STEM TEACHING TOOL #83

Steps to Designing Justice-Focused Assessments in Science

This nine-step process is designed to help teams develop *Framework*-aligned assessment tasks in science focused on justice-centered phenomena and scenarios. Justice-focused assessments are assessments where students use science knowledge and engineering design practices to solve problems involving matters related to the unequal distribution of consequences (e.g., benefits, harms) to communities that result from human-nature interactions and/or unequal voice of communities in matters affecting their thriving and sustainability. Justice-centered assessments are pertinent when assessing performance expectations that require students to engage in engineering practices, because such practices involve developing and testing solutions that address human needs. In addition, justice-centered assessments engage students with the idea of science as a human endeavor, as called for in the Nature of Science connections of the NGSS.

Assessment design using this process is best conducted in teams, where colleagues can work together to clarify learning goals to be assessed, brainstorm design challenges for scenarios that will require application of the disciplinary core ideas of a performance expectation, and review one another's tasks. The process of task design, if followed as outlined here, can be expected to take between four and six hours for a small team to develop a single extended task to be used as part of a unit test.

Ideally, teams should begin the process with a basic understanding of the vision of *A Framework for K-12 Science Education* (NASEM, 2012). However, the process can also be used to help orient educators to the vision of the *Framework*. In addition, teachers should be familiar with strategies for introducing and teaching socioscientific issues in science classrooms described below. Teachers should also be familiar with school and district rules regarding engaging students with issues pertaining to social and political systems that become the focus of assessment tasks.

JANUARY 2022 VERSION BY WILLIAM R. PENUEL, CAROLINE ESTRADA CARLSON, SHANNON WACHOWSKI, DEBRA FREITAS, ADRIAN ALVAREZ, ROBERT HAMILTON, AMANDA SCHILD, AND ALI RAZA. EDITED BY ABBY RHINEHART AND PHILIP BELL

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ORIGINAL VERSION OF THIS RESOURCE BY WILLIAM R. PENUEL, KATIE VAN HORNE, AND PHILIP BELL

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Justice-focused assessment tasks in science, like other tasks in science, allow you to make inferences about how students use their understanding of disciplinary core ideas, science and engineering practices, and crosscutting concepts together to explain phenomena and solve problems. Unlike some other tasks where there is a single right answer to questions posed, students may propose different solutions to problems that reflect their perspectives on problems, using evidence presented in the task.

Justice-focused assessments are likely to engage students with ideas and practices that include but go beyond those articulated in the *Framework*. That is, students will need to grapple with concepts and practices encountered in the social sciences, in ethical deliberation, and with ways of being, doing, and living in students' communities. The guidance for task design included here is based on the conclusions and recommendations included in the National Research Council (2014) report, Developing Assessments for the Next Generation Science Standards. In addition, the process incorporates use of the Task Screener developed by Achieve, Inc., for analyzing existing assessments.

Throughout this document, we make use of three key terms:

- **Task:** Word used to describe a single, multi-component task designed to elicit understanding of a performance expectation (or part of one).
- **Scenarios:** Introductory part of a task in which a phenomenon to be explained or a problem to be solved is presented to students. The phenomenon or problem presented is the focus of the entire assessment.
- **Prompts:** Individual components or questions, all of which are linked to the scenario.

This tool is intended to be used in conjunction with other STEM Teaching Tools:

- ACESSE Resource E: Selecting an Anchoring Phenomenon for Equitable 3D Teaching
- STEM Teaching Tool 30: Integrating Science Practices into Assessment Tasks
- STEM Teaching Tool 41: Prompts for Integrating Crosscutting Concepts into Assessment and Instruction
- STEM Teaching Tool 67: Focusing Science and Engineering Learning on Justice-Centered Phenomena across PK12
- STEM Teaching Tool 71: How can you advance equity and justice through science teaching?

If you have never developed a three-dimensional assessment task as a team, begin with STEP 0, Preparation or engaging with ACESSE Resource A and ACESSE Resource B. If you have developed *Framework*-aligned assessment tasks as a team, and are familiar with using the task screener, skip to STEP 1.

