Pennsylvania STEELS Classroom Implementation Descriptors

This document outlines levels of classroom implementation of Pennsylvania's Science, Technology & Engineering, Environmental Literacy & Sustainability (STEELS) Standards. These descriptors are organized into an Innovation Configuration (IC) Map, which uses specific, concrete terms to illustrate what levels of STEELS implementation in the classroom look like (and do not look like) in terms of teacher and student behaviors. Key areas for STEELS implementation are defined through the following components and subcomponents.

Component A: Phenomena and/or Problems

A.1 Phenomena (i.e., observable events) or problems (i.e., situations somebody wants to change) are the "why".

A.2 Meaningful phenomena and problems are experienced as directly as possible.

A.3 Student questions and prior experiences about phenomena and problems drive coherent learning.

Component B: Multi-Dimensional Learning

B.1 Students are the "doers" in instruction by engaging in multi-dimensional learning to make sense of phenomena and solve problems.

Component C: Reaching All Students through Scaffolding and Language Development

C.1 Scaffolding strategies support student learning.

C.2 Vocabulary is introduced in context and only after students have learned the related concepts.

Component D: Student-Centered Classroom Culture

D.1 Classroom culture fosters student-centered learning communities.

Component E: Multi-Dimensional, Phenomenon- or Problem-Driven Assessment

E.1 Assessment tasks support all students to demonstrate use of multiple dimensions to make sense of phenomena or solve problems.

E.2 Assessments are used to support students in progressing with their multi-dimensional thinking.

Pennsylvania Department of Education. 2025. Version 1.0

Component A: Phenomena and/or Problems

A.1 Phenomena (i.e., observable events) or problems (i.e., situations somebody wants to change) are the "why".

The purpose for all learning activities is to make sense of phenomena or problems, and the STEELS learning goals are necessary to make sense of phenomena or problems.

The "1" column represents full classroom implementation of STEELS

1. Phenomena/problems motivate learning throughout all activities and support the development of STEELS learning goals.	**2.** Phenomena/problems are mentioned throughout instruction, but not all activities are necessary to make sense of phenomena/problems.	**3.** Phenomena/problems are referenced at beginning and end of an instructional sequence, but not all activities are necessary to make sense of the phenomenon/ problem.	**4.** Phenomena/problems are referenced at the beginning of instruction as a hook or the end of instruction to apply what students have learned.	**5.** Mastery of STEELS Disciplinary Core Ideas or Practices rather than making sense of real-world, observable events or solving problems motivates learning.
What the teacher does	**What the teacher does**	**What the teacher does**	**What the teacher does**	**What the teacher does**
• **Focuses on phenomena/ problems.** Introduces and regularly revisits the phenomenon or problem. • **Frames goal for learning as figuring out phenomena/problems.** Frames figuring out or explaining the phenomenon or problem (pp. 16-19) as the motivation for learning throughout instruction.[1]	• **Focuses on phenomena/ problems.** Introduces and regularly revisits the phenomenon or problem. • **Frames goal for learning as figuring out phenomena/problems.** Frames figuring out or explaining the phenomenon or problem as the motivation for learning throughout instruction.	• **Refers to phenomena/ problems in a limited way.** Only mentions the phenomenon or problem twice: at the beginning and end of instruction. • **Separates learning from phenomena/problems.** Separates the student learning of STEELS dimensions from the process of explaining the phenomenon or designing a solution to problem.	• **Refers to phenomena/ problems in a limited way.** Either uses the phenomenon or problem as a hook, word problem, or an application activity at the end of instruction. • **Separates learning from phenomena/problems.** Separates the student learning of STEELS dimensions from the process of explaining the phenomenon or designing a solution to problem (e.g.,	• **Focuses on topics or skills.** STEELS topics and facts or isolated skills without connections to real-world, observable examples (phenomena or problems). • **Frames goal for learning as content mastery or skill development.** Emphasizes that the purpose for learning is to remember or memorize STEELS dimensions (e.g., rote test prep, graphing

[1] This could be accomplished through a larger "anchor" phenomenon/problem that students describe over a series of lessons OR through a series of lesson-level phenomena/problems connected by a common theme.

• **Alignment between learning goals and phenomena/problems.** Facilitates an activity where the STEELS learning goals are necessary (pp. 19-21) for explaining the phenomenon or solving the problem.	• **Lacks alignment between learning goals and phenomena/problems.** Facilitates an activity where the STEELS learning goals are targeted but not necessary for explaining the phenomenon or solving the problem.		facilitating STEELS learning before or after presenting the phenomenon or problem). • **Uses limited real-world examples and frames goal for learning as memorization.** May weave in real-world examples for brief demonstration purposes before or during direct instruction, but those examples do not motivate student learning.	skills, because "we have to").
What the student does • **Revisits phenomena / problems often.** After observing a phenomenon or problem early in instruction, regularly revises their explanations or solutions based on their new learning. • **Asks questions about the phenomenon or problem.** Demonstrates curiosity about phenomena or problems, asking questions and making connections. • **Learns consistently with the intent to figure out phenomena/problems.** Thinks the reason they are developing and using STEELS learning goals is for the purpose of helping them explain a	**What the student does** • **Revisits phenomena / problems often.** After observing a phenomenon or problem early in instruction, regularly revises their explanations or solutions based on their new learning. • **Asks questions about the phenomenon or problem.** Demonstrates curiosity about phenomena or problems, asking questions and making connections. • **Learns sometimes with the intent to figure out phenomena/problems.** Thinks the reason they are developing and using STEELS ideas and practices is for the purpose of helping them explain a	**What the student does** • **Discusses phenomena/problems intermittently.** Observe a phenomenon or problem at the beginning of instruction and revisit it again only at the end. • **Learning is separate from discussion of phenomena/problems.** Experiences the phenomenon or problem separately from the process of learning the material, but they have the opportunity to consider the phenomenon or problem before and after they have learned the STEELS ideas and practices. • **Learns STEELS content because they are told to rather than to figure out phenomena / problems.**	**What the student does** • **Discusses phenomena / problems once.** Observes a phenomenon or problem either at the beginning as an introductory activity or at the end of instruction as an application or wrap up activity. • **Learns STEELS content separate from discussion of phenomena/problems.** Experiences phenomena or problems separately from the process of learning the STEELS ideas and practices. • **Learns STEELS content because they are told to rather than to figure out phenomena/problems.** Does not realize that they are learning STEELS	**What the student does** • **Makes few connections to real-world applications.** Learns STEELS Disciplinary Core Ideas or practices without making connections to everyday examples or their own questions. • **Learns STEELS content because they are told to rather than to figure out phenomena/problems.** Engages in learning about a STEELS topic because they are told to, not to inform a real-world explanation or solution.

phenomenon or solve an engineering design problem.	phenomenon or solve an engineering design problem, though does not use all learning goals to make sense of them.	Does not realize that they are learning STEELS dimensions that will help them explain phenomena or solve problems.	dimensions that will help them explain phenomena or solve problems.	
Example	***Example***	***Example***	***Example***	***Example***
Phenomenon Example: *Students observe the phenomenon of a time-lapse video showing a seedling in the Susquehannock State Forest growing into a gigantic tree, leading them to ask, "Where does all the 'stuff' of the tree come from?" Each learning activity is framed around students answering part of that question and revising their initial ideas about factors that impact a tree's growth. Students return to the phenomenon several times throughout instruction. Through this process, students may explore related phenomena that help provide evidence for their original question.*[2] **OR** **Problem Example:** *Students are introduced to the problem that orangutans could go extinct in the next*	*Students observe a time-lapse video showing the phenomenon of a seedling in the Susquehannock State Forest growing into a gigantic tree, leading them to ask, "Where does all the 'stuff' of the tree come from?" Subsequent learning activities mention the initial student question and the Susquehannock State Forest, but activities focus on a variety of STEELS Disciplinary Core Ideas (e.g., LS2.C Ecosystem dynamics, functioning, and resilience) that are not necessary to explain the phenomenon.*	*After viewing a time-lapse video of a seedling in the Susquehannock State Forest growing into a gigantic tree, students learn about photosynthesis, how different kinds of organisms reproduce, and matter and energy flow in organisms.* *At the end of the instructional sequence, students revisit the giant tree example and are asked to use what they learned to explain where the mass of the tree came from.*	**Beginning of instruction example:** *Students watch a time-lapse video showing a seedling in the Susquehannock State Forest growing into a gigantic tree as a hook. The teacher then provides direct instruction to the class about matter and energy flow in organisms and photosynthesis and explains how the tree grows.* **Application of phenomenon at end of instruction example:** *After completing several activities to learn the inputs and outputs of photosynthesis, students are provided with an example of a seedling's growth over many years in the Susquehannock State Forest and asked to use the concept of photosynthesis to explain how the tree*	*Students watch a video about matter and energy flow in organisms and the chemical processes in photosynthesis and label a diagram with key inputs and outputs of photosynthesis.*

