twig Science



Designed for NGSS: Program Rubric

Analyze Evidence

Directions

1. Review the Designed for NGSS: Program Rubric.
2. Review the teacher materials and/or student materials to assess the strength of each element.
3. Record strengths and limitations for each component based on your evidence. Cite specific examples.

PROGRESSIONS OF LEARNING. Within a program, learning experiences are more likely to help students develop a greater sophistication of understanding of the elements of SEPs, CCCs, and DCIs when teacher materials:	Strong	Adequate	Weak
• make it clear how each of the three dimensions builds logically and progressively over the course of the program and make clear how:	✓		
• students engage in the science and engineering practices with increasing grade-level appropriate complexity over the course of the program.	✓		
• students utilize the crosscutting concepts with increasing grade-level appropriate complexity over the course of the program.	✓		
• students engage in grade level/band appropriate disciplinary core ideas	✓		
• provide a rationale for a logical sequence and treatment of ETS and NoS.	✓		

Strengths

Twig Science teacher materials show great strengths in making it clear how the dimensions build logically and progressively over the program.

Evidence

Progression Across the Program

The **Twig Science Program Guide** (provided online and at the front of every Teacher Edition) outlines the instructional design of the program and how all the components work together to support students to use the three dimensions to make sense of phenomena and solve problems.

The **K–6 NGSS Alignment and Progression Guide** details how the three dimensions build logically and progressively over the program.

The **NGSS Framework Alignment** (front cover of every Teacher Edition) sets out the logical sequence for the Performance Expectations (PEs) across the Twig Science K–6 modules, and shows where they are addressed in each grade. It illustrates how the 29 modules align directly to the NGSS Topic Arrangements.

NGSS Framework Alignment

It shows how each module targets a bundle of PEs from different disciplines, including engineering.. This interdisciplinary approach to learning, supports students to make connections between Life, Physical, Earth and Space Science, and Engineering, and reflects how scientists and engineers work in the real world, as opposed to working in a single discipline.

The **Performance Expectation Progressions table**, included in the **K–6 NGSS Alignment and Progression Guide** and in the relevant Teacher Edition (back cover), are module specific. They tell the story of how students have used, and will use, the module-relevant three dimensions with increasing complexity across the program.

For example, the Performance Expectation Progressions table for Grade 3 Module 1 identifies that, before this module, students have investigated:

- Push and pull forces in Kindergarten Module 2 (Marble Run Engineers), covering K-PS2-1, and K-PS2-2.
- Engineering tasks in Grade 1 Module 3 (Shadow Town), covering SEP-3.
- Practices in Grade 2 Module 2 (Master of Materials), covering K–2-ETS1-1, K–2-ETS1-2, K–2-ETS1-3.

In later grades, students will encounter:

- The relationship between energy and forces when objects collide in Grade 4 Module 4 (PS3.C).
- Planning and carrying out fair tests where variables are controlled in Grade 5 Module 1 (3–5-ETS1-1).

Grade 4 Module 4 Performance Expectation Progressions table

Progression Across the Grade

K–6 NGSS Alignment and Progression Guide includes the Scope and Sequence tables for K–6. A grade-specific Scope and Sequence is included in the front cover of each Teacher Edition.

The **Scope and Sequence tables** clearly identify the sequence of the modules in every grade, as well as the Module Phenomenon or Investigative Problem the students are figuring out, and the storyline, which puts the learning journey into a captivating context. The PEs that each module addresses are also identified, as are the sequence of the three dimensions that are addressed over the course of the grade.

Progression Across a Module

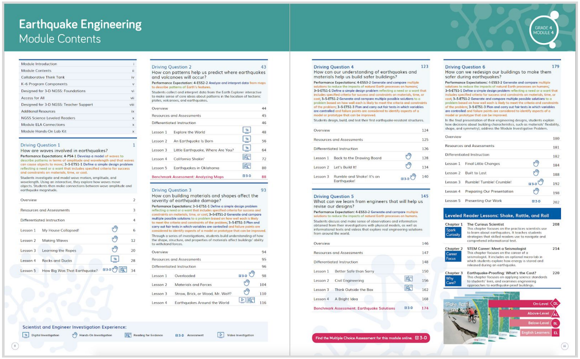
In every module, students follow a sequence of **Driving Questions (DQs)** designed to progressively build their skills and scientifically accurate understandings. The flow of SEPs, CCCs, and DCIs across the DQs follow a logical sequence supporting students to gain expertise of the practices and concepts they need to address the **Module Phenomenon/ Investigative Problem.**

The **Module Contents** in every Teacher Edition provides an overview of the module conceptual flow and details the sequence of the PEs addressed.

For example, in Grade 4 Module 4 the Module Investigative Problem is: How can we reduce the damage caused by earthquakes?

Students tackle the problem in stages, by following a sequence of six DQs:

- DQ1: How are waves involved in earthquakes?
- DQ2: How can patterns help us predict where earthquakes and volcanoes will occur?
- DQ3: How can building materials and shapes affect the severity of earthquake damage?
- DQ4: How can our understanding of earthquakes and materials help us build safer buildings?
- DQ5: What can we learn from engineers that will help us revise our designs?
- DQ6: How can we redesign our buildings to make them safer during earthquakes?



Grade 4 Module 4 Module Contents

Flow of DCIs

- DQ1: Students explore natural hazards (PS4-1), properties of waves (ESS3.B), and define and develop engineering engineering solutions (ETS1.A and ETS1.B).
- DQ2: Students investigate plate tectonics (ESS2.B).
- DQ3: Students define, develop, and optimize engineering solutions (ETS1.A, ETS1.B, and ETS1.C).
- DQ4: Students build on the engineering DCIs (ETS1.A, ETS1.B, and ETS1.C) and revisit natural hazards (ESS3.B).
- DQ5: Students revisit natural hazards (ESS3.B) and design solutions (ETS1.B).
- DQ6: Students revisit natural hazards (ESS3.B) and define, develop, and optimize engineering solutions(ETS1.A, ETS1.B, and ETS1.C).

Flow of SEPs and CCCs

- DQ1: Students ask questions and define problems (SEP-1), use models (SEP-2), and apply the concept of patterns (CCC 1).
- DQ2: Students analyze data (SEP-4) and use patterns (CCC-1).
- DQ3: Students ask questions and define problems (SEP-1), construct explanations and design solutions (SEP-6), analyze and interpret data (SEP-4), and explore the influence of science, technology and engineering on society and the natural worlds.
- DQ4: students gain further experience of asking questions and defining problems, constructing explanations and designing solutions, analyzing and interpreting data (SEPs1 and 6)), apply the concept of cause and effect and exploring the influence of science, technology and engineering on society and the natural worlds (CCC 2).

- DQ5: Students construct explanations and designing solutions (SEP-6), apply the concept of cause and effect (CCC-2), and explore the influence of science, technology and engineering on society and the natural worlds.
- DQ6: Students consolidate asking questions and defining problems (SEP-1), constructing explanations and designing solutions (SEP-6), analyzing and interpreting data (SEP-4), applying cause and effect (CCC-2), and exploring the influence of science, technology and engineering on society and the natural worlds.
- By the end of DQ6, students have figured out the answer to the Module Investigative Problem. They understand that earthquake damage can be reduced by not building on active fault lines, where possible, and/or by using a variety engineering solutions that allow buildings to withstand the shaking caused by the energy of seismic waves.

Progression Across a Driving Question

More detail on how the sequence of ideas and practices flow across each DQ is provided in every **Driving Question Overview** which provides a short summary of the three dimensional activities in each lesson.

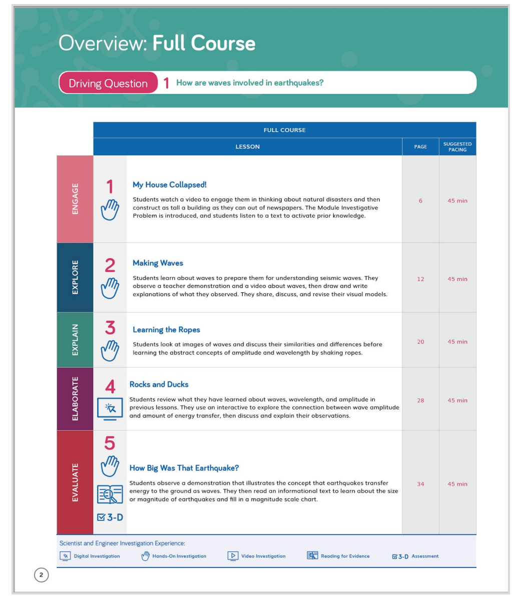
For example, in Grade 4 Module 4:

In DQ1, students explore the question: How are waves involved in earthquakes? Over five lessons, students are first introduced to the phenomena of natural hazards (ESS3.B), before carrying out investigations—both physical and digital—to model waves (SEP-2), and understand the properties of waves and how they transfer energy (PS4.A). They interrogate texts, watch videos, and apply the Crosscutting Concepts of cause and effect (CCC-2) and energy and matter (CCC-5) to figure out the answer to the DQ—seismic waves cause earthquakes, and larger waves, which transfer more energy, cause earthquakes of greater magnitude and the potential to cause more destruction.

Progression Across a Lesson

The five-part Twig Science lesson structure has been designed to support students to develop their metacognitive abilities on a daily basis:

- **Spark:** An engaging "hook" activity, which motivates students for the investigations ahead.
- **Investigate:** Students think like scientists and design like engineers, through hands-on, digital, video, and informational text Investigations.
- **Report:** Students articulate what they've learned today, citing evidence and their use of the three dimensions.
- **Connect:** Students make connections to the DQs and Module Phenomenon/Investigative Problem, while building knowledge of CCCs and SEPs.
- **Reflect:** Students use different means to think about what they have learned so far and how they can use their new understandings to better figure out phenomena/problems.



Overview: **Full Course**

Driving Question 1 How are waves involved in earthquakes?

	FULL COURSE		
	LESSON	PAGE	SUGGESTED PACING
ENGAGE	1 **My House Collapsed!** Students watch a video to engage them in thinking about natural disasters and then construct as tall a building as they can out of newspapers. The Module Investigative Problem is introduced, and students listen to a text to activate prior knowledge.	6	45 min
EXPLORE	2 **Making Waves** Students learn about waves to prepare them for understanding seismic waves. They observe a teacher demonstration and a video about waves, then draw and write explanations of what they observed. They share, discuss, and revise their visual models.	12	45 min
EXPLAIN	3 **Learning the Ropes** Students look at images of waves and discuss their similarities and differences before learning the abstract concepts of amplitude and wavelength by shaking ropes.	20	45 min
ELABORATE	4 **Rocks and Ducks** Students review what they have learned about waves, wavelength, and amplitude in previous lessons. They use an interactive to explore the connection between wave amplitude and amount of energy transfer, then discuss and explain their observations.	28	45 min
EVALUATE	5 3-D **How Big Was That Earthquake?** Students observe a demonstration that illustrates the concept that earthquakes transfer energy to the ground as waves. They then read an informational text to learn about the size or magnitude of earthquakes and fill in a magnitude scale chart.	34	45 min

Scientist and Engineer Investigation Experience: Digital Investigation · Hands-On Investigation · Video Investigation · Reading for Evidence · 3-D Assessment

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Driving Question Overview

Each Lesson Overview includes the lesson's targeted standards, the 3-D Learning Objectives, and the sequence of learning, which is displayed in a simple graphic organizer with a suggested pacing guide to help teachers plan. For example, in Grade 4 Module 4 **(Grade 4 Module 4 DQ2L1 Overview TE p. 48)**, students will:

- **Investigate** patterns in the locations of earthquakes, volcanoes, and mountain ranges using an interactive map.
- **Report** their observations and discuss these with the class.
- **Connect** what they have learned to the PE 4-ESS2-2.
- **Reflect** on how knowing where earthquakes occur will help them answer the Module Investigative Problem.