Overview of the Steps Outlined in this Document

STEP 0: Preparation
STEP 1: Choose a performance expectation that addresses science in its societal and political contexts and analyze the relevant sections of *A Framework for K-12 Science Education* and craft learning claims
STEP 2: Analyze the facets of the claim to be assessed related to the focal disciplinary core ideas of science
STEP 3: Choose a social or environmental justice issue in which students can use their knowledge of science ideas and engineering practices to address
STEP 4: Write a complete student explanation of the solution to the design challenge
STEP 5: Use the Science and Engineering Practices and Crosscutting Concepts Tools to develop individual prompts
STEP 6: Integrate questions to assess student interest and identification with science and engineering presented in the scenario
STEP 7: Develop a range of ideal student answers and a scoring guide
STEP 8: Review your task with peers for intelligibility, worldview, alignment, and accessibility
STEP 9: Pilot and revise your assessment

STEP 0: Preparation

Preparation Part 1: Preparing to Engage students with socioscientific issues as part of your teaching

There is strong evidence that teaching socioscientific issues supports learning in science (Sadler et. al., 2017). However, it requires preparation and skill to identify issues and engage students productively with those issues.

If you are designing a justice-focused assessment task for the first time, it is important to consider how well your teaching has prepared students to engage with tasks where they are required to engage with a problem for which there are no clear solutions. Prior to engaging students in such a task, students should have had the opportunity to engage with problems in science class where they not only use evidence to support proposed solutions but also take into account economic, political, and ethical concerns linked to those solutions. There are a number of resources available to teachers for supporting students in engaging with socioscientific issues, such as those at the Rigorous Investigation of Relevant Issues, Learning for Justice, STEM Teaching Tools, and Learning in Places web sites.

Your team may also need to develop knowledge of the relevant social, economic, and political systems (Ewing & Sadler, 2020) or the ethical deliberation and decision making that are involved. Examples of potentially relevant knowledge are values and histories that have shaped how communities view science, economic costs and benefits of engineering solutions to social problems, policies, and treaties regulating how people and institutions can interact with the environment. Developing knowledge of these systems may benefit from including as members of assessment teams educators from social science disciplines.

Teams can also benefit from including community experts with knowledge of relevant concerns of stakeholders in designing assessments. Such experts can help teams identify issues that are priorities for groups working for promoting justice in your community. In addition, community experts can help teams avoid perpetuating narratives about communities by building tasks that portray communities as "damaged" or from a deficit perspective.

Justice is always salient in the presentation and discussion of socioscientific issues. This is so, because engaging with social, economic, and political systems will inevitably bring to light issues of the unequal distribution of power and resources in society. Teachers need to be prepared to "explicitly acknowledge the uneven distribution of power in our society and support students in recognizing the role of power in these issues" (Ewing and Sadler, 2020, p. 20). You might consider using this framework from Learning in Places to attend to these issues of power and historicity.

In engaging students with matters of justice, students should be encouraged to consider issues from different perspectives and the consequences of proposed solutions to different stakeholders, including non-human entities in the ecosystem. After completing the assessment task, students can also be encouraged to reflect on the ways that the task reveals science to be a human endeavor. Finally, prior to using a justice-focused assessment, it is important to learn about relevant school and district policies regarding how educators may engage students in socioscientific issues. Some district policies restrict educators from discussing issues considered to be "political." Knowing the policies affecting you can help you make informed decisions about whether and how to use a justice-focused assessment.

Preparation Part 2: Becoming familiar with qualities of *Framework*-aligned assessment tasks.

For people just beginning to develop *Framework*-aligned assessment tasks, it is useful to begin with an analysis of existing tasks. One task designed using the process described here is the Swallows Task. It assesses students' understanding of a high school life science performance expectation. As a team, discuss what you notice about the assessment, especially how it is different from assessments you may have used in the past.

Next, look at an annotated version of the task, which shows what others who have experience developing *Framework*-aligned assessments have written about it. How are their ideas similar or different from your own? What ideas do you now have about what makes for a good *Framework*-aligned assessment?

You can record your ideas about what makes for a good *Framework*-aligned assessment task and keep it nearby as you go through the rest of the steps in the process.