[2] Example adapted from the middle school unit *Tree Mass* developed by the California NGSS Early Implementers Initiative led by the K–12 Alliance and partner school districts. 2020.

10 years, and buying candy in the United States may be contributing to the problem. Each learning activity is dedicated to learning more about the problem and figuring out possible solutions, such as altering the design of a palm oil farm.[3]			*gained so much mass over time.* **Application of problem at the end of instruction example¿***At the end of a unit on ecosystem dynamics, students are asked to apply their knowledge and skills in an engineering design challenge, creating a model of a palm oil farm that benefits people and minimizes impact on the orangutan population, which is in danger of becoming extinct.*	

[3] Example adapted from the middle school unit *7.5 Ecosystem Dynamics & Biodiversity* developed by OpenSciEd. 2021.

A.2 Meaningful phenomena and problems are experienced as directly as possible.

Students experience the phenomena or problems as directly as possible and find them authentic and meaningful.

The "1" column represents full classroom implementation of STEELS

1. The phenomenon/problem is authentic and presented as directly as possible.	**2.** The phenomenon/problem is authentic but introduced indirectly.	**3.** The phenomenon/problem is presented directly but is contrived or inauthentic.	**4.** A STEELS concept or engineering design solution is presented as the focus for learning.
What the teacher does	**What the teacher does**	**What the teacher does**	**What the teacher does**
• **Uses authentic phenomena/problems.** Ensures that the phenomenon or problem is authentic (pp. 32-33) and meaningful to a range of student backgrounds and interests. • **Introduces phenomena/problems directly.** Presents the phenomenon or problem as directly as possible (firsthand such as a demonstration or through media such as a video).	• **Uses authentic phenomena / problems.** Ensures that the phenomenon or problem is authentic and meaningful to a range of student backgrounds and interests. • **Introduces phenomena/problems indirectly.** Presents the phenomenon indirectly when they could have made the experience more direct for students (e.g., through video or photos). • **Provides an example of somebody else explaining a phenomenon or solving a problem.** Provides an example of somebody else making sense of a phenomenon or problem but does not provide students with opportunities to make sense of it themselves.	• **Uses contrived phenomena.** Presents a contrived phenomenon/problem that is not authentic or meaningful to a range of student backgrounds, sometimes due to lack of real-world relevance (e.g., Newton's Cradle). • **Uses contrived engineering or design challenge as a "problem."** Presents a "design for design's sake" challenge (e.g., egg drop challenge) as a problem with no effort to make it meaningful or connect to the real world for students. • **Introduces phenomena/problems directly.** Presents the phenomenon or problem as directly as possible (firsthand such as a demonstration or through media such as a video).	• **Introduces topics or solutions instead of phenomena or problems.** Presents a core disciplinary idea, science factoid, solution, or explanation as the focus for learning.

What the student does	What the student does	What the student does	What the student does
• **Experiences phenomena/problems directly.** Watches a video, makes observations via first-hand evidence or accounts, or experiences phenomena/problems "in-the-field." • **Observes phenomena/problems that are authentic and meaningful.** Demonstrates wonder and excitement through questioning or making connections to their own experiences because students recognize the phenomena/problems as meaningful or interesting.	• **Gathers information about the phenomenon or problem second-hand.** Listens to a teacher describe the phenomenon/problem or reads a description of the phenomenon/problem rather than more directly observing it (e.g., via a video, photos, or in-person observation) • **Observes phenomena/problems that are authentic and meaningful.** Demonstrates wonder and excitement through questioning or making connections to their own experiences. • **Hears about somebody else figuring out phenomena/problems.** Learns about somebody else making sense of phenomena or problems rather than making sense of it themselves.	• **Experiences phenomena/problems directly.** Watches a video, makes observations via first-hand evidence or accounts, or experiences phenomena/problems "in-the-field." • **Observes phenomena/problems that are inauthentic.** Observes phenomena/problems that only feel relevant in school or to scientists, but not authentic or meaningful to them, their communities, the natural world, or global significance.	• **Does not observe real-world phenomena/problems.** Gathers information or asks questions about a STEELS idea, factoid, explanation, or solution rather than an observable phenomenon or problem. • **Makes no connection to the real world.** Does not connect instruction to their own life, the natural world, or global significance in any way.
Example	***Example***	***Example***	***Example***
Phenomenon example: *Students attend a virtual field trip to watch a live car crash test to improve vehicle and occupant safety. The students see that the car partially crumples in some areas but protects the crash test dummies. Students have an opportunity to share what this experience reminds them of from their own lives, and one student shares how her cell phone case protected her phone from breaking when she dropped it recently.*	**Phenomenon example:** *The teacher tells students that an important safety feature of cars is that they crumple in some areas when hit but protect the passengers. Students have an opportunity to share what this experience reminds them of from their own lives, and one student shares how her cell phone case protected her phone from breaking when she dropped it recently.*	**Phenomenon example:** *Students observe a demonstration of balls at each end of a Newton's Cradle moving when the balls in the middle appear to stay still, and the balls at the end eventually stop moving.* **Engineering Problem example:** *The teacher presents an engineering design challenge of needing to construct a dam out of popsicle sticks that will keep the water on one side of a plastic container.*	**Phenomenon example:** *The teacher presents the idea that energy can be transferred from one object to another when objects collide, and in such collisions, some energy is typically also transferred to the surrounding air. The teacher prompts students to ask questions or share ideas about what happens to energy.* **Engineering Solution example:** *The teacher shares that water's movements cause weathering and*

Engineering Problem example: *Students tour their school grounds immediately following a storm and see huge amounts of storm water runoff. They see that runoff is causing flooding and soil erosion and notice that no plants are growing on that side of the hill.*	**Engineering Problem example:** *The teacher tells the students that their school grounds has huge amounts of storm water runoff, which causes flooding and soil erosion, harming the plants.* OR *Students read an article about another student who is trying to solve a local flooding problem using STEELS Disciplinary Core Ideas about regional weather patterns and the water cycle.*		*erosion, which change the land's surface features and asks students to share ideas about how the netting on the side of highways can be used to prevent erosion.*

A.3 Student questions and prior experiences about phenomena and problems drive coherent learning.

Students make connections to prior experiences and ask questions that motivate the next step in instruction.