Back to the Drawing Board

OVERVIEW

Spark	8 min	Students review the design rubric for the module's Performance Task, the Engineering Design Challenge.
Investigate	25 min	Students write three things they learned that they want to include in their design, and three things they do not. Student teams discuss and design their earthquake-resistant building.
Report	6 min	Students hold a class brainstorming session about their designs, sharing concerns or questions they may have about their design and proposing solutions.
Connect	3 min	Students share ideas about why they think focusing on waves and forces may be important to solving an engineering problem.
Reflect	3 min	Students write or draw one design feature that reflects something they learned in class.

STANDARDS

NGSS

PE
4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans
3–5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost
3–5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem

DCI
ETS1.A Defining Engineering Problems
ETS1.B Developing Possible Solutions

SEP
SEP-1 Asking Questions and Defining Problems
SEP-2 Developing and Using Models
SEP-3 Planning and Carrying Out Investigations
SEP-6 Constructing Explanations and Designing Solutions

3-D LEARNING OBJECTIVES

Students will:
- Review prior knowledge and discuss learning from past experiments to inform new designs
- Begin the first stage of the module's Performance Task, the Engineering Design Challenge, by working with peers to design an earthquake-resistant structure that meets specified criteria and constraints.

CROSS-CURRICULAR CONNECTIONS

EPC
Principle V Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

CCSS ELA
Standard 1: Social and Instructional Language (Listening, Speaking)
Standard 3: The Language of Mathematics (Writing, Reading)
Standard 4: The Language of Science (Listening, Speaking)

CCSS MATH
SL.4.1 Comprehension and Collaboration

WIDA
4.NBT.B.4–6 Use place value understanding and properties of operations to perform multi-digit arithmetic
4.MD.A.1–3 Solve problems involving measurement and conversion of measurements

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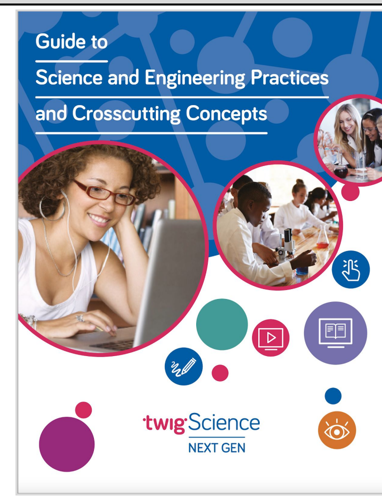
Grade 4 Module 4 DQ2L1 Overview TE p. 48

Twig Science teacher materials show great strengths in getting students to engage in the science and engineering practices with increasing grade-level appropriate complexity over the course of the program.

Evidence

Students use the SEPs with increasing grade-level appropriate complexity over the course of the program. The progression for how students apply the SEPs in Twig Science directly aligns with the NGSS Framework expectations for grade bands K–2, 3–5, and 6–8. Details of the progression for how SEPs are applied are found in the digital Guide to SEPs and CCCs. This guide contains a short summary of each SEP and why it's important. The progression of the SEPs through each grade band is discussed, with grade-specific contextual examples.

For example, pages 17–22 detail (with specific contextual examples) how students use Planning and Carrying Out Investigations (SEP-3) with increasingly complexity across the program. In addition to supporting teachers in the implementation of the SEPs, the digital guide provides some top tips for improving teaching of each SEP.



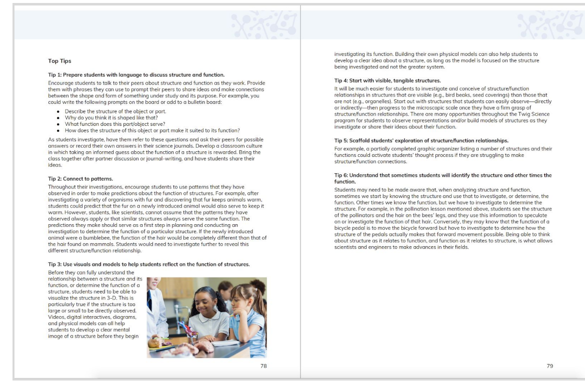
Guide to SEPs and CCCs

Twig Science teacher materials show great strengths in supporting students to utilize the crosscutting concepts with increasing grade-level appropriate complexity over the course of the program.

Evidence

Students use the CCCs with increasing grade-level appropriate complexity over the course of the program. The progression for how students apply the CCCs in Twig Science directly aligns with the NGSS Framework expectations for grade bands K–2, 3–5, and 6–8. Details of the progression for how CCCs are applied are found in the digital Guide to SEPs and CCCs. This guide contains a short summary of each CCC and why it's important. The progression of the CCCs through each grade band is discussed, with grade-specific contextual examples.

For example, pages 79–83 detail (with specific contextual examples) how students use Stability and Change (CCC-7) with increasingly complexity across the program. In addition to supporting teachers in the implementation of the CCCs, the digital guide provides some top tips for improving teaching of each CCC.



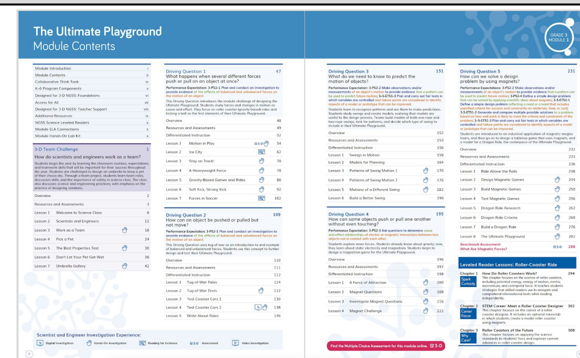
Guide to SEPs and CCCs

Twig Science teacher materials show great strengths at supporting students to engage in grade level/band appropriate disciplinary core ideas.

Evidence

Twig Science has been developed to directly align to the NGSS Framework, and spiral students' progression at understanding the DCIs, as mapped out in the Framework. The progression of the DCIs across the Twig Science Program is shown clearly at a program level in the NGSS Framework Alignment table, at a grade level in the Grade Scope and Sequence, and at a module level in the **Module Contents** and **Lesson Overviews**.

To drive student engagement and motivation for exploring the DCIs, every module has a storyline that puts the science content and phenomena and problems in authentic, grade-relevant contexts. These storylines are presented to the students at the start of each module through a movie-style Trailer video. For example, students in Grade 1 explore Electromagnetic Radiation (PS4.B) and the phenomena of light, reflection, and shadows to figure out a solution for a town in Norway that experiences darkness for 6 months of the year—the so-called Shadow Town. Students in Grade 6 Module 3 explore the DCIs of Inheritance and Variation of Traits (LS3.A and LS3.B) and Growth and Development of Organisms (LS1.B), and explore the phenomena of extinct species in The Red List, where they have to develop a conservation plan for an endangered species of their choice.



Module Contents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4.NBT.B.4–6 Use place value understanding and properties of operations to perform multi-digit arithmetic
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3-D LEARNING OBJECTIVES

Students will:
- Review prior knowledge and discuss learning from past experiments to inform new designs
- Begin the first stage of the module's Performance Task, the Engineering Design Challenge, by working with peers to design an earthquake-resistant structure that meets specified criteria and constraints.

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Lesson Overview

Twig Science teacher materials show great strengths in providing a rationale for a logical sequence and treatment of ETS and NoS

Evidence

The [K–6 NGSS Alignment and Progression Guide] shows where ETS is fully integrated into each module and how it progresses across the K–6 program, rather than being an add on. The engineering design process, the skills of defining problems and designing solutions, and connections to the NoS are logically and imaginatively woven into the science and narrative storyline of each module.

For example, in Grade 1 Module 1:

- Students create a plant museum using SEPs, CCCs, DCIs, ETS and NoS to figure out the Module Phenomenon: How are all plants alike and how are they different? Through a series of hands-on and data investigations, and nature explorations (outdoors and growing plants from seed in the classroom), students gain understanding of the different plant parts, as well as their shapes and functions. At the same time, students develop valuable skills in making observations and comparisons, and identifying patterns.
- Students investigate what plants need and how a plant's parts help it to grow and survive. They go on to explore the many methods that plants use to distribute seeds away from the parent plant. Students work in teams to tackle their first Engineering Design Challenge: to design and build seeds for dispersal by the wind. They test and present the results of their design, before adding a Seeds Room to the Museum of Leafology.
- Students then observe the seedlings they planted, as well as plants in nature, and record similarities and differences. They also investigate the clever strategies plants use to get what they need, including the defences that some plants use. After observing and discussing existing inventions that were inspired by plants, students tackle their second Engineering Design Challenge: to design, build, and present their own plant-inspired solution to a human problem.

- At the end of the module, students invite other classes and their own families to visit the museum, in order to demonstrate their learning. This is followed by a celebratory plant parts salad—using plants that they grew themselves!

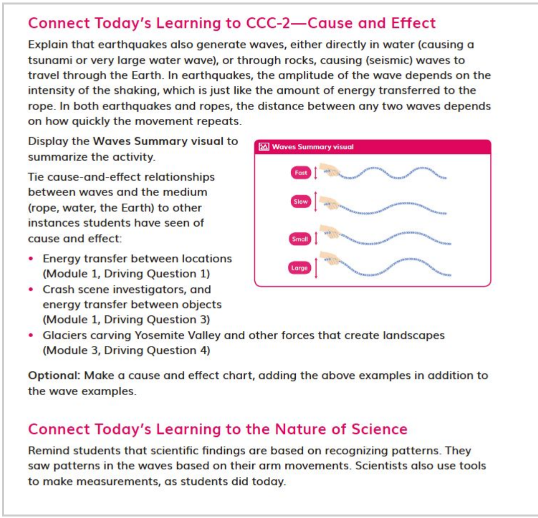
Likewise, in Grade 4 Module 4, students integrate the use of ETS and NoS to solve the Module Investigative Problem: How can we reduce the damage caused by earthquakes?

- Students start by modeling the phenomena of waves and gain understanding of how waves are involved in earthquakes.
- Then, using an interactive map, students make sense of why earthquakes appear in patterns along plate boundaries, and how those patterns help earthquake engineers plan how and where to build. Students are assessed on their ability to analyze data in maps, identify the Earth's features, and identify patterns where earthquakes occur.
- Through a series of investigations, students build understanding of how the shape, structure, and properties of materials affect a building's ability to withstand forces. They apply this knowledge to the engineering design process to design, build, and test their first earthquake-resistant structures. Students continue to make observations and obtain information from physical models, informational texts, and videos that showcase real-world engineering solutions that inform their design revisions.
- In the final presentation of their engineering designs, students explain how decisions about building characteristics, such as materials' flexibility, shape, and symmetry, address the Module Investigative Problem. Students are assessed on their ability to evaluate multiple design solutions for make buildings more earthquake-resistant, and ensuring the solutions meet the design criteria and constraints.

Throughout all module teachers are prompted to raise visibility of the use of ETS and NoS. For example, in **Grade 4 Module 4 (G4M4DQ1L3 Connect TE p.26)**, support is given to connect the learning activity to ETS.