Achieve, Inc's Science Task PreScreen: Basic Criteria for *Framework*-Aligned Assessment Tasks

- Is there a phenomenon or problem driving the task?
- Can the majority of the task be answered without using information provided by the task scenario? (answer should be "no")
- Can significant portions of the task be answered successfully by using rote knowledge (e.g., definitions, prescriptive or memorized procedure)? (answer should be "no")
- Does the majority of the task require students to use reasoning to successfully complete the task?
- Does the task require students to use some understanding of disciplinary core ideas to successfully complete the task?
- Do students have to use at least one science and engineering practice to successfully complete the task?
- Are the dimensions assessed separately in the majority of the task?
- Is the task coherent and comprehensible from the student perspective?

STEP 1: Choose a performance expectation that addresses science in its societal and political contexts and analyze the relevant sections of *A Framework for K-12 Science Education* and craft learning claims

Assessment begins with defining what you want to be able to say about what your students know and can do. The *Framework* provides a starting place for defining the understanding that should be assessed at each grade band. The practices chapter (Chapter 3) and crosscutting concepts chapter (Chapter 4) highlight grade 12 endpoints and what is known about progressions across K-12. The disciplinary core ideas chapters (Chapters 5-8) include descriptions for what students are expected to know and be able to do by the end of grades 2, 5, 8, and 12.

Some performance expectations will lend themselves more easily to justice-focused assessment tasks. Those involving engineering design practices that call for consideration of human needs are good candidates, as are performance expectations focused on human-nature relationships. This does *not* mean that other standards cannot be used. For example, an assessment of nuclear chemistry (e.g., HS-PS1-8: Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay) could be assessed in a justice-focused task by asking students to use what they have learned about radioactive decay to propose solutions for addressing potential and past harms to communities exposed to radiation from uranium mining. It is valuable to consider using justice-focused assessment tasks for such standards, because it gives students a chance to apply what they have learned to a community-relevant issue.

Use the text to define a set of "learning claims" that you want to be able to make about what students know and can do. A claim is more than just a phrase that references a concept (e.g., "ecosystem stability"). For example, "A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions," is a statement derived from the 12th grade expectation for LS2C. This particular claim is not sufficient to develop a learning claim for an assessment, as it does not account for performance related to the other two dimensions (Science and Engineering Practices and Crosscutting Concepts), as shown in the example below. The performance expectations can be the basis for developing claims. However, many assessment tasks will only assess part of a performance expectation. You can choose parts that fit together, for example, because they are necessary to explain a particular phenomenon, or because conceptually they are related.

Below, we present a performance expectation in the form of a claim, and show the relevant *Framework* text that makes up the claim. This text is the same text that is in the "connections" boxes of the NGSS.

Claim

Students can propose and defend a solution that addresses the threats to species caused by changes in human activity at a border between two countries.

Associated PEs (partially addressed): MS-LS2-4, MS-LS2-5, MS-ESS3-3

Relevant *Framework* Text

Disciplinary Core Ideas: Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (LS2C: Ecosystem Dynamics, Functioning, and Resilience)

Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (LS2C: Ecosystem Dynamics, Functioning, and Resilience)

Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (ESS-3C: Human Impacts on Earth Systems)

Science and Engineering Practices: Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (SEP: Engaging in Argument from Evidence)

Crosscutting Concept: Small changes in one part of a system might cause large changes in another part. (CCC: Stability and Change)

STEP 2: Analyze the facets of the claim to be assessed related to the focal disciplinary core ideas of science

Developing a deeper understanding of the components of the performance expectation is needed, both to help select a design challenge for the assessment, and also to help develop a sense of what is important to score in an assessment. Depending on your purposes for the assessment, you may choose to assign a score or grade only for students' use of target science ideas, practices, and crosscutting concepts. If you want to assess students' understanding of the social, economic, and political systems that inform the focal issue, you may wish to analyze relevant social studies or social justice standards.

An analysis of the *facets* of the performance expectation is the second step in assessment design. A facet is a small observable piece of knowledge or a strategy that a student uses to make sense of a problem (Minstrell, 1992). Facets can be about any dimension, and can be written as claims, such as "Students can define the boundaries of ecosystems on the basis of direct and indirect interactions among organisms," or "Argument from evidence involves evaluation of given claims."

The NGSS Evidence Statements are one representation of the facets of a performance expectation. However, analyzing facets can be a valuable way for a team to develop a shared understanding of the learning targets for an assessment task.

