilities, consider using descriptive audio for the thermal imaging, providing annotations that explain what the students are viewing. For instance, label different areas to highlight the temperature differences and potential impact visually and textually. *Example*: Use a digital tool that allows for interactive thermal images where students can hover or click for descriptions.
- **Showing what they know?** Allow students to express their ideas through various formats. Instead of only drawing their models on paper, they can use digital platforms (like Google Slides) to build their models, incorporating images, text, and voice recordings to represent their understanding of energy movement and solutions. *Example*: Provide templates on a digital platform where students can drag and drop images and record voice notes to describe their findings.

Use these Inclusive Strategies to help reduce barriers[2]

[2] The Inclusive Big Ideas were adapted from resources created by the NCSC Project , a federal grant from the US Department of Education (PR/Award #: H373X100002), However, the contents do not necessarily represent the policy of the US Department of Education and no assumption of endorsement by the Federal government should be made.

Expanded Learning Progression for Secondary Science

	WA-AIM Access Points			Teacher Adjusted	Grade Level Standard
	Less Complex	**Intermediate**	**More Complex**	**Further Complexity**	**Grade Level Standard**
Student Skill	Student will use data to identify whether a technological solution reduces a human impact on natural systems.	Student will use data to refine a technological solution that reduces a human impact on natural systems and meets the given criteria and constraints.	Student will use data to refine a technological solution and describe how the refined solution reduces a human impact on natural systems and meets the given criteria and constraints.	Student will **evaluate or refine** a technological solution by comparing data from multiple trials to determine which version best reduces human impact on natural systems while meeting specific criteria and constraints.	HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
Complexity Details	• Binary success/failure data • Single variable (e.g., trash levels)	• Choose between two versions of a solution • Basic constraints (e.g., cheap vs. expensive)	• Explaining the “Why” behind a refinement • Multiple constraints (e.g., cost AND weight)	• Comparative data analysis • Identifying trade-offs • Evidence-based justification	• Complex natural systems • Long-term vs. short-term impacts • Scientific discourse
Success Criteria Ex:	• Points to a "Before/After" graph to show that pollution went down. • Uses a visual to communicate success or failure	• Selects the option from a choice board because it fits a particular constraint (e.g., budget). • Match criteria and constraints with potential solutions	• Classifies solutions by multiple constraints (e.g., least to most expensive or lightest to heaviest) • Uses a sentence frame to say: "I changed the_____ (refined solution) because it is ___________(constraint)."	• Completes a decision matrix to justify why one design version is superior to another. • Answers a series of multiple choice questions evaluating the technological solution.	• Independently evaluates a new technology using a technical data report.
Instructional Strategy Examples	<u>Visual Supports</u> • High-contrast bar graphs <u>Scaffolds</u> • "Thumbs up/down" for success <u>Technology</u> • Voice output for "It worked!"	<u>Visual Supports</u> • Icon cards for cost ($) and heat (dots) <u>Scaffolds</u> • "Pick the best fit" choice board <u>Technology</u> • Virtual simulators	<u>Visual Supports</u> • "If/Then" graphic organizers <u>Scaffolds</u> • Descriptive sentence starters <u>Technology</u> • AAC with science vocabulary • Speech-to-text software	<u>Visual Supports</u> • Comparison charts/tables <u>Scaffolds</u> • Claims, Evidence, Reasoning (CER) writing templates <u>Technology</u> • Data logging software	<u>Visual Supports</u> • Professional data sets/PDFs <u>Scaffolds</u> • Socratic seminars <u>Technology</u> • Environmental modeling software