Twig Science integrates stunning videos as part of its instructional design. These video bring ETS and NoS to life for students, having them make the connection to what they are learning in the real world. They also prive a wide range of positive role models for scientists and engineers working across a range of fields.

In Grade 4 Module 4, the LAX Engineer video (DQ4L2) relates earthquake engineering to a real world example, while the Edison video (DQ4L4) gives context to the idea that failure can be a positive learning experience. Failure and persistence in finding a solution is also portrayed in positive light in Grade 1 Module 2, when students watch the **Trial and Error–Lion Lights video** and meet the young engineer Richard Turere who solved the problem of lions eating his village's livestock.



Connect Today's Learning to CCC-2—Cause and Effect

Explain that earthquakes also generate waves, either directly in water (causing a tsunami or very large water wave), or through rocks, causing (seismic) waves to travel through the Earth. In earthquakes, the amplitude of the wave depends on the intensity of the shaking, which is just like the amount of energy transferred to the rope. In both earthquakes and ropes, the distance between any two waves depends on how quickly the movement repeats.

Display the **Waves Summary visual** to summarize the activity.

Tie cause-and-effect relationships between waves and the medium (rope, water, the Earth) to other instances students have seen of cause and effect:

- Energy transfer between locations (Module 1, Driving Question 1)
- Crash scene investigators, and energy transfer between objects (Module 1, Driving Question 3)
- Glaciers carving Yosemite Valley and other forces that create landscapes (Module 3, Driving Question 4)

Optional: Make a cause and effect chart, adding the above examples in addition to the wave examples.

Connect Today's Learning to the Nature of Science

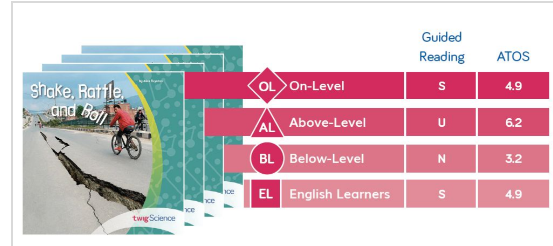
Remind students that scientific findings are based on recognizing patterns. They saw patterns in the waves based on their arm movements. Scientists also use tools to make measurements, as students did today.

Grade 4 Module 4 DQ1L3 Connect TE p.26.

In addition, every module is complemented with a magazine-style leveled reader (available in four levels, plus Spanish) that provides additional exposure to relevant phenomena/problems, as well as interviews with scientists and engineers from diverse backgrounds. Packed with stunning images, cartoons, and jokes, they are designed to appeal to students from a diverse range of learning abilities.

Chapter 1 often takes a look at the historical accumulation of knowledge that led has led to our present understanding of the module phenomena.
Chapter 2 features interviews with many positive role models in the field of science and engineering, and is designed to cultivate interest in STEM careers for all students.
Chapter 3 always connects the ideas explored in the reader's back to a context that is relevant for the students, again help them make the connection to NoS.

For example, the Leveled Reader for Grade 4 Module 4, *Shake, Rattle*, explores what different cultures used to think caused earthquakes, features an interview with a young female volcanologist, and investigates the cost of earthquake proofing our cities.



***Shake, Rattle, and Roll* (Grade 4 Module 4 Leveled Reader)**

Twig Science teacher materials make clear how the PEs are addressed in the program.

Evidence

The K–6 NGSS Alignment table clearly identifies where each PE is addressed in each grade. The Module Contents clearly identifies where and how each PE is addressed in each module. The Module Assessment Overview clearly identifies where and how the PEs are assessed in each module.

UNIT-TO-UNIT COHERENCE. Units across a program demonstrate coherence when student materials:	Strong	Adequate	Weak
• are designed with an appropriate sequence and development of DCIs, CCCs, and SEPs to support students in demonstrating learning across a program as they figure out phenomena/problems.	✓		
• make explicit connections from one unit to the next across the three dimensions to connect prior learning, current learning, and future learning as they figure out phenomena/problems.	✓		
• support students in making connections across units and disciplines by helping student negotiate more sophisticated understandings and abilities.	✓		

Strengths
Twig Science demonstrate strengths at unit-to unit coherence as student materials are designed with an appropriate sequence and development of DCIs, CCCs, and SEPs to support students in demonstrating learning across a program as they figure out phenomena/problems.

Evidence

The K–6 NGSS Alignment and Progression Guide shows the sequence of DCIs, CCCs, and SEPs that the students use across the program and how they spiral in complexity.

For example, Kindergarten Module 1 uses the three dimensions to explore the phenomenon of different plants and animals living in different place. Students investigate how living things get the things they to survive from their environments. That concept is also explored in greater depth in Grade 2 Module 4, where students use the dimensions with more sophistication to make sense of the phenomenon of the interdependence of living things in an environment. Later, in Grade 5 Module 2, students use the three dimensions to explore food webs and the phenomenon of energy and matter moving through an ecosystem. Finally, in Grade 6 Module 3, students use their growing mastery of the three dimensions to further expand their exploration of these concepts when investigating how the environment and genetics can affect living things.

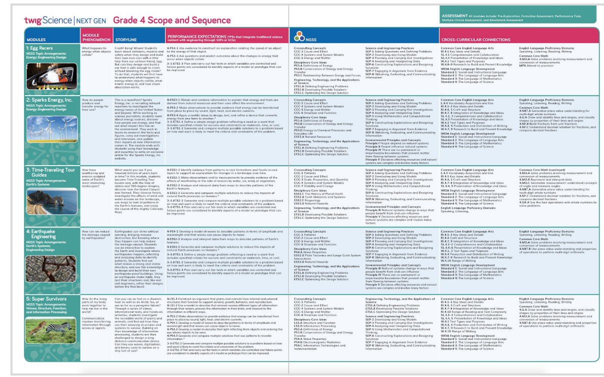
► PROGRESSION				
CURRENT GRADE	FUTURE KNOWLEDGE			
KINDERGARTEN	GRADE 2	GRADE 3	GRADE 5	GRADE 6
Module 4 K-ESS2-2 K-ESS3-3 **I Can** Students build on their understanding from My Big Nature Adventure, that there are relationships between animals (including humans) and the environment. Students learn not only that living things use natural resources from their habitat to survive, but also that using those resources impacts and changes the environment. They are also introduced to the idea that humans can take actions that protect the environment.	**Module 4** 2-LS2-1 2-LS4-1 **A Garden for Life** Students reinforce ideas from Kindergarten about what plants need to survive and grow. They grow plants in different conditions, and create models to explore the interdependence of flowering plants and their pollinators. Students also build on their Kindergarten discoveries about relationships between organisms and where they live. They look for patterns, compare and contrast habitats, and investigate biodiversity.	**Module 3** 3-LS4-1 3-LS4-3 3-LS4-4 **How to Survive an Ice Age** Students explore fossil evidence of organisms from the Pleistocene Ice Age. By comparing fossils to plants and animals alive today, students develop ideas about how the Ice Age organisms met their survival needs. Students revisit ideas from prior grades about the interconnectivity between organisms and their environment. In this module, they investigate the effects of environmental conditions on plant and animal traits. They argue that the ways in which an organism meets its needs make it more or less suited to particular environments. They explore the effects of changes to an environment on its living organisms.	**Module 2** 5-LS1-1 5-LS2-1 **Yellowstone: Uncovered** Students grow plants and formalize their understanding of how plants convert matter (from the air and water) and energy (from the Sun) into "food." They explore ecosystem interdependencies by modeling food chains and food webs, and creating an "ecosystem model" (a self-contained terrarium). They explore how changes to an ecosystem affect all the organisms within the ecosystem and alter the food web.	**Module 3** MS-LS1-5 **The Red List** Students reinforce their ideas about the relationships between organisms and their environment, looking at how environmental conditions affect plant growth.

Kindergarten Module 1 Performance Expectation Progressions table

The Twig Science **Scope and Sequences**, available in the K–6 NGSS Alignment and Progression Guide, and in the front cover of each Teacher Edition, show the sequence of SEPs, CCCs, and DCIs that the students use across the grade. They make it clear to see where new dimensions are introduced and where they are revisited.

For example, in Grade 4:

- Module 1: Students explore what happens to energy when objects collide.
- Module 2: Students revisit the concept of energy, and investigate energy sources and the energy needs of the United States.
- Module 4: Students investigate the phenomena of waves and how earthquakes transfer energy to the ground as waves.
- Module 5: Students build on their knowledge of waves and energy transfers, and solve the engineering design problem of building a long-distance communication device.



Grade 4 Scope and Sequence

Twig Science demonstrates strengths at unit-to unit coherence as the materials make explicit connections from one unit to the next across the three dimensions to connect prior learning, current learning, and future learning as they figure out phenomena/problems.

Evidence

At the start of each grade, the class creates its own Science Tools poster. It starts off as a blank piece of paper, and the class gradually adds the SEPs that they use to make sense of phenomena and solve problems. They also refer back to it when they revisit a SEP. By the time the class has completed the last module in the grade, students will have used the SEPs explicitly many times. This metacognitive activity helps students to build a growing awareness of their use and mastery of these practices. It also helps them make explicit connections to their prior and future learning. For example:

- In Grade 3 Module 1, students revisit “Design solutions” (SEP-6), and add “Make models,” “Use models” (SEP-2), “Plan investigations” (SEP-3), and “Define problems” (SEP-1) to their poster.
- In Grade 4 Module 4, students revisit “Develop and use models” (SEP-2), and add “Evaluate information” (SEP-8), “Analyze and interpret data” (SEP-4), and “Define problems”(SEP-1) to their poster. In DQ2L3 Connect TE p. 70, students further add “Analyze data” to their Science Tools Poster.

Teachers are prompted when to add a SEP to the Science Tools Poster, and are reminded of the context for when the students previously used a SEP and where they will go on to use the SEP. For example, Grade 4 Module DQ2L4 Connect TE p. 78, the teacher is prompted to add “Define problems” to their poster and to let students know that, in future lessons, they will both define and solve problems.

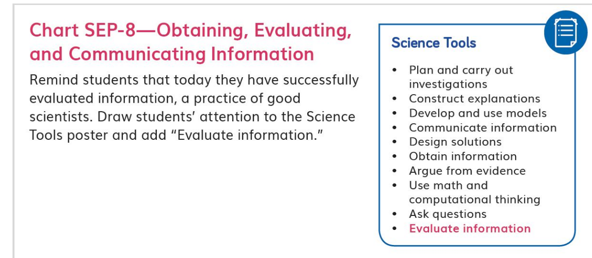


Chart SEP-8—Obtaining, Evaluating, and Communicating Information

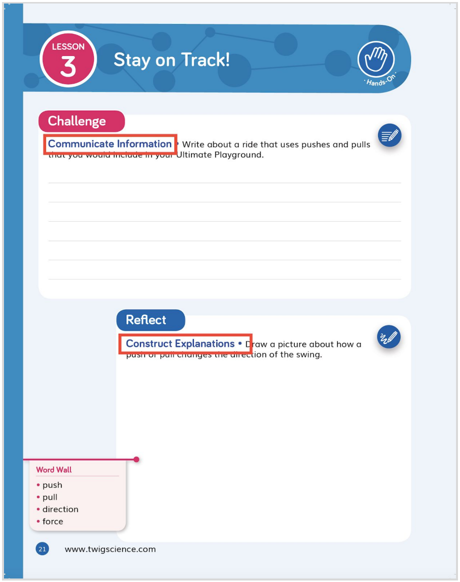
Remind students that today they have successfully evaluated information, a practice of good scientists. Draw students’ attention to the Science Tools poster and add “Evaluate information.”