Making "sticky notes" with the facets on them can help teams keep track of whether the assessment prompts you design actually elicit each one. Facet analysis can also be used to understand the breadth of student thinking revealed through their assessment responses.

Sample Facets (DCI Only)

Ecosystems are dynamic in nature; their characteristics can vary over time.
- Changes can be to physical (e.g., climate) or biological (e.g., number and species of organisms that live there) of components.
- Changes can also be to interactions among components.

Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.
- Ecosystems' components are highly connected.
- Changes to climate affect the ability of particular species to survive in an area.
- Because many species are interdependent (e.g., part of a food web), changes to populations of one species can affect survival of another.
- Many changes are caused by human activity, such as resource extraction, adverse land use patterns, pollution, introduction of nonnative species, and global climate change.

Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems.
- Different ecosystems have different levels of biodiversity.
- Levels of biodiversity are related to the fact that organisms vary in their requirements for food, water, oxygen and other resources.
- A change to the habitat of an organism can affect organisms living there (from LS4.D, elementary school). Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species.
- Human activities can have major effects on the land. (From elementary school)
- Individuals and communities are doing things to protect or restore habitats. (From elementary school)

But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- All human activity draws on natural resources, and has positive and negative consequences for the health of people, other organisms, and the environment.

Relevant *Framework* Text

Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (LS2C: Ecosystem Dynamics, Functioning, and Resilience)

Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (LS2C: Ecosystem Dynamics, Functioning, and Resilience)

Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (ESS-3C: Human Impacts on Earth Systems)

STEP 3: Choose a social or environmental justice issue in which students can use their knowledge of science ideas and engineering practices to address

Justice-centered assessments present problems for students to solve, in which they use science ideas, crosscutting concepts, and engineering practices to address. There are many types of issues that could be the focal point of assessments. A problem could be an issue or matter of concern to local communities, to particular cultural groups, or to people across the globe. It could be a matter of care related to the more-than-human world. The problem could also arise from contemporary scientific developments.

It is quite likely that most students overwhelmingly encounter natural phenomena and images of science that are framed as apolitical. However, there is a growing understanding that science education has a vital role to play in helping students develop deep ethical sensibilities and develop complex views of natural systems are inextricably tied to social systems. Students have a right to learn how science and engineering are connected to justice and injustice.

Justice-focused design challenges ask "should we?" questions that can invite students to use their knowledge, clarify values and goals, and explore potential impacts of solutions they design. Such questions can pertain to everyday decisions in families, or they can relate to decisions made on a community or society level.

Engaging with the issue should require students to apply their understanding of pieces of one or more targeted performance expectations. This particular requirement means that developing a task will involve considerable time looking for a good phenomenon or design challenge. The task's scenario should be engaging, relevant, and culturally accessible to a wide range of students (Achieve, 2018). In addition, justice-focused assessments should be ones that engage students in science and engineering practices in expansive ways, so that students are encouraged to notice and articulate connections between the science they are learning and the broader social and political forces that are implicated in an issue.

ACESSE Resource E presents a process for selecting a problem or phenomenon to anchor a 3D assessment or sequence of lessons. The resource outlines a multi-step process that includes an analysis of the standards as shown in Step 2, as well as the use of a student survey to elicit students' ideas about their interest in phenomena, as well as how important problems are to them and people in their community. For groups new to phenomena and design challenges, it may be useful to play the Phenomenon Game that is part of Resource E, a card sort activity that helps participants learn to distinguish questions posed as phenomena and design challenges from those posed about disciplinary core ideas. Justice-focused assessments pose questions as design challenges or problems to be solved.

Another useful guide to selecting an issue that has both social and scientific dimensions is the [RI]² Issue Selection guide. This resource produced at the University of Missouri's ReSTEM Institute provides a list of questions that can be asked when selecting an issue: Is the issue a socio-scientific issue? Is it productive for the intended audience? What instructional moves need to be made to promote successful teaching? As part of analyzing whether the issue is productive, designers of tasks are invited to consider how the issue is related to standards.

Ideally, multiple candidate issues are identified initially for use in an assessment, since not all will likely meet the criteria above on close scrutiny. No issue is likely to require mastery of a full performance expectation, either. It is more likely that any issue will address parts of multiple performance expectations. Once several candidate issues have been identified, you can use the Task Annotation Project in Science's Equity criteria to assess the issue's integrity to those criteria.