The "1" column represents full classroom implementation of STEELS

1. Students ask questions about the phenomena/problems based on their own prior experiences, and the teacher uses these questions to motivate the learning.	**2.** Students ask questions about the phenomena/problems based on their own prior experiences, but the teacher does not use these questions to motivate the learning.	**3.** The teacher asks the questions about the phenomena/problems that motivate the learning.	**4.** Neither students nor teachers ask questions about phenomena/problems; the teacher tells students what they will learn next.
What the teacher does	**What the teacher does**	**What the teacher does**	**What the teacher does**
• **Encourages student curiosity and connection to lives and communities.** Provides an opportunity for students to ask questions about the phenomenon or problem and prompts students to consider prior experiences or how it might be relevant to their lives or communities. • **Uses student questions to create the need to engage in learning experiences.** Refers to student questions and ideas (e.g., on a class chart, in student notebooks) to drive next steps in learning (pp. 27-29). Throughout learning, prompts students to ask new questions based on what they've learned so far and answer previous questions.	• **Encourages student curiosity and connection to lives and communities.** Provides an opportunity for students to ask questions about the phenomenon or problem and prompts students to consider prior experiences or how it might be relevant to their lives or communities. • **Does not refer back to student questions.** Moves on to the next step in instruction without making the connection between students' initial questions and where instruction is heading next.	• **Does not encourage student curiosity or connections.** Offers little opportunity (if at all) for students to wonder about the phenomenon or problem or how it might be relevant to their lives or communities. • **Asks questions about the phenomenon/problem.** Presents a phenomenon or problem, then provides students with questions to answer about it. May pose a question instead of a phenomenon or problem. • **Does not elicit student questions.** Does not elicit or discuss student questions, ideas, or prior experiences related to the phenomenon or problem.	• **Does not encourage student curiosity or connections to lives or communities.** Does not offer opportunities for students to wonder or ask questions about a phenomenon or problem or prompt students to consider prior experiences or how it might be relevant to their lives or communities. • **Introduces each next step with no connection to questions.** Explains the connections between the phenomena or problem and STEELS Disciplinary Core Ideas.

What the student does	What the student does	What the student does	What the student does
• **Asks questions and makes connections.** Asks questions and/or shares their prior experiences related to their observations of the phenomenon or problem being investigated. • **Sees own questions guiding the next steps in learning.** Refers back to their original questions at the conclusion of an activity, determining which questions have been answered and asking new questions.	• **Asks questions and makes connections.** Asks questions and/or shares their prior experiences related to their observations of the phenomenon or problem being investigated. • **Does not make connections between student questions and next steps.** Engages in the next investigation when prompted, with no connection to their own questions or ideas.	• **Does not ask questions about phenomena/problems.** Observes the phenomenon or problem but does not ask questions about it. Asks questions only focused on logistics or disciplinary topics (e.g., “What does ‘atmosphere’ mean?”). • **Sees teacher questions guiding next steps in learning.** Engages in learning or investigations based on teacher-provided questions about the phenomenon or problem.	• **Does not ask questions about phenomena/problems.** Observes the phenomenon or problem but does not ask questions about it. Asks questions only focused on logistics or disciplinary topics (e.g., “What does ‘atmosphere’ mean?”). • **Does not make connections between their own questions and the next steps in learning.** Engages in learning unrelated to questions about the phenomenon or problem. Engages in the next investigation when prompted, with no connection to their own questions.
Example	***Example***	***Example***	***Example***
After showing a video of large, golf ball-size hail falling and harming the crops in Sugar Grove, PA on July 20, 2023, the teacher facilitates a discussion to elicit student questions and prior experiences with hail. The teacher then refers to student questions that the class will try to answer by engaging in a series of scientific investigations and explorations. Throughout the learning sequence, the teacher continually refers back to the student questions and prompts students to see	*After showing a video of large, golf ball-size hail falling and harming the crops in Sugar Grove, PA on July 20, 2023, the teacher facilitates a discussion to elicit student questions and prior experiences with hail. The teacher then moves onto the next activity without mentioning how it connects to student questions or experiences.*	*After showing a video of large, golf ball-size hail falling and harming the crops in Sugar Grove, PA on July 20, 2023, the teacher shares the driving questions the class will be investigating: “Why does hail fall sometimes and not others? What can farmers do to protect their crops when it hails?” The teacher then asks students to journal a few ideas about possible reasons.*	*After showing a video of large, golf ball-size hail falling and harming the crops in Sugar Grove, PA on July 20, 2023, the teacher leads a learning sequence about the factors that influence weather and climate.*

connections between their questions and what will be investigated next.[4]			

[4] Example adapted from middle school unit *6.3 Weather, Climate & Water Cycling* developed by OpenSciEd. 2020.

Component B: Multi-Dimensional Learning

B.1 Students are the “doers” in instruction by engaging in multi-dimensional learning to make sense of phenomena and solve problems.

Students use and develop grade-appropriate STEELS dimensions to make sense of phenomena or problems.

The "1" column represents full classroom implementation of STEELS

1. Students use multiple grade-appropriate STEELS dimensions to make sense of phenomena/problems.	**2.** Students use multiple STEELS dimensions to make sense of phenomena or problems, but the dimensions are below grade level.	**3.** Students use one or two grade-appropriate STEELS dimensions together, but dimensions are not used to make sense of phenomena/problems.	**4.** Students use one grade-appropriate dimension (practices) to make sense of phenomena/problems.	**5.** Students use one or two below-grade-level dimensions, but these are not used to make sense of phenomena/problems.
What the teacher does	**What the teacher does**	**What the teacher does**	**What the teacher does**	**What the teacher does**
• **Supports students to use at least two grade-appropriate STEELS dimensions.** Facilitates a learning experience that requires students to use Disciplinary Core Ideas (DCIs) with at least one other dimension on grade level, including: ○ DCIs and Science and Engineering Practices (SEPs) ○ DCIs and Technology and Engineering Practices (TEPs) ○ DCIs and Crosscutting Concepts (CCCs) ○ DCIs, SEPs, and CCCs	• **Supports students to use at least two below-grade-level STEELS dimensions.** Facilitates a learning experience that requires students to use multiple *below-grade-level* dimensions. This may include DCIs with at least one other dimension, including: ○ DCIs and SEPs ○ DCIs and TEPs ○ DCIs and CCCs ○ DCIs, SEPs, and CCCs • **Facilitates learning in which students are using targeted STEELS**	• **Supports students to use one or two grade-appropriate dimensions.** Facilitates a learning experience that requires students to use one or two grade-appropriate dimensions. These dimensions may not be used together (e.g., reading about a DCI, then learning separately about what should be included in a model — but not combining the two). • **Facilitates an experience in which dimensions are learned separately from making**	• **Supports students to use one grade-appropriate dimension.** Facilitates a learning experience that requires students to use one grade-appropriate dimension, usually SEPs, without any other dimensions. • **Facilitates learning where students use a STEELS dimension to explain phenomena or design solutions to problems.** Provides opportunities for students to use one STEELS dimension to develop an explanation or solution	• **Supports students to use one or two below-grade-level dimensions.** Facilitates a learning experience that requires students to use just one or two dimensions that are below grade level. • **Facilitates learning focused on memorizing content.** Facilitates learning experiences that are for the purpose of remembering DCIs (rather than to develop explanations of phenomena or to design solutions to problems).