Science Tools

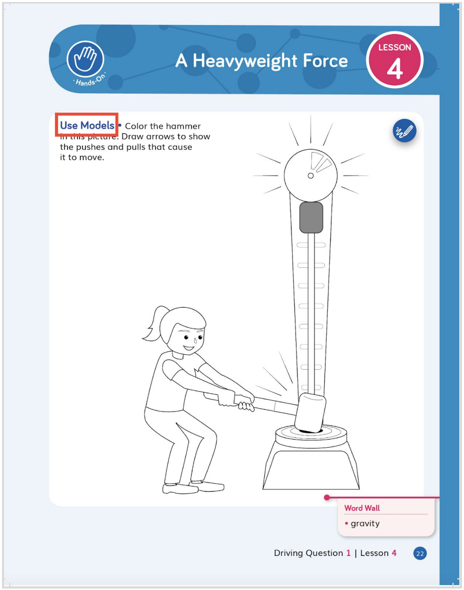
- Plan and carry out investigations
- Construct explanations
- Develop and use models
- Communicate information
- Design solutions
- Obtain information
- Argue from evidence
- Use math and computational thinking
- Ask questions
- Evaluate information

Grade 4 Module 4 DQ2L2 TE p.62

As students take notes in their Twig Book, they are supported to make explicit connections to the relevant SEPs, which are labeled in blue text before the student question/prompt.



Grade 3 Module 1 DQ1L3 TB p. 21

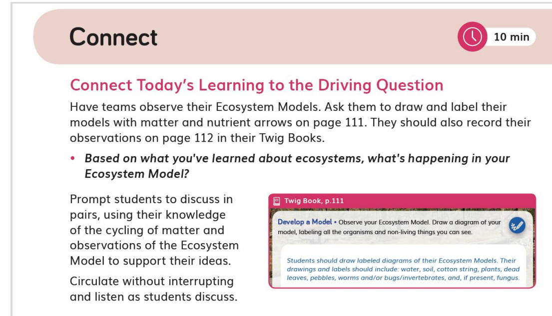


Grade 3 Module 1 DQ1L4 TB p. 22

Twig Science demonstrate strengths at unit-to unit coherence as the materials support students in making connections across units and disciplines by helping student negotiate more sophisticated understandings and abilities.

Evidence

Teachers using Twig Science are supported at the point of use in each lesson to raise the visibility of student thinking, making the connection for where their prior knowledge and growing mastery of the three dimensions across all disciplines (both within the module and in previous modules and grades) is helping them to make sense of the module phenomena and problems. This point of connection is often made in the Connect section of the lesson.



Connect

10 min

Connect Today's Learning to the Driving Question

Have teams observe their Ecosystem Models. Ask them to draw and label their models with matter and nutrient arrows on page 111. They should also record their observations on page 112 in their Twig Books.

- ***Based on what you've learned about ecosystems, what's happening in your Ecosystem Model?***

Prompt students to discuss in pairs, using their knowledge of the cycling of matter and observations of the Ecosystem Model to support their ideas.

Circulate without interrupting and listen as students discuss.

Twig Book, p.111

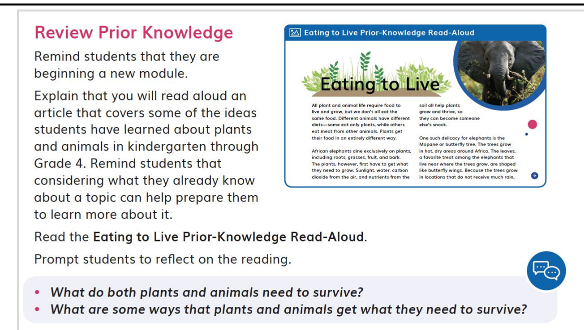
Develop a Model • Observe your Ecosystem Model. Draw a diagram of your model, labeling all the organisms and non-living things you can see.

Students should draw labeled diagrams of their Ecosystem Models. Their drawings and labels should include: water, soil, cotton string, plants, dead leaves, pebbles, worms and/or bugs/invertebrates, and, if present, fungus.

Grade 5 Module 2 DQ5L4 Connect p. 183

For example, in **Grade 5 Module 2**:

- Throughout the module students are consistently supported to revise their claims and relate their new understandings to answering the DQs and solving the Module Phenomenon (How do matter and energy move through an ecosystem?)
- Students engage with a Prior-Knowledge Read-Aloud about animals, plants, and matter **(DQ1L1 TE p. 8)**.



Review Prior Knowledge

Remind students that they are beginning a new module.

Explain that you will read aloud an article that covers some of the ideas students have learned about plants and animals in kindergarten through Grade 4. Remind students that considering what they already know about a topic can help prepare them to learn more about it.

Read the **Eating to Live Prior-Knowledge Read-Aloud**.

Prompt students to reflect on the reading.

- ***What do both plants and animals need to survive?***
- ***What are some ways that plants and animals get what they need to survive?***

Eating to Live Prior-Knowledge Read-Aloud

Eating to Live

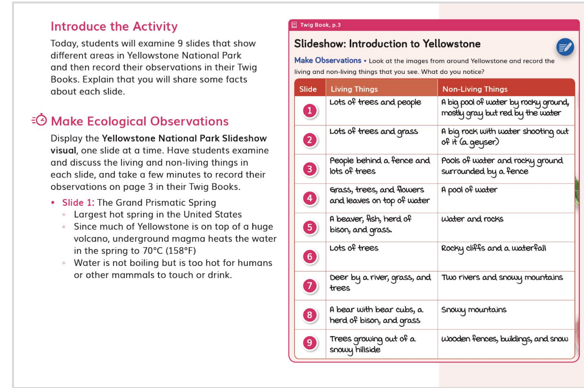
All plant and animal life require food to live and grow, but we don't all eat the same food. Different animals have different diets—some eat only plants, while others eat meat from other animals. Plants get their food in an entirely different way.

African elephants dine exclusively on plants, including roots, grasses, fruit, and bark. The plants, however, first have to get what they need to grow. Sunlight, water, carbon dioxide from the air, and nutrients from the soil all help plants grow and thrive, so they can become someone else's snack.

One such delicacy for elephants is the Mopane or butterfly tree. The trees grow in hot, dry areas around Africa. The leaves, a favorite treat among the elephants that live near where the trees grow, are shaped like butterfly wings. Because the trees grow in locations that do not receive much rain,

Grade 5 Module 2 DQ1L1 Spark TE p. 8

- Students observe a series of slides from Yellowstone, activating their prior knowledge of the national park, its features, and some of the organisms that live there **(DQ1L1 TE p. 9)**.



Introduce the Activity

Today, students will examine 9 slides that show different areas in Yellowstone National Park and then record their observations in their Twig Books. Explain that you will share some facts about each slide.

Make Ecological Observations

Display the **Yellowstone National Park Slideshow visual**, one slide at a time. Have students examine and discuss the living and non-living things in each slide, and take a few minutes to record their observations on page 3 in their Twig Books.

- Slide 1: The Grand Prismatic Spring
  - Largest hot spring in the United States
  - Since much of Yellowstone is on top of a huge volcano, underground magma heats the water in the spring to 70°C (158°F)
  - Water is not boiling but is too hot for humans or other mammals to touch or drink.

Twig Book, p.3

Slideshow: Introduction to Yellowstone

Make Observations • Look at the images from around Yellowstone and record the living and non-living things that you see. What do you notice?

Slide	Living Things	Non-Living Things
1	Lots of trees and people	A big pool of water by rocky ground, mostly gray but red by the water
2	Lots of trees and grass	A big rock with water shooting out of it (a geyser)
3	People behind a fence and lots of trees	Pools of water and rocky ground surrounded by a fence
4	Grass, trees, and flowers and leaves on top of water	A pool of water
5	A beaver, fish, herd of bison, and grass.	Water and rocks
6	Lots of trees	Rocky cliffs and a waterfall
7	Deer by a river, grass, and trees	Two rivers and snowy mountains
8	A bear with bear cubs, a herd of bison, and grass	Snowy mountains
9	Trees growing out of a snowy hillside	Wooden fences, buildings, and snow

Grade 5 Module 2 DQ1L1 Investigation TE p. 9

- Students are prompted to think back of their use of Scale, Proportion, and Quantity (CCC-3) in Grade 5 Module 1, where they investigated where plants get their matter from **(DQ1L2 TE p. 19)**.
- Students review all the evidence they have gathered throughout the DQ2 and use it to construct scientific explanations **(DQ2L6 TE p. 78, TB pp. 35–36)**.

Write Supporting Evidence

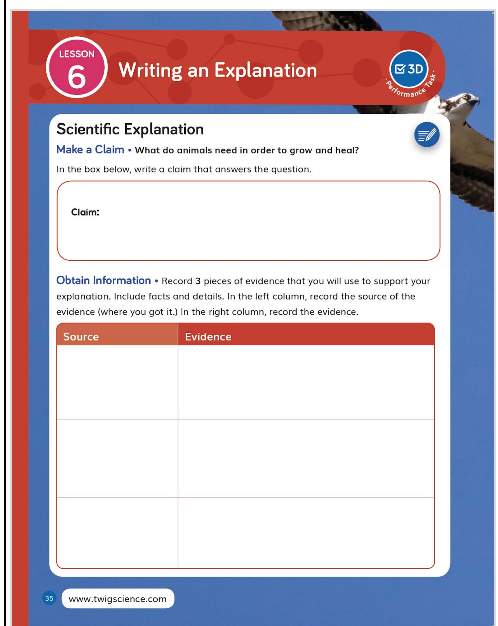
Ask students to independently write their scientific explanations on page 36 in their Twig Books. Encourage students to write in pencil so they can make revisions, as needed. Remind them to explain how the evidence supports their claim. They must provide their reasoning and include a conclusion that sums up their findings.

Stronger and Clearer Each Time (Language Routine)

Once their explanations have been drafted, have students work together to give and receive feedback. First, they will share with their current partners and then they will refine their work and share with two other partners in succession. Explain that during this process, they should be referring to the rubric on page 35 in their Twig Books.

1. Partner 1 tells their ideas while Partner 2 listens. Partner 2 asks questions and tries to get more detail, clarifications, and input from Partner 1. Give pairs 30–45 seconds for this step. Give Partner 1 time to revise.
2. Partner 2 tells their ideas while Partner 1 listens. Partner 1 asks questions and should try to get more details, clarifications, and input from Partner 2. Give pairs 30–45 seconds for this step. Give Partner 2 time to revise.
3. Students switch to a new partner. They follow the same process as in steps 1 and 2, but use what they heard from their first partner to strengthen what they share with their new partner (e.g., add more detail and be clearer).

Grade 5 Module 2 DQ2L6 Investigation TE p. 78


LESSON 6 Writing an Explanation

3D Performance Task

Scientific Explanation

Make a Claim • **What do animals need in order to grow and heal?**

In the box below, write a claim that answers the question.

Claim:

Obtain Information • Record **3** pieces of evidence that you will use to support your explanation. Include facts and details. In the left column, record the source of the evidence (where you got it.) In the right column, record the evidence.