Phenomenon and Associated Facets

Border walls have been threatening and continue to threaten the survival of many species of organisms along the border between the United States and Mexico in two ecosystems, the Sonoran Desert and the Sky Islands. Within the communities along the border walls, the walls have been a focus of controversy as well.

Explaining this phenomenon requires students to apply their understanding of species' dependence on movement to secure resources they need, and the harms caused by human activity.

Designing a solution to the problem requires students to engage with policies that affect the border wall and with competing perspectives of people with different political views. It also requires them to consider at the same time how to balance human concerns with the thriving of non-human animal populations that are affected by human activity.

Scenario

U.S. policies about the U.S.-Mexico border have changed a lot over the past 100 years. Over the past six years, government officials in the US built a long border wall between Mexico and Arizona in public lands. A goal was to keep people from entering the U.S. from the Mexican side of the border. The border wall has been controversial within border communities (link to PBS video to show students). It has also affected wildlife along the border.

Human activity has been threatening and continues to threaten the survival of many species of organisms along the border between the United States and Mexico in two ecosystems, the Sonoran Desert and the Sky Islands. These two ecosystems are biodiverse, meaning they have lots of different species (McCallum et al., 2014). This makes them healthy and resilient, if not disrupted by human activity.

Accesss pictures and audio of the sounds of the Sonoran Desert and pictures and audio of the Sky Islands.

An example of a threatened species is the jaguar. Until the middle of the 20th century, there were many jaguar populations in the US, north of the border. Today, camera traps have found only male jaguars living in the area (McCain & Childs, 2008). Camera traps take pictures of animals when they move in front of them. The populations of US jaguars will die out if females do not join them. Jaguars are predators that feed on javelina and deer, as well as some birds.

Answer the questions below to address these three big questions:

1. *How could human activity along the border threaten the survival of species like the jaguar?*
2. *What should be done to protect animals like the jaguar in these two ecosystems?*
3. *How would people with different perspectives on the border wall between the U.S. and Mexico in Arizona respond to your proposed solution?*

STEP 4: Write a complete student explanation of the solution to the design challenge

Before developing specific prompts for the task, it is useful to write a complete student explanation of the scientific phenomenon and/or a possible solution to the design challenge. The explanation or solution should be what you expect students to develop in writing or through some other means of expression (e.g., a video). They are the "answers" to the questions or prompts that you will develop in your assessment. **Write them as an emerging bilingual or multilingual student who had mastered the performance expectation would write an explanation.**

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Complete Student Explanation

Possible Explanation
There are three possible *claims to evaluate*, to decide if human activity threatens other species' populations. First, human migration across the border could scare animals away. Jaguars would be especially affected by this activity: because travel happens at night when jaguars are most likely to be spotted, it could affect their movements. Second, border walls could be barriers that prevent travel across the border, and also disrupt paths animals use to seek out food or mates across the border. Walls stop animals from reaching resources they need on the other side of the border (Flesch et al., 2010). Third, building and protecting the border wall itself could be destroying habitats for organisms.

Evidence from a study shows that animal activity was affected by border walls, but not by humans crossing the border (McCallum et al., 2014). Scientists found similar numbers of crossings of animals where there were also people crossing the border. But they also found fewer numbers of animals crossing near border walls.

A separate study by Lasky and colleagues (Lasky et al., 2011) evaluated the impacts of the existing border wall and other barriers on amphibians, reptiles and mammals. They identified 56 species that have likely been affected by existing border walls. Some of these are at risk of extinction. Their study argues that the impact is not limited to a single organism, but is affecting the biodiversity of the ecosystem.

A change to one aspect of the ecosystem—the building of a border wall—could lead to the extinction of jaguar populations and populations of other species. That is because the range of these animals crosses the border: they seek food and mates across the border. If the jaguar, a key predator, went extinct, then the javelina and deer populations could grow very large.