• **Facilitates learning in which students use STEELS dimensions to explain phenomena or design solutions to problems.** Provides opportunities for students to use the STEELS dimensions to develop an explanation or solution about the phenomenon/ problem	**dimensions to explain phenomena or design solutions to problems.** Centers the learning experience on phenomena or problems that require students to use the STEELS dimensions to develop an explanation or solution.	**sense of a phenomenon or problem.** Facilitates a learning experience that does not support students to use dimensions to explain phenomena or design solutions to problems. While these activities are more interactive than a traditional lecture, they lack authentic purpose of figuring something out. For example: ○ exploring a question focused on a DCI ("open-ended inquiry") ○ exploring an idea with no end goal (often called "hands on") ○ following [step-by-step directions] (often called "cookbook labs").	about the phenomenon/problem.	
What the student does • **Develops and uses at least two grade-appropriate dimensions.** Develops and uses DCIs with at least one other dimension on grade level, including: ○ DCIs and SEPs ○ DCIs and TEPs ○ DCIs and CCCs ○ DCIs, SEPs, and CCCs	**What the student does** • **Develops and uses at least two below-grade-level dimensions.** Develops and uses elements from at least two below-grade-level STEELS dimensions. • **Makes sense of phenomena and problems.** Uses dimensions together to make sense of phenomena or design	**What the student does** • **Develops and uses one or two grade-appropriate dimensions.** Develops and uses one or two grade-appropriate dimensions. • **Engages with dimensions in a way that does not require reasoning or sense-making.** Engages in activities that may use	**What the student does** • **Develops and uses one grade-appropriate dimension.** Develops and uses one dimension, usually an SEP, on a grade-appropriate level. • **Makes sense of phenomena and problems.** Uses an SEP or TEP to make sense of phenomena or design solutions to problems.	**What the student does** • **Develops and uses one or two below-grade-level dimensions.** Develops and uses elements from one or two below-grade-level STEELS dimensions. • **Focuses on developing and using DCIs with little real-world application.** "Learns about" STEELS dimensions (usually DCIs) rather than developing and using STEELS

• **Makes sense of phenomena and problems.** Uses dimensions together to make sense of phenomena or design solutions to problems (i.e., multi-dimensional learning).	solutions to problems (i.e., multi-dimensional learning).	interactive approaches to learn STEELS dimensions, but students don't authentically make sense of phenomena/problems. For example: ○ exploring a question focused on a DCI ("open-ended inquiry") ○ exploring an idea with no end goal (often called "hands on") ○ following step-by-step directions (often called "cookbook labs")		dimensions to "figure out" phenomena or problems.
Example *Students develop a model of a design solution (SEP) for a local flooding problem using ideas about regional weather patterns and the water cycle (DCI) and how parts of a system work together (TEP, CCC).*	***Example*** *High school students plan and carry out an investigation collaboratively (3–5 SEP) to address a local flooding problem (K–2 ELS standard) using the ideas that water cycles partially through downhill flows on land and movements of water are propelled by gravity (6–8 DCI) to figure out if a downhill trench will solve the problem.*	***Example*** *"Open-Ended Inquiry" example: Students are prompted to write a question they want to explore about how water evaporates and design an experiment to investigate it.* **OR** *"Hands on" example: Students rotate to different stations in the room where they complete a variety of activities, taking notes about a different property of water at each station. The purpose is to gather*	***Example*** *Students construct a solution (SEP) using trial and error for a local flooding problem (but they do not use any ideas about regional weather patterns or the water cycle to construct their solution).*	***Example*** *High school students watch a video about water cycling partially through downhill flows on land (6–8 DCI) and take notes on a worksheet.*

		key ideas about the properties of water, but learning is disconnected from a phenomenon or problem. **OR** *"Hands on" design challenge example: Students read about how engineers use design principles to control the flow of water in rivers. Then, they follow directions to build a dam out of popsicle sticks. There is no discussion of a real-world problem that needs to be solved.*		

Component C: Reaching All Students through Scaffolding and Language Development

C.1 Scaffolding strategies support student learning.

Students have access to scaffolding and support as needed (and gradually reduced over time) to meet grade-level STEELS learning goals.

The "1" column represents full classroom implementation of STEELS

1. Scaffolding strategies allow all students to engage in grade-level learning experiences; scaffolding is reduced over time.	**2.** Scaffolding strategies are unnecessary or fixed, oversimplifying tasks and preventing some students from accessing grade-level learning.	**3.** Scaffolding strategies are non-existent or too minimal, preventing some students from accessing grade-level learning.	**4.** Scaffolding strategies are non-existent; instead, alternative activities are provided that support below-grade-level learning.
What the teacher does	**What the teacher does**	**What the teacher does**	**What the teacher does**
• **Provides appropriate scaffolding for STEELS learning goals.** Provides scaffolding strategies (e.g., checklists, examples) that support all students to engage in grade-level learning experiences. Encourages students to use these strategies when needed. • **Reduces STEELS scaffolding over time.** Monitors student learning needs, adjusting scaffolding as needed over time and increasing the rigor of student learning. • **Uses strategies to reach all students.** Differentiates (pp. 27-29) as needed for students who are not proficient in grade-level mathematics and reading, students with special needs and abilities, and emerging multi-	• **Provides too much scaffolding for STEELS learning goals.** Provides too much scaffolding, taking away the opportunity for students to engage in grade-appropriate work (e.g., giving too much information up front before students have a chance to develop ideas or practices). • **Does not reduce STEELS scaffolding over time.** Does not expect students to take increased responsibility for completing grade-appropriate STEELS learning goals. • **Uses strategies to reach all students.** Differentiates as needed for students who are not proficient in grade-level mathematics and reading, students with special needs and abilities, and emerging multi-lingual students (e.g., reading	• **Provides no scaffolding for STEELS learning goals.** Provides the right answer to correct student work after-the-fact and does not provide scaffolding strategies while they are completing their work. • **Does not use strategies to reach all students.** Does not differentiate for students who are not proficient in grade-level mathematics and reading, students with special needs and abilities, and emerging multi-lingual students, causing a potential barrier to students engaging with the targeted content.	• **Provides alternate activities.** Gives struggling students different activities that reduce rigor, such as a worksheet. Does not expect struggling students to engage in reasoning with grade-level content.

lingual students (e.g., reading an excerpt aloud, providing an extension activity for students who have already met learning goals). Expects grade-appropriate work from all students relative to the intended learning targets.	an excerpt aloud, providing an extension activity for students who have already met learning goals). Expects grade-appropriate work from all students relative to the intended learning targets.		
What the student does • **Uses scaffolding to complete work.** Recognizes and uses scaffolding tools that support their learning. Makes choices about the tools they use as they gain proficiency with skills or content. • **Over time, completes work with no scaffolding support.** Requests support less often, and ultimately not at all, to complete grade-appropriate work as instruction goes on.	**What the student does** • **Uses scaffolding to complete work.** Uses scaffolding tools to help them complete their work. • **Over time, continues to use all of the same scaffolding tools.** Relies on the use of scaffolding tools throughout the entire instructional sequence. May not develop or use grade-appropriate dimensions on their own due to continued use of scaffolding.	**What the student does** • **Is unable to fully engage in task as designed due to lack of scaffolding.** Fails to meet grade-appropriate expectations for a given task, due to inadequate support. • **Is unable to successfully engage in learning due to non-STEELS barriers (e.g., reading level, language of materials).** Is unable to engage in grade-level STEELS learning due to lack of differentiation with activity.	**What the student does** • **Completes below-grade level alternate activities.** Some or all students engages in a "simpler" activity provided by the teacher, such as coloring and labeling parts of a model instead of developing their own model. Does not engage in reasoning with grade-level content.
Example *Students create a model to explain how a bear gains weight quickly (up to 30 pounds a week of extra mass) when preparing for winter. To support all students to develop a model at the beginning of instruction, the teacher provides a modeling checklist of what components to include (blood, cells, fat stores, lungs, oxygen, carbon dioxide, energy, food) as well as what unobservable interactions they might include (digestion, absorption, eating, excretion,*	***Example*** *Students create a model to explain how a bear gains weight quickly (up to 30 pounds a week of extra mass) when preparing for winter. To support students with the practice of modeling, the teacher provides the model and asks students to interpret it. For the remainder of the unit, students are given the option to refer to the teacher's initial model or create their own, and some students continue to use the teacher's model throughout the unit.*	***Example*** *The teacher prompts students to create a model to explain how a bear gains weight quickly (up to 30 pounds a week of extra mass) when preparing for winter. There are no additional supports or scaffolds. Most students fail to represent components of a model or do not even attempt to draw a model. Two students spend time translating the directions for the assignment to their home language but run out of time to complete it.*	***Example*** *Rather than being asked to develop an explanatory model about what causes bears to gain weight before winter, some students complete a word search that includes terms like "hibernation" and "bear."*

delivery to cells, inhaling and exhaling) in their models. *A student who is a multi-lingual learner is provided with materials in their home language, which they incorporate into the model.* *By the end of the learning sequence, the teacher no longer provides the modeling checklist to students, and they are expected to create grade-appropriate explanatory models with all necessary components without scaffolding.*[5]			

[5] Example adapted from middle school unit *7.3 Metabolic Reactions* (middle school) by OpenSciEd. 2019.