Source	Evidence

35 www.twigscience.com

Grade 5 Module 2 DQ2L6 TB pp. 35–36

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- Students are reminded of when they used Cause and Effect (CCC-2) in Grade 5 Module 1 while investigating what happens when certain substances are mixed. Students review the science tools they've used and add “Ask questions” to the Science Tools poster **(DQ3L1 TE p. 97)**.

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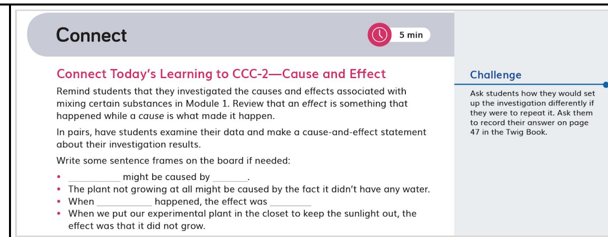

Connect
5 min

Connect Today's Learning to CCC-2—Cause and Effect

Remind students that they investigated the causes and effects associated with mixing certain substances in Module 1. Review that an *effect* is something that happened while a *cause* is what made it happen.

In pairs, have students examine their data and make a cause-and-effect statement about their investigation results.

Write some sentence frames on the board if needed:

- __________ might be caused by _______.
- The plant not growing at all might be caused by the fact it didn't have any water.
- When __________ happened, the effect was ________
- When we put our experimental plant in the closet to keep the sunlight out, the effect was that it did not grow.

Challenge

Ask students how they would set up the investigation differently if they were to repeat it. Ask them to record their answer on page 47 in the Twig Book.

Grade 5 Module 2 DQ3L1 Connect TE p. 97

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- Students complete a diagnostic pre-assessment (Pre-Exploration) to elicit awareness of their prior knowledge and misconceptions of dead matter and decomposition **(DQ4L4 TB p. 88)**.

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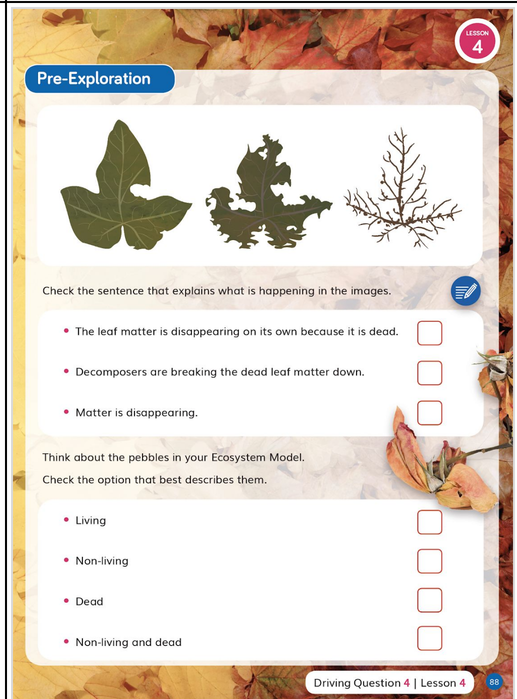

LESSON 4

Pre-Exploration

Check the sentence that explains what is happening in the images.

- The leaf matter is disappearing on its own because it is dead. ☐
- Decomposers are breaking the dead leaf matter down. ☐
- Matter is disappearing. ☐

Think about the pebbles in your Ecosystem Model.
Check the option that best describes them.

- Living ☐
- Non-living ☐
- Dead ☐
- Non-living and dead ☐

Driving Question 4 | Lesson 4 88

Grade 5 Module 2 DQ4L4 TB p. 88

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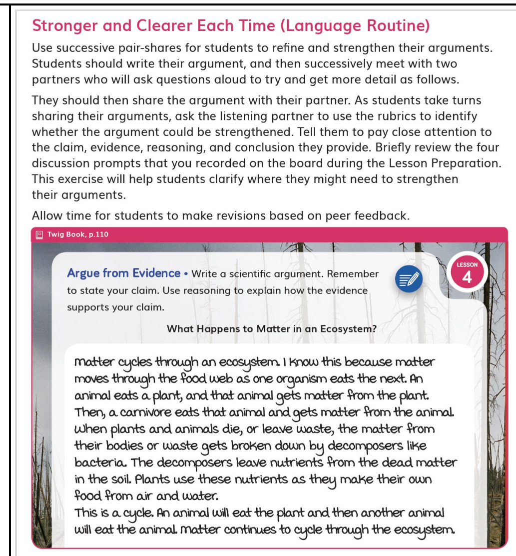
- Following a collaborative language routine, students revise their explanations about how matter moves through an ecosystem **(DQ5L4 TE p. 182/TB p. 110)**.



Stronger and Clearer Each Time (Language Routine)

Use successive pair-shares for students to refine and strengthen their arguments. Students should write their argument, and then successively meet with two partners who will ask questions aloud to try and get more detail as follows.

They should then share the argument with their partner. As students take turns sharing their arguments, ask the listening partner to use the rubrics to identify whether the argument could be strengthened. Tell them to pay close attention to the claim, evidence, reasoning, and conclusion they provide. Briefly review the four discussion prompts that you recorded on the board during the Lesson Preparation. This exercise will help students clarify where they might need to strengthen their arguments.

Allow time for students to make revisions based on peer feedback.

Twig Book, p.110

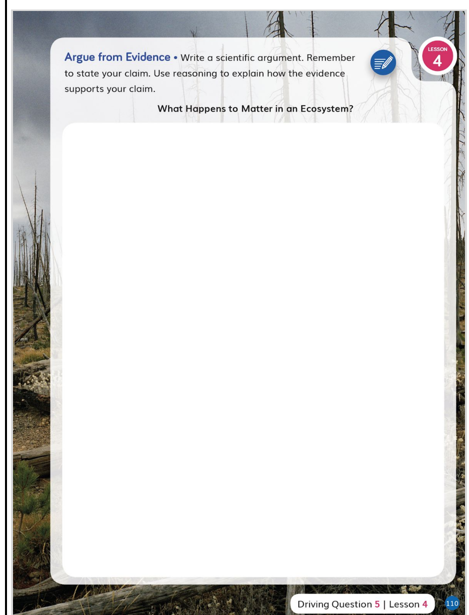
Argue from Evidence • Write a scientific argument. Remember to state your claim. Use reasoning to explain how the evidence supports your claim.

LESSON 4

What Happens to Matter in an Ecosystem?

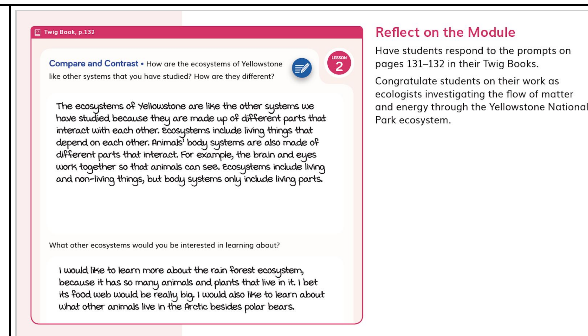
Matter cycles through an ecosystem. I know this because matter moves through the food web as one organism eats the next. An animal eats a plant, and that animal gets matter from the plant. Then, a carnivore eats that animal and gets matter from the animal. When plants and animals die, or leave waste, the matter from their bodies or waste gets broken down by decomposers like bacteria. The decomposers leave nutrients from the dead matter in the soil. Plants use these nutrients as they make their own food from air and water.
This is a cycle. An animal will eat the plant and then another animal will eat the animal. Matter continues to cycle through the ecosystem.

Grade 5 Module 2 DQ5L4 Investigate TE p. 182



Grade 5 Module 2 DQ5L4 TB p. 110

- Students reflect on their new understandings and ideas about ecosystems, comparing and contrasting the Yellowstone ecosystem with other ecosystems they've studied in science class **(DQ6L2 TE p. 208/TB p. 132)**.



Twig Book, p.132

LESSON 2

Compare and Contrast • How are the ecosystems of Yellowstone like other systems that you have studied? How are they different?

The ecosystems of Yellowstone are like the other systems we have studied because they are made up of different parts that interact with each other. Ecosystems include living things that depend on each other. Animals' body systems are also made of different parts that interact. For example, the brain and eyes work together so that animals can see. Ecosystems include living and non-living things, but body systems only include living parts.

What other ecosystems would you be interested in learning about?

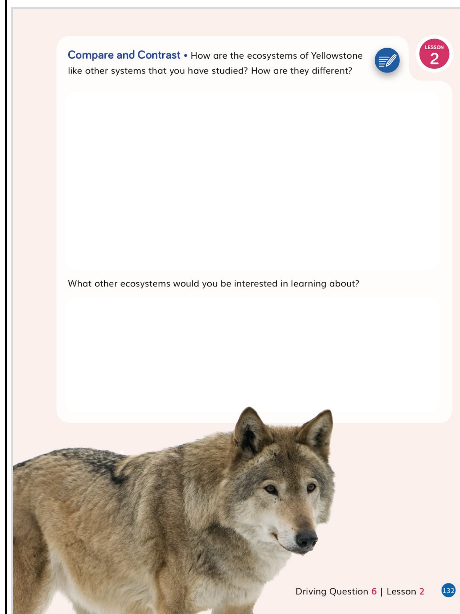
I would like to learn more about the rain forest ecosystem, because it has so many animals and plants that live in it. I bet its food web would be really big. I would also like to learn about what other animals live in the Arctic besides polar bears.

Reflect on the Module

Have students respond to the prompts on pages 131–132 in their Twig Books.

Congratulate students on their work as ecologists investigating the flow of matter and energy through the Yellowstone National Park ecosystem.

Grade 5 Module 2 DQ6L2 Reflect TE p. 208



LESSON 2

Compare and Contrast • How are the ecosystems of Yellowstone like other systems that you have studied? How are they different?

What other ecosystems would you be interested in learning about?

Driving Question 6 | Lesson 2 132

Grade 5 Module 2 DQ6L2 TB p. 132

PROGRAM ASSESSMENT SYSTEM. Over the course of the program, teacher materials will demonstrate a system of assessments that	Strong	Adequate	Weak
• coordinates the variety of ways student learning is monitored to provide information to students and teachers regarding student progress for all three dimensions of the standards and toward proficiency at the identified grade level/band performance expectations.	✓		
• includes support for teachers and other leaders to make program level decisions based on unit, interim, and/or year-long summative assessment data	✓		
• is driven by an assessment framework and provides a structured conceptual map of student learning along with details of how achievement of the outcomes can be measured.	✓		

Strengths

The Twig Science system of assessments demonstrates strengths by coordinating the variety of ways student learning is monitored to provide information to students and teachers regarding student progress for all three dimensions of the standards and toward proficiency at the identified grade level/band performance expectations.

Evidence

The Twig Science Assessment System has been developed in partnership with Stanford University's SCALE team. It is designed to provide a three-dimensional assessment system that allows teachers to evaluate student attainment of the three dimensions and PEs of the NGSS.

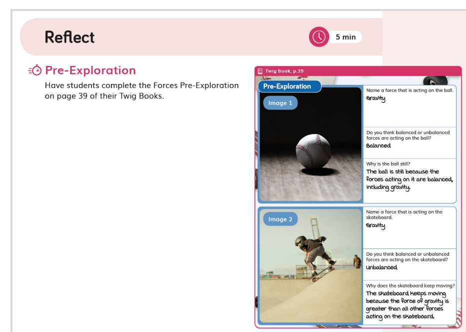
The assessment strategies measure students' knowledge and ability. They favor Performance Tasks over rote memorization and include a rich variety of measures, such as written assignments, collaborative engineering design challenges, and oral presentations. There are also lots of informal ways to quickly evaluate student progress.