STEP 5: Use the Science and Engineering Practices and Crosscutting Concepts Tools to develop individual prompts

A key challenge for many teams is to develop tasks that elicit students' grasp of the science and engineering practices and their understanding of crosscutting concepts. Two tools exist to help develop prompts (individual questions) that do so:

STEM Teaching Tool 30: Integrating Science Practices into Assessment Tasks

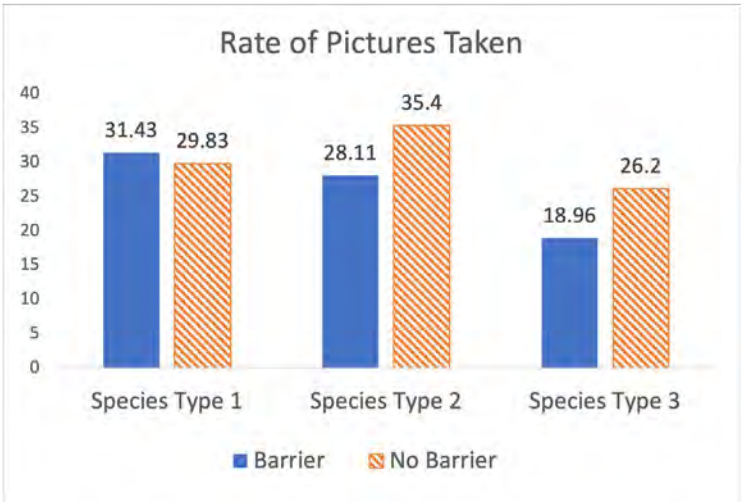
STEM Teaching Tool 41: Prompts for Integrating Crosscutting Concepts into Assessment and Instruction

You can use the first tool to organize a sequence of prompts that make sense for students, and then adapt prompts from the second tool in appropriate places so that students can show their understanding of crosscutting concepts.

There are multiple task formats for the science and engineering practices. Having multiple task formats to choose from allows for variety in assessment prompts. The formats vary in how challenging they are likely to be for students, too. Most assessments will rely on more than one practice, because multiple practices are almost always needed to solve problems (see STEM Teaching Tool 3).

SEP Task Format	Linked Prompt to Elicit Explanation
Analyzing and Interpreting Data *Format 4* Describe an investigation, the phenomenon under investigation, and one or more recorded observations from the investigation, then • Ask students to organize, represent, and analyze the data in at least two different ways, and • Ask students to compare how the representations and analyses help them to identify patterns in the data. *Continued on the next page*	Researchers put out "camera traps" in four different areas of the desert. They wanted to test whether human presence affected animal migrations across the border. They also wanted to test whether there was a difference between animals seen in areas that had a wall, versus those that didn't. A camera trap takes a picture of any animal (including humans) whenever it goes in front of the camera. Here are some examples of pictures taken in this region. Table 1 shows the rate of pictures taken of different types of species at different sites. Where there are more humans, are there fewer animals of species type 1 seen? Re-organize the data in the table or draw a graph to identify relationships that are important to consider in answering the overall question about the relationship between human presence and the number of animals. *Continued on the next page*

	Species Type 1	Species Type 2	Species Type 3	Humans
Site 1	0.09	4.94	4.77	1.93
Site 2	9.12	10.53	7.74	1.89
Site 3	8.72	5.95	4.49	5.81
Site 4	13.66	8.06	4.51	2.34

SEP Task Format (Continued)	Linked Prompt to Elicit Explanation (Continued)
Engaging in Argument from Evidence Format 2 Present students with a claim about a phenomenon, then • Ask students to identify evidence that supports the claim, and • Articulate the reasons for how scientific principle(s) connect each piece of evidence to the claim.	The scientists who conducted this study concluded that the presence of humans crossing borders did **not** impact migration of animals across the border. • What evidence from the study supports the claim? • What evidence might refute that claim? • Using your knowledge of ecosystems, explain why the conclusion is surprising.
Constructing Explanations Format 6 Present students with data from independent and dependent variables in an investigation, then • Ask them to construct a quantitative and/or qualitative claim about how the independent variables relate to the dependent variables.	Figure 1 shows the rate of pictures taken of different types of species at sites with barriers (walls) and those without.  Using data shown above, what do you conclude about how walls affect the movement of different types of species?
Engaging in Argument from Evidence Format 4b Describe a scenario in which two or more explanations are offered for a phenomenon and associated evidence using text, images, video, and/or data, then • Ask students to identify the differences in reasoning and the evidence that supports or contradicts each. *Continued on the next page*	One scientist concludes that human activity is affecting migration of animals across the border, and thus is a likely explanation for why some species are threatened. Another says that human activity is not affecting migration of animals, and so something else must be threatening the animals, if their numbers are decreasing. What evidence from Table 1 and Figure 1 supports each scientist's position? What evidence contradicts their position? Why do you think the first scientist thinks reduced migration of animals across the border is affecting species' ability to survive? *Continued on the next page*