C.2 Vocabulary is introduced in context and only after students have learned the related concepts.

Students learn scientific vocabulary after they have developed a conceptual understanding of the terms. Students are given the opportunity to describe terms in their own words and apply vocabulary as part of final explanations of phenomena.

The "1" column represents full classroom implementation of STEELS

1. Vocabulary is introduced in context and at flexible times only after students have learned the related concepts.	**2.** Teachers introduce vocabulary at set times regardless of whether students have already developed the concept behind them.	**3.** Teachers facilitate the rote memorization of terminology before the ideas are developed and before they can be used in explanations of phenomena or problems.
What the teacher does	**What the teacher does**	**What the teacher does**
• **Encourages student use of everyday language while developing knowledge.** Encourages and allows students to describe their ideas about phenomena/problems using everyday or home language (as well as models, drawings, or gestures) as they develop their conceptual understanding. • **Introduces vocabulary terms after students understand the concepts behind them.** Introduces scientific terms and vocabulary only after students learn the concepts behind them so that terms can be used to authentically communicate ideas, explanations, or solutions. Prioritizes conceptual understanding over rote memorization of vocabulary.	• **Introduces scientific vocabulary regardless of student progress.** Introduces new scientific vocabulary at predetermined times throughout instruction regardless of whether students have already developed a conceptual understanding of the terms. • **Emphasizes use of scientific vocabulary over conceptual understanding.** Expects students to use scientific vocabulary right away while explaining phenomena or designing solutions to problems rather than everyday language.	• **Introduces scientific vocabulary at the beginning of instruction.** Expects students to memorize scientific vocabulary, often at the beginning of instruction before they have learned or figured out the concepts behind them. • **Emphasizes memorization of scientific vocabulary.** Emphasizes remembering the definition of terms as the end goal rather than how the concept behind them can inform explanations of phenomena or solutions to problems.

What the student does	What the student does	What the student does
• **Uses everyday language while developing knowledge.** Use everyday or home language (as well as models, drawings, or gestures) to describe their ideas about phenomena/problems and related STEELS Disciplinary Core Ideas and concepts. • **Learns vocabulary after they have developed the concept behind it.** After developing disciplinary ideas and concepts, learns and begins to use new scientific vocabulary in context of explaining a phenomenon or designing a solution to a problem. • **Uses vocabulary to help communicate explanations or solutions.** Feels like the vocabulary word helps them to communicate explanations of phenomena or solutions to problems more easily.	• **Attempts to memorize terms regardless of whether they understand the ideas behind them.** Memorizes definitions of scientific vocabulary regardless of whether they have developed an understanding of the concept behind it. Does not have the opportunity to use everyday or home language to build conceptual understanding. • **May use terms in explanations or solutions with a superficial level of understanding.** Attempts to use scientific vocabulary to communicate ideas, but the use may be superficial (e.g., fill in the blank, labeling) and lack conceptual understanding.	• **Attempts to memorize terms before developing understanding of concepts behind them.** Memorizes definitions of scientific vocabulary at the beginning of instruction. • **May use terms in explanations or solutions with a superficial level of understanding.** Attempts to use scientific vocabulary to communicate ideas, but the use may be superficial (e.g., fill in the blank, labeling) and lack conceptual understanding.
Example	***Example***	***Example***
As students figure out why a plunger sticks to the wall, they realize air is made up of little pieces that are too small to see and describe using everyday language. After students have developed this understanding, they develop a consensus model of the plunger stuck to the wall that included drawings and everyday language like "pieces of air." The teacher then introduces the vocabulary word "particles" for them with an arrow connecting it to the word "pieces" and small circles already drawn. Students are then able to use the term to communicate clearly about the concept in their explanations.	*On the second day of students figuring out why a plunger sticks to the wall, the teacher introduces the vocabulary word "particles" and asks students to add the definition to their notebook and label it in their initial model. Students follow instructions, but many student models demonstrate varying ideas about what particles are or even if they are involved in making the plunger stick to the wall. Students have not yet reached consensus on the idea that air is made up of little pieces that are too small to see, a concept which will be developed in the upcoming lesson.*	*Before investigating what makes a plunger stick to a wall, the teacher adds the term "particles" to the word wall and asks students to write a definition in their notes. Students then complete a worksheet, reading about and answering several questions about terms like "pressure" and "particles." Later, when asked why a plunger sticks to the wall, a student replied, "because of the pressure and particles" but could not elaborate further.*

Component D: Student-Centered Classroom Culture

D.1 Classroom culture fosters student-centered learning communities.

Students communicate like scientists and engineers using norms and protocols that support all students to participate.

The "1" column represents full classroom implementation of STEELS

1. Students communicate like scientists through practices, norms, and protocols that foster a learning community.	**2.** Students work together and communicate, but students lack helpful norms or protocols to do so effectively.	**3.** Students mostly work individually or in groups that don't require discourse or collaboration.	**4.** Students mostly work individually and/or engage in whole class discussions that involve teachers asking questions with one right answer.
What the teacher does	**What the teacher does**	**What the teacher does**	**What the teacher does**
• **Co-constructs norms for collaboration and discussion.** Works with students at the beginning of the course or semester to co-construct and establish shared collaboration/discussion expectations (e.g., norms). • **Refers to norms consistently.** Positively reinforces the use of norms as a tool to support reflection and growth, rather than only referencing norms when arguments arise. • **Provides structures and protocols to support all students with engaging in scientific discourse.** Consistently provides support (e.g., sentence frames, protocols such as A-B partner talk protocol, jigsaw, or group roles) that enable all students to engage in scientific discourse (including talk moves to support expressing, clarifying, and justifying their reasoning) and build	• **Introduces classroom norms but only refers to them after disagreement.** Tells students discussion norms rather than co-constructing. Refers to norms only when students are in a disagreement. • **Offers opportunities for discussion without structures or protocols to support scientific discourse.** Provides opportunities for discussion without clear guidance for using protocols or norms, leading to several students not engaging in equitable or scientific discourse. • **Offers frequent collaboration opportunities.** Frequently asks students to collaborate and build on each other's ideas.	• **Monitors students to make sure they are on task but does not refer to norms.** Checks to ensure students are on task without referring to discussion or collaboration norms. • **Offers few opportunities for small group discussion and does not provide structures or protocols to support scientific discourse**. Provides opportunities for discussion without clear guidance for using protocols or norms, leading to several students not engaging in equitable or scientific discourse. • **Does not support effective student collaboration.** Facilitates activities where students work in small groups but does not set clear expectations or provide clear	• **Monitors students to make sure they are on task but does not refer to norms.** Checks to ensure students are on task without referring to discussion or collaboration norms. • **Facilitates whole group discussions by posing questions for individual students to answer.** Leads whole group class conversations by asking right/wrong-style questions for individual students to answer. Most class discussion happens this way. • **Seeks rights answers rather than discourse.** Asks questions looking for one right answer and students rarely build on each other's ideas. • **Prioritizes individual student work time.** Has students work