Pre-Explorations (Diagnostic Pre-Assessment)

Near the start of each module, students complete a Pre-Exploration (Diagnostic Pre-Assessment). Pre-Explorations enable teachers to identify student prior knowledge of the three dimensions as well as any misconceptions students may hold.

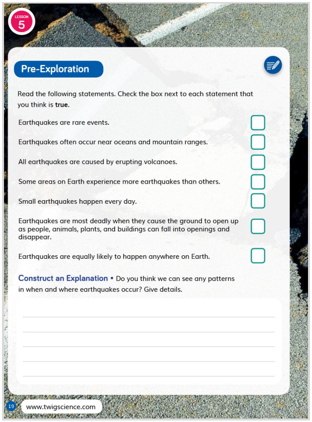
Progress Trackers are provided to support teachers as they track how students address their misconceptions and demonstrate their growing mastery of the three dimensions and PEs targeted in each module. Guidance is also given in the Teacher Edition for how to tailor instruction for students whose misconceptions persist, or who need extra scaffold to reach the required grade proficiency of the standards.

SCALE
Stanford Center for Assessment, Learning, & Equity



Pre-Explorations

Additional **Pre-Explorations** are integrated at strategic points throughout the module where they add most value. For example, in Grade 4 Module 4, students complete a Pre-Exploration in **DQ1L1 Reflect TB p. 19 and DQ3L1 Reflect TE p. 103**.



LESSON 5

Pre-Exploration

Read the following statements. Check the box next to each statement that you think is **true.**

- Earthquakes are rare events. ☐
- Earthquakes often occur near oceans and mountain ranges. ☐
- All earthquakes are caused by erupting volcanoes. ☐
- Some areas on Earth experience more earthquakes than others. ☐
- Small earthquakes happen every day. ☐
- Earthquakes are most deadly when they cause the ground to open up as people, animals, plants, and buildings can fall into openings and disappear. ☐
- Earthquakes are equally likely to happen anywhere on Earth. ☐

Construct an Explanation • Do you think we can see any patterns in when and where earthquakes occur? Give details.

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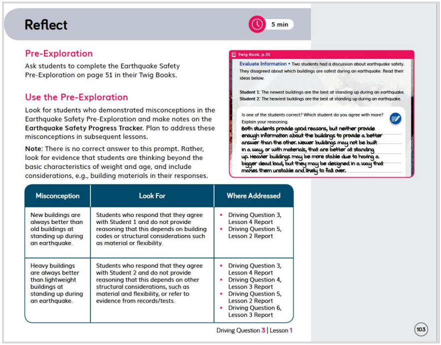
Grade 4 Module 4 DQ1L1 Reflect TB p. 9



Reflect

5 min

Pre-Exploration

Ask students to complete the Earthquake Safety Pre-Exploration on page 51 in their Twig Books.

Use the Pre-Exploration

Look for students who demonstrated misconceptions in the Earthquake Safety Pre-Exploration and make notes on the **Earthquake Safety Progress Tracker.** Plan to address these misconceptions in subsequent lessons.

Note: There is no correct answer to this prompt. Rather, look for evidence that students are thinking beyond the basic characteristics of weight and age, and include considerations, e.g., building materials in their responses.

Twig Book, p.51

Evaluate Information • Two students had a discussion about earthquake safety. They disagreed about which buildings are safest during an earthquake. Read their ideas below.

Student 1: The newest buildings are the best at standing up during an earthquake.
Student 2: The heaviest buildings are the best at standing up during an earthquake.

Is one of the students correct? Which student do you agree with more? Explain your reasoning.

Both students provide good reasons, but neither provide enough information about the buildings to provide a better answer than the other. Newer buildings may not be built in a way, or with materials, that are better at standing up. Heavier buildings may be more stable due to having a bigger dead load, but they may be designed in a way that makes them unstable and likely to fall over.

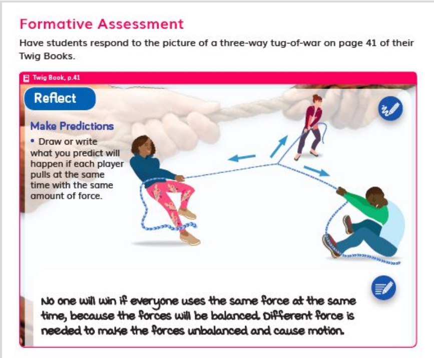
Misconception	Look For	Where Addressed
New buildings are always better than old buildings at standing up during an earthquake.	Students who respond that they agree with Student 1 and do not provide reasoning that this depends on building codes or structural considerations such as material or flexibility.	• Driving Question 3, Lesson 4 Report • Driving Question 5, Lesson 2 Report
Heavy buildings are always better than lightweight buildings at standing up during an earthquake.	Students who respond that they agree with Student 2 and do not provide reasoning that this depends on other structural considerations, such as material and flexibility, or refer to evidence from records/tests.	• Driving Question 3, Lesson 4 Report • Driving Question 4, Lesson 3 Report • Driving Question 5, Lesson 2 Report • Driving Question 6, Lesson 3 Report

Driving Question 3 | Lesson 1 103

Grade 4 Module 4 DQ3L1 Reflect TE p. 103

Formative Assessments (Informal Assessment)

Ongoing **Formative Assessments**, sometimes referred to as Informal Assessments, are woven into each lesson. These are quick ways to gauge student understanding, allowing teachers to tailor their instruction accordingly. They include a wide variety of formats with clear expectations that allow students to demonstrate their understanding of the learning goals in multiple ways. They include class discussions, constructed responses (written and drawn), self and peer assessment, and teacher observations.



Formative Assessment

Have students respond to the picture of a three-way tug-of-war on page 41 of their Twig Books.

Twig Book, p.41

Reflect

Make Predictions

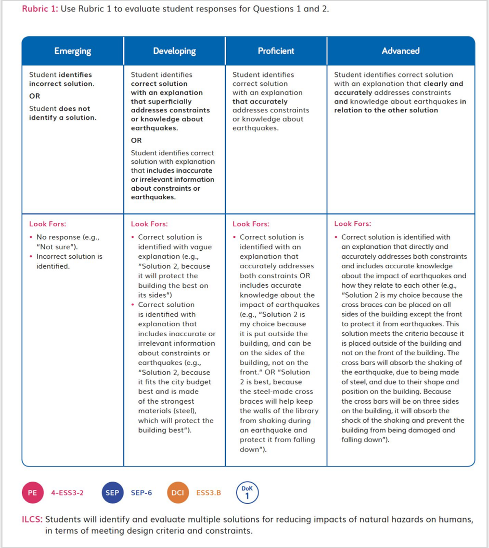
• Draw or write what you predict will happen if each player pulls at the same time with the same amount of force.

No one will win if everyone uses the same force at the same time, because the forces will be balanced. Different force is needed to make the forces unbalanced and cause motion.

Formative Assessments

Summative Assessments

Summative Performance Tasks are rich and highly engaging activities designed to motivate students to demonstrate their mastery of the expected grade-level proficiency for the PEs. Leveled rubrics are provided from Grade 2 onwards to support teachers to grade attainment level of students of all abilities (Emerging, Developing, Proficient, and Advanced), and student versions of the rubrics give students a clear understanding of what success looks like.



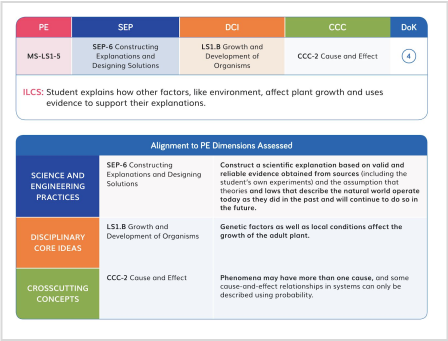
Rubric 1: Use Rubric 1 to evaluate student responses for Questions 1 and 2.

Emerging	Developing	Proficient	Advanced
Student **identifies incorrect solution**. OR Student **does not identify a solution.**	Student identifies **correct solution with an explanation that superficially addresses constraints or knowledge about earthquakes.** OR Student identifies correct solution with explanation that **includes inaccurate or irrelevant information about constraints or earthquakes.**	Student identifies correct solution with an explanation **that accurately** addresses constraints or knowledge about earthquakes.	Student identifies correct solution with an explanation that **clearly and accurately** addresses constraints **and** knowledge about earthquakes **in relation to the other solution**
Look Fors: • No response (e.g., "Not sure"). • Incorrect solution is identified.	Look Fors: • Correct solution is identified with vague explanation (e.g., "Solution 2, because it will protect the building the best on its sides") • Correct solution is identified with explanation that includes inaccurate or irrelevant information about constraints or earthquakes (e.g., "Solution 2, because it fits the city budget best and is made of the strongest materials (steel), which will protect the building best").	Look Fors: • Correct solution is identified with an explanation that accurately addresses both constraints OR includes accurate knowledge about the impact of earthquakes (e.g., "Solution 2 is my choice because it is put outside the building, and can be on the sides of the building, not on the front." OR "Solution 2 is best, because the steel-made cross braces will help keep the walls of the library from shaking during an earthquake and protect it from falling down").	Look Fors: • Correct solution is identified with an explanation that directly and accurately addresses both constraints and includes accurate knowledge about the impact of earthquakes and how they relate to each other (e.g., "Solution 2 is my choice because the cross braces can be placed on all sides of the building except the front to protect it from earthquakes. This solution meets the criteria because it is placed outside of the building and not on the front of the building. The cross bars will absorb the shaking of the earthquake, due to being made of steel, and due to their shape and position on the building. Because the cross bars will be on three sides on the building, it will absorb the shock of the shaking and prevent the building from being damaged and falling down").

PE 4-ESS3-2 SEP SEP-6 DCI ESS3.B DoK 1

ILCS: Students will identify and evaluate multiple solutions for reducing impacts of natural hazards on humans, in terms of meeting design criteria and constraints.

Grade 6 Module 3 DQ5 Benchmark Assessment Teacher Rubric TE p. 176



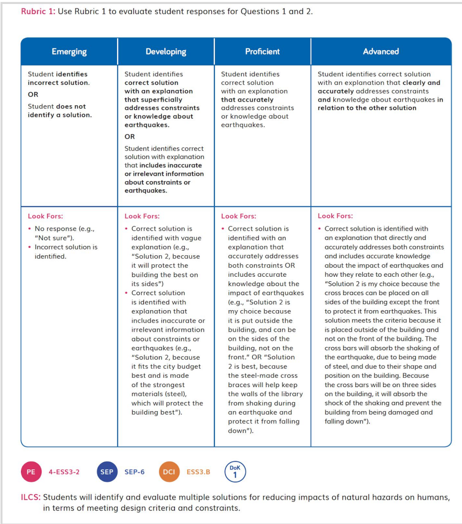
PE	SEP	DCI	CCC	DoK
MS-LS1-5	**SEP-6** Constructing Explanations and Designing Solutions	**LS1.B** Growth and Development of Organisms	**CCC-2** Cause and Effect	4

ILCS: Student explains how other factors, like environment, affect plant growth and uses evidence to support their explanations.