SEP Task Format (Continued)	Linked Prompt to Elicit Explanation (Continued)
Designing Solutions *Format 5* Present students with a description of two competing solutions to a well-defined problem given a set of described needs, criteria and constraints, along with evidence related to the performance of each solution, then • Ask students to evaluate which design better addresses the needs, • Evaluate which design meets the criteria and constraints, and • Justify their conclusion using evidence presented.	One possible solution to the problem of protecting animals along the border is to remove the border wall altogether, which would allow for the free migration of animals across the border. Each of these solutions might be viewed differently by people who have different viewpoints about the wall along the U.S.-Arizona border. (Optional audio story) Another is to build a corridor that allows for animals to cross, preserving that land for this purpose. What human needs or concerns does each solution address? *Use evidence from the video about how different people in the town of Douglas, Arizona view the wall to support your answer.* What needs of the jaguar population does each solution address? *Use evidence from your explanation to support your answer.* How could you test whether your solution was effective in protecting the jaguar? One possible criterion for a successful solution is that it addresses "multi-species justice," the idea that decisions should be made by considering how organisms (including humans) and trees, rivers, and soil are all interdependent and depend on resilient ecosystems. If you were an advocate of multi-species justice, which solution would be better? *Use evidence to support your conclusion.*

CCC Prompts	Linked Prompt to Elicit Explanation
Stability and Change Small changes in one part of a system might cause large changes in another part. What are the factors causing this system to be unstable at [time point named in the scenario where the system is changing or not at equilibrium] ?	*Asked at the beginning:* What are some factors that might be causing the Sky Island and Sonoran Desert ecosystems to be unstable at this time? *Asked at the very end:* How might these ecosystems be affected in the long-term by creating a corridor for animals to cross the border? By removing the border wall between the U.S. and Mexico entirely?

STEP 6: Integrate questions to assess student interest and identification with science and engineering presented in the scenario

Interest and identification with science can be assessed in the context of an assessment. Gathering evidence of students' perceptions of the personal or community relevance of a scenario can help you monitor equity goals. Assessments can help build relationships with students and help them see themselves in the science, even though they are not typically used for this purpose.

Construct	Example Question (Ideal answers are bolded)
Relevance to Community	What we did in class today matters to people in my city or town because: (select the option that **best** describes your feelings) **A. This material is important and people should know about it** **B. This material could improve the lives of people in my city or town** C. What we did today doesn't matter to people in my city or town D. Other: (Please write in an answer)
Connection to Culture and History	How (if at all) is this topic important to people in your culture or its history?
Identification with Science	While completing this assessment, I felt (circle all that apply): A. Excited B. Bored C. Frustrated **D. Like a scientist** E. Afraid F. Angry E. Happy
Agency	As a result of learning about this, I feel like I could make a difference in solving this problem by... Talking with other people about the issue Advocating for changes to laws Using social media to advocate for a position or engage others in the issue... Organize a group at school to address the issue Make a connection to a global issue How much of a difference do you think you could make in solving the problem in this scenario? Likert: I can't have an impact at all — With others, we can have a big impact...

STEP 7: Develop a range of ideal student answers and a scoring guide

Next, develop an answer key, and assign points to facets included in student answers that are linked to the facets identified when analyzing the performance expectation targeted in the assessment. Be open to the idea that a number of different ideal student answers likely exist. When developing a scoring guide, make sure that students get the most points for answers that reflect the facets you analyze.

A total score for the assessment can be given as the sum of the individual points. The higher the number of points, the stronger the evidence of a deep understanding of elements of the targeted performance expectations.

Feedback to students can focus on the facets that students still need to develop to construct a satisfactory explanation of the phenomenon or solution to the problem.