on each other's ideas in a way that is respectful and grounded in ideas and evidence. In whole group share out, uses low-risk engagement strategies (e.g., "share an idea your partner told you") to support all students to share. • **Prioritizes collaboration opportunities in a variety of formats.** Frequently offers students opportunities to be able to collaborate and build on each other's ideas in meaningful ways, such as through scientist circles and consensus discussions that use sentence stems to promote scientific discourse.		structures to support effective collaboration. • **Facilitates whole group discussions by posing questions for individual students to answer.** When leading whole group class conversations, asks right/wrong-style questions for individual students to answer.	individually unless engaging in whole class discussions.
What the student does	**What the student does**	**What the student does**	**What the student does**
• **Engages in discourse with other students frequently.** Engages in discourse by sharing ideas and learning from one another, building on their peers' ideas, and offering feedback to one another on a regular basis. This includes expressing, clarifying, and justifying their reasoning with peers. • **Variety of formats.** Speaks to peers in a variety of ways (e.g., diverse partners, small groups, formal presentations, technology-enhanced). • **Uses classroom discourse norms consistently.** Uses protocols and co-constructed norms regularly (not just when in a disagreement). • **All students are able to contribute to whole group discussions regularly with the use of protocols.** In whole group discussions, uses protocols that	• **Has regular opportunities to engage in small group discussions.** Has opportunities to engage in small group discussions to share ideas and learn from one another, building on their peers' ideas, and offering feedback to one another on a regular basis. • **Some do not engage in discourse while in small groups.** In small group discussions, some speak much more than others and several students do not contribute because of the absence of equitable discourse protocols or norms. • **Only a few students contribute to whole group discussions.** In whole group discussions, only a few students typically engage or share ideas.	• **Occasionally works in small groups that do not require discourse.** Primarily works individually or in small groups that don't require discourse to complete the activity (e.g., completing a worksheet together), resulting in students sitting quietly in their groups or discussing unrelated things. • **Answers questions from teachers during whole group discussion.** Mostly listens and answers individual questions from the teacher, rarely having an opportunity to build on other students' ideas. Only a few students answer questions.	• **Engages in talk mostly by answering questions from the teacher during whole class conversations.** Mostly listens and answers individual questions from the teacher, rarely having an opportunity to build on other students' ideas. This is where most of the talking happens in class. • **Only a few students participate.** Only those who frequently participate are the ones who answer questions. • **Works individually when not in whole group discussion.** Primarily works individually or as a whole class, resulting in most students sitting quietly throughout the learning period.

gives them and their classmates a chance to contribute.			
Example *After making an initial model to explain why some clothes stick together when they come out of the dryer, students collect evidence related to how charged objects interact with other objects.* *Students then follow co-constructed classroom norms and structured prompts to discuss with partners what they found in the investigation and how they might improve their explanatory models of why the clothes stick.* *Then, in a whole-class conversation, students share their partners' ideas with the group and use a protocol to come to a class consensus for a revised model explaining the electrostatic phenomenon in which all students vote on model components.* *The teacher facilitates the conversation to help put student ideas on the consensus model rather than inserting her own ideas.* [6]	***Example*** *After making an initial model to explain why some clothes stick together when they come out of the dryer, students collect evidence related to how charged objects interact with other objects.* *The teacher asks students to work in small groups to discuss findings and their implications, but students aren't given a structure or protocol to follow in these discussions.* *In a whole group share out, only the students who frequently participate end up sharing their thinking with the whole group and contribute to the class model.*	***Example*** *After making an initial model to explain why some clothes stick together when they come out of the dryer, students collect evidence related to how charged objects interact with other objects.* *Students have an opportunity to work in small groups to complete a worksheet related to their findings, but the teacher does not ask them to discuss. There is little conversation between students as they complete the worksheet. In the debrief, the teacher talks to students through her reasons for filling out each part of the classroom model.*	***Example*** *After making an initial model to explain why some clothes stick together when they come out of the dryer, students collect evidence related to how charged objects interact with other objects.* *The teacher then leads a whole class discussion related to the findings, asking right/wrong questions like "which objects stuck together?" One student who frequently talks answers the question while other students listen. The teacher then moves on to another question.*

[6] Example adapted from high school *Interactions Unit 1 - Why do some clothes stick together when they come out of the dryer?* developed by the CREATE for STEM Institute at Michigan State University, the Concord Consortium, and University of Michigan. 2018.

D.2 Students are aware of their own learning and how it can be applied to explain phenomena and solve problems.

Students reflect on their own learning and the extent to which new understandings help them explain phenomena and make sense of problems.

The "1" column represents full classroom implementation of STEELS

1. Students regularly reflect on what and how their thinking has changed across more than one dimension and how their new knowledge is helping them to figure out the phenomenon/solve the problem.	**2.** Students regularly reflect on what and how their thinking has changed across one dimension (typically core ideas) and how their new knowledge is helping them to figure out the phenomenon/solve the problem.	**3.** Students occasionally reflect on what and how their thinking has changed across one dimension (typically core ideas) but not how these new ideas help them to explain phenomena or solve problems.	**4.** Students think about what they have learned at the end of instruction, but they do not reflect on how the learning experiences can be applied to the real world.
What the teacher does	**What the teacher does**	**What the teacher does**	**What the teacher does**
• **Provides regular reflection opportunities.** Regularly (i.e., after each investigation) offers students explicit opportunities, strategies, and structures to reflect on what supported them in their learning. • **Encourages reflection related to multiple dimensions.** Facilitates reflection opportunities to focus on their progression toward learning goals across multiple dimensions rather than just Disciplinary Core Ideas (DCIs). • **Encourages reflection related to what helped them make sense of phenomena/problems.** Prompts students to explicitly reflect on the ways classroom activities helped to further learning that helps them progress toward explaining the phenomenon or designing a solution to a problem (e.g., through the use of tools such as Driving Question	• **Provides regular reflection opportunities.** Regularly (i.e., after each investigation) offers students explicit opportunities, strategies, and structures to reflect on what supported them in their learning. • **Encourages reflection related to one dimension.** Facilitates reflections that mostly focus on their progress toward one dimension, typically DCIs. • **Encourages reflection related to what helped them make sense of phenomena/problems.** Prompts students to explicitly reflect on the ways classroom activities helped to further learning that helps them progress toward explaining the phenomenon or designing a solution to a problem (e.g., through the use of tools such as DQBs or Incremental Modeling Trackers).	• **Provides occasional reflection opportunities.** Occasionally (i.e., once or twice per unit) offers students explicit opportunities, strategies, and structures to reflect on what supported them in their learning. • **Encourages reflection related to one dimension.** Facilitates reflections that mostly focus on their progress toward one dimension, typically DCIs. • **Does not connect reflection to phenomena/problems.** Prompts students to reflect on their learning, but in a way that is more abstract and disconnected from real-world applications.	• **Provides little to no reflection opportunities.** Does not prompt students to reflect on what they are figuring out over time and how the class's learning activities support these changes in thinking.

Boards (DQBs) or Incremental Modeling Trackers).			
What the student does • **Regularly reflects on their own thinking.** Uses strategies (e.g., meta-cognitive reflection routines) and structures (e.g., a learning tracker tool, a DQB) that help them regularly reflect on how their thinking is evolving over time. • **Reflects on the usefulness of multiple dimensions for explanations and solutions.** Uses strategies to consider how their learning in multiple dimensions helped them better understand the phenomenon or problem.	**What the student does** • **Regularly reflects on their own thinking.** Uses strategies (e.g., meta-cognitive reflection routines) and structures (e.g., a learning tracker tool, a DQB) that help them regularly reflect on how their thinking is evolving over time. • **Reflects on the usefulness of one dimension for explanations and solutions.** Uses strategies to consider how their learning of DCIs helped them better understand the phenomenon or problem.	**What the student does** • **Reflects on acquisition of facts.** Monitors their own learning, but in an abstract way that is not connected to real-world uses. May use structures such as a learning tracking tool, but there is little support to consider how learning can be applied to make sense of phenomena/problems.	**What the student does** • **Focuses only on summative learning or achievement.** Reflects on their own learning once at the end of an instructional sequence if at all.
Example *Students have been working toward explaining why their local sand dunes have changed shapes. At the end of each investigation, students are asked to talk about or write down what changed about their ideas and how the investigation helped them better understand what was happening to the sand dunes.* *After coming to agreement on the final explanation, students are asked to think silently and then talk with a partner about the prompt "Was it more helpful to look at the patterns or at the details of each sand dune to figure out why the sand dunes are changing?" Next, students are asked to think*	***Example*** *Students have been working toward explaining why their local sand dunes have changed shapes. At the end of each investigation, students are asked to talk about or write down what they learned about what was happening to the sand dunes. After coming to agreement on the final explanation, students are asked to reflect on the book they read together about sand dunes, discussing how the information from the book helped them with their explanation.*	***Example*** *Students carry out investigations and gather information to deepen understanding of Earth changes over time. After reading a book together as a class about different kinds of changes to land, the teacher asks students to reflect on what new ideas they learned from the book.*	***Example*** *Students carry out investigations and gather information to deepen understanding of Earth changes over time. At the end of the unit, students show what they learned on a test. The teacher grades the tests and students are provided with an opportunity to review their score and teacher feedback.*

silently and then talk with a partner using the prompt "Think about the way we planned our investigations this time and how that worked. What would you like to remember about the investigation design to make it easier to get data next time?" Students are then prompted to write in their scientific journals about the things they want to remember from the discussion that might be helpful in figuring out other phenomena in the future.[7]			