Alignment to PE Dimensions Assessed		
SCIENCE AND ENGINEERING PRACTICES	**SEP-6** Constructing Explanations and Designing Solutions	**Construct a scientific explanation based on valid and reliable evidence obtained from sources** (including the student's own experiments) and the assumption that theories **and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.**
DISCIPLINARY CORE IDEAS	**LS1.B** Growth and Development of Organisms	**Genetic factors as well as local conditions affect the growth of the adult plant.**
CROSSCUTTING CONCEPTS	**CCC-2** Cause and Effect	**Phenomena may have more than one cause,** and some cause-and-effect relationships in systems can only be described using probability.

Grade 6 Module 3 DQ5 Benchmark Assessment Standards

Modules in Grades 3–6 include SCALE Benchmark Assessments, which assess students' ability to apply the knowledge and skills gained throughout the module to new contexts. This gives students exposure to the types of assessment items they will face in the state test. Leveled rubrics support easy grading with sample student answers provided in the form of "Look Fors." Student versions of these rubrics are available without the "Look Fors."



Rubric 1: Use Rubric 1 to evaluate student responses for Questions 1 and 2.

Emerging	Developing	Proficient	Advanced
Student **identifies incorrect solution.** **OR** Student **does not identify a solution.**	Student identifies **correct solution with an explanation that superficially addresses constraints or knowledge about earthquakes.** **OR** Student identifies correct solution with explanation that **includes inaccurate or irrelevant information about constraints or earthquakes.**	Student identifies correct solution with an explanation **that accurately** addresses constraints or knowledge about earthquakes.	Student identifies correct solution with an explanation that **clearly and accurately** addresses constraints **and** knowledge about earthquakes **in relation to the other solution**
Look Fors: • No response (e.g., "Not sure"). • Incorrect solution is identified.	Look Fors: • Correct solution is identified with vague explanation (e.g., "Solution 2, because it will protect the building the best on its sides") • Correct solution is identified with explanation that includes inaccurate or irrelevant information about constraints or earthquakes (e.g., "Solution 2, because it fits the city budget best and is made of the strongest materials (steel), which will protect the building best").	Look Fors: • Correct solution is identified with an explanation that accurately addresses both constraints OR includes accurate knowledge about the impact of earthquakes (e.g., "Solution 2 is my choice because it is put outside the building, and can be on the sides of the building, not on the front." OR "Solution 2 is best, because the steel-made cross braces will help keep the walls of the library from shaking during an earthquake and protect it from falling down").	Look Fors: • Correct solution is identified with an explanation that directly and accurately addresses both constraints and includes accurate knowledge about the impact of earthquakes and how they relate to each other (e.g., "Solution 2 is my choice because the cross braces can be placed on all sides of the building except the front to protect it from earthquakes. This solution meets the criteria because it is placed outside of the building and not on the front of the building. The cross bars will absorb the shaking of the earthquake, due to being made of steel, and due to their shape and position on the building. Because the cross bars will be on three sides on the building, it will absorb the shock of the shaking and prevent the building from being damaged and falling down").

PE 4-ESS3-2 SEP SEP-6 DCI ESS3.B DoK 1

ILCS: Students will identify and evaluate multiple solutions for reducing impacts of natural hazards on humans, in terms of meeting design criteria and constraints.

Grade 6 Module 3 DQ5 Benchmark Assessment Teacher Rubric TE p. 176

Grades 3–6 also include 3-D Multiple Choice Assessments, which quickly assess student understanding of a range of dimensions covered in the module. An extended section (Part C) has been designed to stretch GATE students.

Grading the Assessment

The answer key for the print assessment can be accessed by going to "Student View" and selecting "Show Answers."

Next Generation Science Standards

These tables list the relevant Next Generation Science Standards and Depth of Knowledge (DoK) levels in the assessment. The highlighted standards show the main focus of each question.

Part A

Item	PE	SEP	DCI	CCC	DoK
1	MS-LS3-2	SEP-7	LS1.B	CCC-4	1
2	MS-LS3-2	SEP-7	LS1.B	CCC-4	1
3	MS-LS1-4	SEP-7	LS1.B	CCC-4	1
4	MS-LS1-4	SEP-7	LS1.B	CCC-4	1
5	MS-LS1-4	SEP-7	LS1.B	CCC-4	1
6	MS-LS1-4	SEP-7	LS1.B	CCC-4	1
7	MS-LS1-4	SEP-7	LS1.B	CCC-4	1
8	MS-LS1-4	SEP-7	LS1.B	CCC-4	1
9	MS-LS3-2	SEP-7	LS1.B	CCC-6	1
10	MS-LS3-2	SEP-7	LS1.B	CCC-6	1

Grade 6 Module 3 Multiple Choice Assessment Grading DOK and Standards

Part A: True or False Questions

Select **True** or **False** for each statement.

		True	False
1	Sexual reproduction happens only in animals and not in plants.	○	●
2	All plants need bees for pollination.	○	●
3	All small animals lay eggs and all large animals give birth.	○	●
4	Wasps can pollinate plants.	●	○
5	Some animals use mating rituals to attract mates.	●	○
6	Animals use instinct to carry out mating rituals.	●	○
7	Only land animals can give birth.	○	●
8	All animals that live in water lay eggs.	○	●
9	Some animals can regrow lost limbs.	●	○
10	Some organisms can reproduce by splitting in half.	●	○

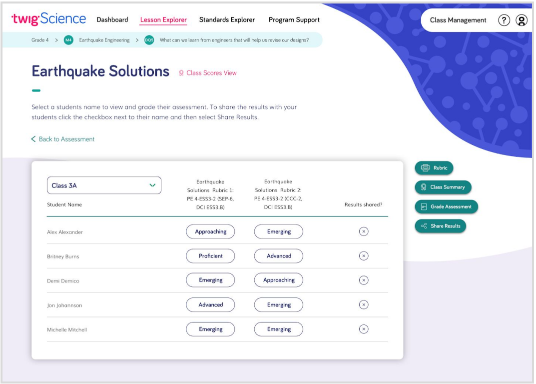
Grade 6 Module 3 Multiple Choice Assessment Answer Guide

The Twig Science system of assessments demonstrates strengths at including support for teachers and other leaders to make program level decisions based on unit, interim, and/or year-long summative assessment data

The assessment items in the Pre-explorations, Performance Tasks, Benchmark Assessments, and Multiple Choice Assessments are tied to specific dimensions and/or PEs. The data generated by this system of assessments can then provide a picture of student and class progression across a module, grade, or, over time, the full K–6 program.

Teachers have the choice to administer the assessments digitally or in print. Student data is generated automatically if administered digitally, but teachers can still input scores manually if they prefer students to take the printed assessment.

As students revisit the dimensions and PEs several times across a grade, the Twig Science Assessment System can provide a picture of student progressions across the module and grade. It will be clear which students are tracking at the expected grade level (Proficient), which need extra support (Emerging and Developing), and which are performing at an advanced level (Advanced).



Twig Science Assessment System

The Twig Science system of assessments demonstrate strengths at being driven by an assessment framework that provides a structured conceptual map of student learning along with details of how achievement of the outcomes can be measured.

Evidence

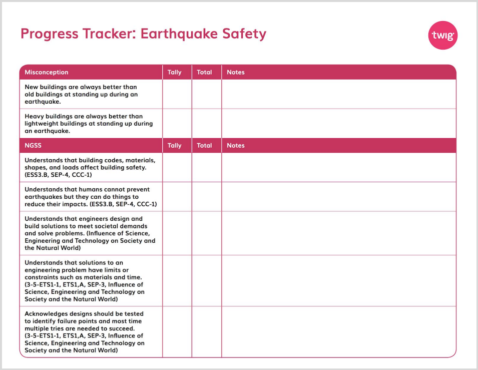
Grade Level

The K–6 NGSS Alignment table details the conceptual flow of student learning across Twig Science. It's clear to see where each of the NGSS PEs are addressed. The grade-level Assessment Overview provides details on where each PEs is assessed, along with details of how outcomes can be measured.

Module Level

A more detailed map of the assessment opportunities (both formal and informal) of all dimensions in each module are provided in the Module Assessment Overviews. All assessments in Twig Science are tied to specific learning goals, with tools provided for how to measure student success.

- Student performance at the Pre-Explorations is measured using the Progress Tracker. Formative Assessments (Informal Assessments) are measured using a variety of means. This could be a show of hands, a class discussion, or student answers in their Twig Books. A version of the Twig Book with sample answers is provided to support teachers to know what success looks like. Reduxes of the student answers are also included at point of use in the Teacher Editions.
- Student performance at the PEs are assessed in the Summative Performance Tasks and Benchmark Assessments are measured using rubrics.
- Multiple Choice Assessments are machine-scored or by using answer grids if administered in print.



Progress Tracker

Designed for the NGSS: Foundations	High Quality 5	Medium Quality 3	Low Quality 1

PROGRESSIONS OF LEARNING. Within a program, learning experiences are more likely to help students develop a greater sophistication of understanding of the elements of SEPs, CCCs, and DCIs when teacher materials:
● make it clear how each of the three dimensions builds logically and progressively over the course of the program and make clear how:
    ● students engage in the science and engineering practices with increasing grade-level appropriate complexity over the course of the program.
    ● students utilize the crosscutting concepts with increasing grade-level appropriate complexity over the course of the program.
    ● students engage in grade level/band appropriate disciplinary core ideas
    ● Teacher materials make clear how the performance expectations are addressed in the program.
● provide a rationale for a logical sequence and treatment of ETS and NoS.
	Materials enact progressions of learning that have all or most of the quality characteristics	Materials enact progressions of learning that have some of the quality characteristics	Materials enact progressions of learning that have none or few of the quality characteristics

UNIT-TO-UNIT COHERENCE. Units across a program demonstrate coherence when student materials: ● are designed with an appropriate sequence and development of DCIs, CCCs, and SEPs to support students in demonstrating learning across a program as they figure out phenomena/problems. ● make explicit connections from one unit to the next across the three dimensions to connect prior learning, current learning, and future learning as they figure out phenomena/problems. ● support students in making connections across units and disciplines by helping student negotiate more sophisticated understandings and abilities.	The materials consistently justify sequencing and demonstrate strong unit-to-unit coherence for developing competence in three dimensions.	The materials occasionally justify sequencing and sometimes demonstrate strong unit-to-unit coherence for developing competence in three dimensions.	The materials never justify sequencing and rarely demonstrate unit-to-unit coherence for developing competence in three dimensions.
PROGRAM ASSESSMENT SYSTEM. Over the course of the program, teacher materials demonstrate a system of assessments that ● coordinates the variety of ways student learning is monitored to provide information to students and teachers regarding student progress for all three dimensions of the standards and toward proficiency at the identified grade level/band performance expectations. ● includes support for teachers and other leaders to make program level decisions based on unit, interim, and/or year-long summative assessment data. ● is driven by an assessment framework and provides a structured conceptual map of student learning along with details of how achievement of the outcomes can be measured.	The materials use a program-level assessment system that has all or most of the quality characteristics	The materials use a program-level assessment system that has some of the quality characteristics	The materials use a program-level assessment system that has few or none of the quality characteristics

PROGRESSIONS OF LEARNING

The materials are High Quality 5

Materials enact progressions of learning that have all or most of the quality characteristics

Evidence

Progression Across the Program

The **Twig Science Program Guide** (provided online and at the front of every Teacher Edition) outlines the instructional design of the program and how all the components work together to support students to use the three dimensions to make sense of phenomena and solve problems.