The example below focuses on a scoring guide for the solution to the problem to illustrate how a science teacher might evaluate students' solutions, without expecting students to come up with a particular solution.

Prompt
One possible solution to the problem of protecting animals along the border is to remove the border wall altogether, which would allow for the free migration of animals across the border. Each of these solutions might be viewed differently by people who have different viewpoints about the wall along the U.S.-Arizona border. (Optional audio story) Another is to build a corridor that allows for animals to cross, preserving that land for this purpose. What human needs or concerns does each solution address? *Use evidence from the video about how different people in the town of Douglas, Arizona view the wall to support your answer.* What needs of the jaguar population does each solution address? *Use evidence from your explanation to support your answer.* How could you test whether your solution was effective in protecting the jaguar?

Possible Ideal Student Answer and Scoring Guide

Human needs addressed by eliminating the border
Creating a corridor, but not eliminating the border might better address the concerns of the rancher who said that migrants cut fences and water lines on his property and who said he was concerned about security. The mayor who said construction helped the economy might prefer this solution as well.

+1 point for each stakeholder named who would support a solution that would maintain the wall
+1 point for reasoning that is consistent with that stakeholder's position

Removing the wall would likely be the preferred solution of the minister. The minister argued that the wall has led to many deaths. Javier Osorio, a professor, is also likely to support the solution of removing the wall. The migrants fleeing their home countries and seeking refuge in the U.S. might prefer that solution, too.

+1 point for each stakeholder named who would support a solution that would remove the wall
+1 point for reasoning that is consistent with that stakeholder's position

Needs of the Jaguar Addressed by Each Solution
Each solution addresses the survival needs of jaguars potentially. These include needs for food and for mating. This is because both solutions allow jaguars to move more freely across the border.

+1 point for noting each solution potentially addresses the same needs of jaguars, because they allow for movement

Testing the Solution
We could use camera traps along the place where a corridor was created or where the wall would be removed, in order to monitor jaguar movements. By examining data before and after the solution was implemented, we could test whether the solution was effective. If it were effective, we would expect an increase in pictures taken of jaguars crossing the border.

+1 point for generating a strategy for monitoring
+1 point for noting the need to have some point of comparison (e.g., before and after, or monitoring an area with a wall and without one)
+1 point for stating what the data would show, if the solution was effective.

STEP 8: Review your task with peers for intelligibility, worldview, alignment, and accessibility

Sharing your initial tasks with a colleague and asking them for constructive feedback on how to improve them is a good way to begin. There are many roles your colleagues could play in helping improve your task. They can help improve the intelligibility of prompts, so that more students will understand what you are asking. They can help ensure that a justice-centered worldview is maintained in the assessment. They can help ensure alignment to the targeted performance expectation. And, they can help ensure the accessibility of the task.

Tool or Practice	How It Can Improve Your Task
Have a colleague complete your assessment	Can help ensure you are asking what you think you are asking and getting responses you hope to get from students
Discuss the specific ethical and justice dimensions of your assessment	Can help the assessment scenario and prompts be tightly focused on social and political dimensions of justice and injustice
Assess whether the scoring guide is aligned with the Evidence Statements for the targeted performance expectations	Can help ensure you are awarding points for what really matters, in terms of what students know and should be able to do
Review the assessment using the Achieve's Task Screener for equity	Can help ensure that the task is accessible and engaging to a wide variety of users

STEP 9: Pilot and revise your assessment

Assessment design requires many cycles of developing, testing, and revising tasks to ensure that you are getting an accurate picture of what students know and can do. It is very helpful to pilot test assessments with a small number of students to feed that actual student response data into the revision process. It is easy to design assessments where students misunderstand what was intended or asked for.

Carefully review alignment of the different elements presented here (claims, scenarios, application of task formats, and hypothetical/actual student answers) and pilot tasks with students as part of classroom instruction to reveal ways to improve tasks.

A key is to be ready to revise your initial tasks, even when you've put a lot of work into them. Often, the challenge is not with our students but with the questions that we ask. It is difficult to develop tasks that allow all students to show what they know and can do. Yet it is imperative to do so in order to create fair, valid assessments of students' three-dimensional science proficiency. Also, once you test them with students, your hypothetical student responses can be replaced with actual student responses, along with ideas for how to address problematic aspects of student responses.

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