[7] Example adapted from the 2nd grade unit *Saving the Sand Dunes* developed by mySci. 2023.

Component E: Multi-Dimensional, Phenomenon- or Problem-Driven Assessment

E.1 Assessment tasks support all students to demonstrate use of multiple dimensions to make sense of phenomena or solve problems.

Students engage in accessible tasks[8] that allow them to demonstrate their ability to use multiple STEELS dimensions to make sense of phenomena or design solutions to problems.

The "1" column represents full classroom implementation of STEELS

1. Assessment tasks support all students to demonstrate their understanding of targeted dimensions as they explain a phenomenon or solve a problem.	**2.** Assessment tasks support some students to demonstrate their understanding of targeted dimensions as they explain a phenomenon or solve a problem.	**3.** Assessment tasks support few students to demonstrate their understanding of targeted dimensions as they explain a phenomenon or solve a problem.	**4.** Assessment tasks support students to demonstrate understanding of at least one targeted dimension, but dimensions are not used to explain a phenomenon or solve a problem.	**5.** Assessment tasks do not elicit evidence of targeted dimensions or focus on explaining a phenomenon or solving a problem.
What the teacher does	**What the teacher does**	**What the teacher does**	**What the teacher does**	**What the teacher does**
• **Elicits understanding of targeted dimensions.** Provides assessment tasks that explicitly elicit evidence of each targeted dimension that the teacher intends to assess and each prompt integrates (pp. 38-40) at least two dimensions at a time (DCI+SEP or DCI+CCC or DCI+TEP).	• **Elicits understanding of targeted dimensions.** Provides assessment tasks that explicitly elicit evidence of each targeted dimension that the teacher intends to assess from instruction and each prompt integrates at least two dimensions at a time (DCI+SEP or DCI+CCC or DCI+TEP).	• **Elicits understanding of targeted dimensions.** Provides assessment tasks that explicitly elicit evidence of each targeted dimension that the teacher intends to assess from instruction and each prompt integrate at least two dimensions at a time (DCI+SEP or DCI+CCC or DCI+TEP).	• **Elicits understanding of at least one targeted dimension**. Provides assessment tasks that explicitly elicit evidence of at least one targeted dimension that the teacher intends to assess from instruction. • **Does not ask students to make sense of a phenomenon or solve a**	• **Elicits minimal understanding of what students learned**. Provides assessment tasks that ask students to share what they have learned but the prompts are not designed to elicit targeted dimensions.

[8] An assessment task is a specific activity designed to collect evidence about a student's achievement of a targeted learning outcome.

• **Asks students to make sense of a phenomenon or solve a problem.**[9] Facilitates assessment tasks that provide students with data or information about a phenomenon or problem and asks them to use it in the assessment. • **Uses fully accessible tasks so all students can demonstrate what they know and can do.** Facilitates assessment tasks that use accessible (pp. 41-43) language and provide a variety of materials and modalities to make sure students understand the information and task (data, pictures, text) and ways for students to communicate ideas (e.g., writing, drawing, talking). Uses scaffolds as needed without giving away the dimensions (e.g., graphic organizers, sentence stems, visuals). • **Allows students opportunities to share reasoning.** Facilitates a task that allows for a range of responses (i.e., not just right or wrong, but allowing for nuance in between).	• **Asks students to make sense of a phenomenon or solve a problem.** Facilitates assessments that provide students with data or information about a phenomenon or problem and asks them to use it in the assessment. • **Uses somewhat accessible tasks.** Facilitates assessments that have some accessible features (e.g., uses accessible language, variety of materials and modalities, some scaffolds), but scaffolds are not sufficient for all students to demonstrate their understanding, particularly those at the emerging level. • **Allows students opportunities to share reasoning.** Facilitates a task that allows for a range of responses (i.e., not just right or wrong, but allowing for nuance in between).	• **Asks students to make sense of a phenomenon or solve a problem.** Facilitates assessments that provide students with data or information about a phenomenon or problem and asks them to use it in the assessment. • **Uses inaccessible tasks.** Facilitates assessments that have very limited design features for accessibility and scaffolds are not sufficient for most students to demonstrate their understanding. • **Allows students opportunities to share reasoning.** Facilitates a task that allows for a range of responses (i.e., not just right or wrong, but allowing for nuance in between).	**problem**. Facilitates assessments that do not provide students with any data or information about a phenomenon or problem and/or students are not prompted to explain a phenomenon or design a solution to a problem. • **Allows students opportunities to share reasoning.** Facilitates a task that allows for a range of responses (i.e., not just right or wrong, but allowing for nuance in between).	• **Focuses on recalling facts or summarizing activities.** Facilitates assessments that do not provide students with any data or information about a phenomenon or problem and/or does not ask students to explain a phenomenon or design a solution to a problem.

[9] For transfer or summative tasks, the phenomenon/problem is not one the students have previously made sense of during instruction.

What the student does	What the student does	What the student does	What the student does	What the student does
• **Demonstrates knowledge and skills related to targeted dimensions.** Completes task, showing what they know and can do with each of the targeted dimensions. • **Makes sense of a phenomenon or solves a problem.** Explains the target phenomenon or solves the problem by the end of the assessment. • **Is able to access the task and show what they know.** Answers all prompts using their own ideas and resources and does not express confusion about instructions/wording or why a question is present.	• **Demonstrates knowledge and skill related to targeted dimensions.** Completes task, showing what they know and can do with each of the targeted dimensions. • **Makes sense of a phenomenon or solves a problem.** Explains the target phenomenon or solves the problem by the end of the assessment. • **Is able to access the task and show what they know on most prompts.** Answers most prompts using their own ideas and resources but may express confusion about instructions/wording or why a question is present and may ask for additional support.	• **Demonstrates knowledge and skill related to targeted dimensions.** Completes task, showing what they know and can do with each of the targeted dimensions. • **Makes sense of a phenomenon or solves a problem.** Explains the target phenomenon or solves the problem by the end of the assessment. • **Has trouble accessing the task and show what they know on most prompts.** Expresses confusion about instructions/wording during many parts of the assessment, asks for lots of additional support, and/or may leave prompts blank and become disengaged.	• **Demonstrates knowledge and skills related to one dimension.** Completes task, showing what they know and can do with one of the targeted dimensions. • **Does not make sense of a phenomenon or solve a problem.** Responds with general prior knowledge and does not use any specific information or data about the phenomenon or problem from the assessment task itself.	• **Responds to general prompts not specific to targeted dimensions.** Completes task, but the student answer provides little data about any of the targeted dimensions. • **Does not make sense of a phenomenon or solve a problem.** Responds with general prior knowledge and does not use any specific information or data about the phenomenon or problem from the assessment task itself.

Example	***Example***	***Example***	***Example***	***Example***
In the unit, students are making sense of how palm oil farming affects resource availability for orangutans and thus their population size. In the middle of the unit, students are given an assessment to elicit what they have learned about the targeted dimensions (for STEELS Standard [3.1.6-8.I](3.1.6-8.I)). *In this assessment, students learn about a decline in the bee population in Pennsylvania and are given a series of data sources to use to make a claim as to why the bee population is declining.* *Each data source is carefully adapted for 7th grade and a graphic organizer* **with. scaffolding.questions** *is provided to help students analyze and organize multiple sources of data.* *During the pilot phase of this unit and task, students said they were confused about why they were being asked one of the questions. That prompt was removed from the assessment, and the culminating prompt is* **chunked.into.bullet.points. that.clearly.prompt.for.***all*	*In the unit, students are making sense of how palm oil farming affects resource availability for orangutans and thus their population size. In the middle of the unit, students are given an assessment to elicit what they have learned about the targeted dimensions (for STEELS Standard [3.1.6-8.I](3.1.6-8.I)).* *In this assessment, students learn about a decline in the bee population in Pennsylvania and are given a series of data sources to use to make a claim as to why the bee population is declining.* *Each data source is carefully adapted for 7th grade and a graphic organizer is provided to help students analyze and organize multiple sources of data.* *During the pilot phase of this unit and task, students said they were confused about why they were being asked one of the questions. That prompt was removed from the assessment, and* **the. culminating.prompt. consists.of.two.sentences. asking.students.to.explain. causes.for.the.change.in.the. bee.population.and.use. data.to.support.their.claim¡**	*In the unit, students are making sense of how palm oil farming affects resource availability for orangutans and thus their population size. In the middle of the unit, students are given an assessment to elicit what they have learned about the targeted dimensions (for STEELS Standard [3.1.6-8.I](3.1.6-8.I)).* *In this assessment, students learn about a decline in the bee population in Pennsylvania and are given a series of data sources to use to make a claim as to why the bee population is declining.* *Students are provided with multiple sources of data and then asked to explain causes for the change in the bee population, using data to support their claim. No scaffolding prompts or supports are provided.*	*In the unit, students are making sense of how palm oil farming affects resource availability for orangutans and thus their population size. In the middle of the unit, students are given an assessment to elicit what they have learned about the targeted dimensions (for STEELS Standard [3.1.6-8.I](3.1.6-8.I)).* *In this assessment, students are asked, "How does resource availability affect organisms in an ecosystem? Provide an example to support your explanation."*	*In the unit, students are making sense of how palm oil farming affects resource availability for orangutans and thus their population size. In the middle of the unit, students are given an assessment to elicit what they have learned so far and relate to something they care about.* *In this assessment, students are asked, "What have you learned so far in this unit? Pick another endangered animal that you care about and explain why we should care about them."*

three of the dimensions it intends to assess.[10]				

[10] Example adapted from middle school unit *7.5 Ecosystem Dynamics & Biodiversity* developed by OpenSciEd. 2021.

E.2 Assessments are used to support students in progressing with their multi-dimensional thinking.

Assessment results are used to further student progress toward proficiency of STEELS Standards.

The "1" column represents full classroom implementation of STEELS

1. Based on information from assessments, students are provided with targeted instruction AND feedback and opportunities to revise in order to further support their learning.	**2.** Based on information from assessments, students are provided with targeted instruction OR feedback and opportunities to revise in order to further support their learning.	**3.** Based on information from assessments, students are provided with a grade that evaluates their understanding of the targeted dimensions.	**4.** After taking an assessment, students receive no information or feedback about their performance.
What the teacher does	**What the teacher does**	**What the teacher does**	**What the teacher does**
• **Analyzes assessment data for evidence of students' learning.** Analyzes student work from the assessments to identify trends in students' strengths and areas of need with the dimensions. • **Uses assessment data to provide feedback and opportunities for revision.** Gives students feedback (pp. 44-49) specific to the targeted dimensions (either whole class based on trends or individual) and provides opportunities for them to use the feedback to revise their thinking. • **Uses assessment data to plan targeted next steps in instruction.** Uses trends in student performance on the targeted dimensions to determine steps for future instruction (e.g., reteach a concept, include additional scaffolds in a future unit, provide additional practice).	• **Analyzes assessment data for evidence of students' learning.** Analyzes student work from the assessments to identify trends in students' strengths and areas of need with the dimensions. • **Uses assessment data to provide feedback and opportunities for revision.** Gives students feedback specific to the targeted dimensions (either whole class based on trends or individual) and provides opportunities for them to use the feedback to revise their thinking. OR • **Uses assessment data to plan targeted next steps in instruction.** Uses trends in how students used the targeted dimensions in the assessment to decide how to best support students in future instruction (e.g., reteach a concept, include additional scaffolds next time, provide additional practice).	• **Analyzes assessment data for evidence of students' learning.** Analyzes student work from the assessments to identify what students know and can do with the targeted dimensions. • **Evaluates individual student performance.** Provides a grade for students and may review correct answers but does not otherwise use assessment data to inform future instruction.	• **Continues with instruction without using information from the assessment.** Continues with instruction as planned, making no mention or use of the assessment.

What the student does	What the student does	What the student does	What the student does
• **Receives feedback and revises thinking**. Receives feedback from the teacher and uses it to revise their thinking on the assessment and/or reflect on how they can improve. • **Receives targeted support**. Engages in future learning experiences that are targeted to their needs and supports them with scaffolding so they feel they are able to improve their development of specific targeted dimensions.	• **Receives feedback and revises thinking.** Receives feedback from the teacher and uses it to revise their thinking on the assessment and/or reflect on how they can improve. OR • **Receives targeted support.** Engages in future learning experiences that are targeted to their needs and supports them with scaffolding so they feel they are able to improve their development of specific targeted dimensions.	• **Receives some information about their performance with targeted dimensions**. Receives a grade for their assessment performance and possibly correct answers for the assessment, but they are uncertain what they need to continue to work on and don't know exactly how to improve.	• **Receives no information about their performance with targeted dimensions**. Completes assessment tasks and moves on to the next activity, without feedback, reflection, or revision opportunities.
Example *Students take an assessment task in which they learn about a decline in the bee population in Pennsylvania and are given a series of data sources to use to make a claim for why the bee population is declining (for STEELS Standard 3.1.6-8.I).* *The results showed the teacher that most of her students were not able to include sufficient reasoning to describe how changes in multiple parts of the ecosystem connect to all the patterns across the data. First, she provides whole class feedback by critiquing an anonymous sample response together that shows this trend and gives students an opportunity to revise their culminating responses. In the upcoming instruction, she finds another lesson where students are analyzing multiple sources of data to make a claim. For this lesson, she provides a flowchart graphic organizer that helps them use reasoning to connect data analysis of*	***Example*** *Students take an assessment task in which they learn about a decline in the bee population in Pennsylvania and are given a series of data sources to use to make a claim for why the bee population is declining (for STEELS Standard 3.1.6-8.I).* *The results showed the teacher that most of her students were not able to include sufficient reasoning to describe how changes in multiple parts of the ecosystem connect to all the patterns across the data. She provides individual feedback to each student and allows them an opportunity to revise their responses to the culminating prompt. She then also has them do a round of peer feedback to continue strengthening their ideas and language.*	***Example*** *Students take an assessment task in which they learn about a decline in the bee population in Pennsylvania and are given a series of data sources to use to make a claim for why the bee population is declining (for STEELS Standard 3.1.6-8.I).* *The teacher evaluates each student's responses on the task and provides each student with a grade, based on how many questions they got correct.*	***Example*** *After students take the Bee Population in Pennsylvania assessment task (for STEELS Standard 3.1.6-8.I), the teacher moves on to the next lesson, considering the activity completed. Students never receive any additional information about how they did on the assessment.*

multiple graphs and provides sentence frames that support students in using the language needed to cite evidence and use cause-and-effect language structures in their reasoning.			