The **K–6 NGSS Alignment and Progression Guide** details how the three dimensions build logically and progressively over the program.

The NGSS Framework Alignment (front cover of every Teacher Edition) sets out the logical sequence for the PEs across the Twig Science K–6 modules, and shows where they are addressed in each grade.

The Performance Expectation Progressions table, included in the **K–6 NGSS Alignment and Progression Guide** and in the relevant Teacher Edition (back cover), are module specific. They tell the story of how students have used, and will use, the module-relevant three dimensions with increasing complexity across the program. For example, the Performance Expectation Progressions table for Grade 3 Module 1.

K–6 NGSS Alignment and Progression Guide

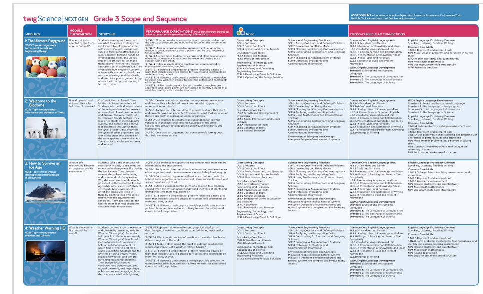
Progression Across the Grade

The **Scope and Sequence tables** clearly identify the sequence of the modules in every grade, as well as the Module Phenomenon or Investigative Problem the students are figuring out, and the storyline, which puts the learning journey into a captivating context. The PEs that each module addresses are also identified, as are the sequence of the three dimensions that are addressed over the course of the grade. (G3 Scope and Sequence)

Progression Across the Module

In every module, students follow a sequence of DQs designed to progressively build their skills and scientifically accurate understandings. The flow of SEPs, CCCs, and DCIs across the DQs follow a logical sequence supporting students to gain expertise of the practices and concepts they need to address the Module Phenomenon/ Investigative Problem.

The Module Contents in every Teacher Edition provides an overview of the module conceptual flow and details the sequence of the PEs addressed. For example, Grade 4 Module 4.



Grade 3 Scope and Sequence

Progression Across a Driving Question

More detail on how the sequence of ideas and practices flow across each DQ is provided in every Driving Question Overview which provides a short summary of the three dimensional activities in each lesson. For example, Grade 4 Module 4.

Grade-Level Progressions of DCIs, SEPs, and CCCs

Students use the SEPs and CCCs with increasing grade-level appropriate complexity over the course of the program. The progression for how students apply the SEPs in Twig Science directly aligns with the NGSS Framework expectations for grade bands K–2, 3–5, and 6–8. Details of the progression for how SEPs are applied are found in the digital Guide to SEPs and CCCs. This guide contains a short summary of each SEP and why it's important. The progression of the SEPs through each grade band is discussed, with grade-specific contextual examples.

Twig Science has been developed to directly align to the NGSS Framework, and spiral students' progression at understanding the DCIs, as mapped out in the Framework. The progression of the DCIs across the Twig Science Program is shown clearly at a program level in the NGSS Framework Alignment table, at a grade level in the Grade Scope and Sequence, and at a module level in the Module Contents and Lesson Overviews.

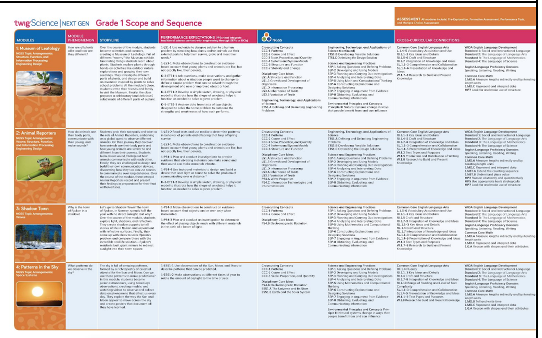
To drive student engagement and motivation for exploring the DCIs, every module has a storyline that puts the science content and phenomena and problems in authentic, grade-relevant contexts. These

Driving Question Overview

storylines are presented to the students at the start of each module through a movie-style Trailer video. For example, Grade 1 Module 3 Shadow Town.

Logical Sequence and Treatment of ETS and NoS

The **K–6 NGSS Alignment and Progression Guide** shows where ETS is fully integrated into each module and how it progresses across the K–6 program, rather than being an add on. The engineering design process, the skills of defining problems and designing solutions, and connections to the NoS are logically and imaginatively woven into the science and narrative storyline of each module. For example, Grade 1 Module 1.



Grade 1 Scope and Sequence (TE Inside Cover)

Throughout all module teachers are prompted to raise visibility of the use of ETS and NoS. For example, in **Grade 4 Module DQ1L3 Connect TE p. 26**, support is given to connect the learning activity to ETS.

Twig Science integrates stunning videos as part of its instructional design. These video bring ETS and NoS to life for students, having them make the connection to what they are learning in the real world. They also prive a wide range of positive role models for scientists and engineers working across a range of fields. For example, Grade 1 Module 2 **Trial and Error–Lion Lights video**.

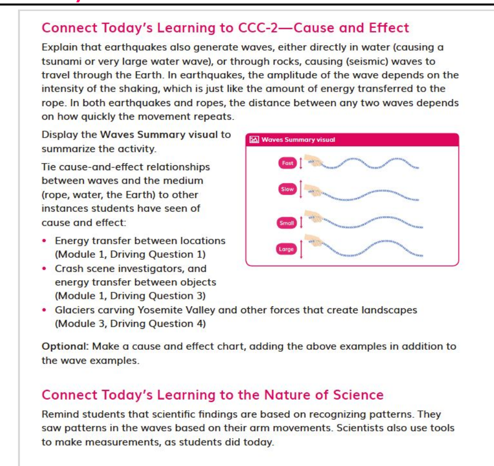
In addition, every module is complemented with a magazine-style leveled reader (available in four levels, plus Spanish) that provides additional exposure to relevant phenomena/problems, the nature of science, and STEM careers.

How Are Performance Expectations Addressed?

The K–6 NGSS Alignment table clearly identifies where each PE is addressed in each grade..

The Module Contents clearly identifies where and how each PE is addressed in each module.

The Module Assessment Overview clearly identifies where and how the PEs are assessed in each module. For example, the Grade 3 Module 1 Assessment Overview.



Connect Today's Learning to CCC-2—Cause and Effect

Explain that earthquakes also generate waves, either directly in water (causing a tsunami or very large water wave), or through rocks, causing (seismic) waves to travel through the Earth. In earthquakes, the amplitude of the wave depends on the intensity of the shaking, which is just like the amount of energy transferred to the rope. In both earthquakes and ropes, the distance between any two waves depends on how quickly the movement repeats.

Display the **Waves Summary visual** to summarize the activity.

Tie cause-and-effect relationships between waves and the medium (rope, water, the Earth) to other instances students have seen of cause and effect:

- Energy transfer between locations (Module 1, Driving Question 1)
- Crash scene investigators, and energy transfer between objects (Module 1, Driving Question 3)
- Glaciers carving Yosemite Valley and other forces that create landscapes (Module 3, Driving Question 4)

Optional: Make a cause and effect chart, adding the above examples in addition to the wave examples.

Connect Today's Learning to the Nature of Science

Remind students that scientific findings are based on recognizing patterns. They saw patterns in the waves based on their arm movements. Scientists also use tools to make measurements, as students did today.

Grade 4 Module DQ1L3 Connect TE p. 26

UNIT-TO-UNIT COHERENCE

The materials are High Quality 5

The materials consistently justify sequencing and demonstrate strong unit-to-unit coherence for developing competence in three dimensions.

Evidence

Appropriate Sequence and Development of DCIs, CCCs, and SEPs

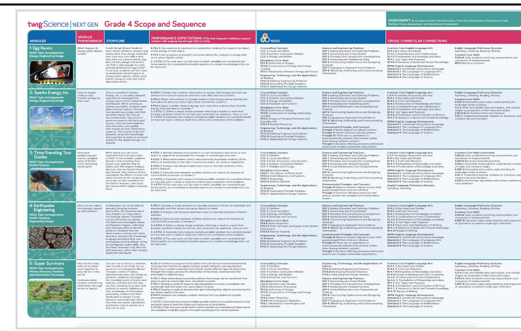
The K–6 NGSS Alignment and Progression Guide shows the sequence of DCIs, CCCs, and SEPs that the students use across the program and how they spiral in complexity.

For example, Kindergarten Module 1 uses the three dimensions to explore the phenomenon of different plants and animals living in different place. Students investigate how living things get the things they to survive from their environments. That concept is also explored in greater depth in Grade 2 Module 4, where students use the dimensions with more sophistication to make sense of the phenomenon of the interdependence of living things in an environment. Later, in Grade 5 Module 2, students use the three dimensions to explore food webs and the phenomenon of energy and matter moving through an ecosystem. Finally, in Grade 6 Module 3, students use their growing mastery of the three dimensions to further expand their exploration of these concepts when investigating how the environment and genetics can affect living things.

The Twig Science Scope and Sequences, available in the K–6 NGSS Alignment and Progression Guide, and in the front cover of each Teacher Edition, show the sequence of SEPs, CCCs, and DCIs that the students use across the grade. They make it clear to see where new dimensions are introduced and where they are revisited.

For example, in Grade 4:

- Module 1: Students explore what happens to energy when objects collide.
- Module 2: Students revisit the concept of energy, and investigate energy sources and the energy needs of the United States.
- Module 4: Students investigate the phenomena of waves and how earthquakes transfer energy to the ground as waves.
- Module 5: Students build on their knowledge of waves and energy transfers, and solve the engineering design problem of building a long-distance communication device.



Grade 4 Scope and Sequence (TE Inside Cover)

Explicit Connections from One Unit to the Next Across the Three Dimensions

At the start of each grade, the class creates its own Science Tools poster. It starts off as a blank piece of paper, and the class gradually adds the SEPs that they use to make sense of phenomena and and solve problems. They also refer back to it when they revisit a SEP. By the time the class has completed the last module in the grade, students will have used the SEPs explicitly many times. This metacognitive activity helps students to build a growing awareness of their use and mastery of these practices. It also helps them make explicit connections to their prior and future learning. For example, In Grade 4 Module 4, students revisit “Develop and use models” (SEP-2), and add “Evaluate information” (SEP-8), “Analyze and interpret data” (SEP-4), and “Define problems”(SEP-1) to their poster. In **DQ2L3 Connect TE p. 70,** students further add “Analyze data” to their Science Tools Poster.

As students take notes in their Twig Book, they are supported to make explicit connections to the relevant SEPs, which are labeled in blue text before the student question/prompt.

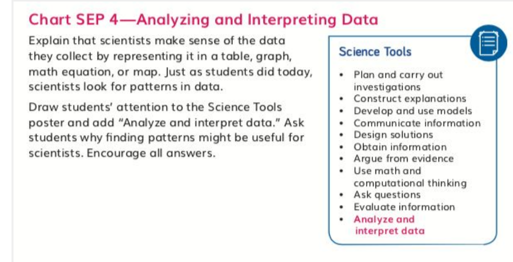


Chart SEP 4—Analyzing and Interpreting Data

Explain that scientists make sense of the data they collect by representing it in a table, graph, math equation, or map. Just as students did today, scientists look for patterns in data.

Draw students' attention to the Science Tools poster and add “Analyze and interpret data.” Ask students why finding patterns might be useful for scientists. Encourage all answers.

Science Tools

- Plan and carry out investigations
- Construct explanations
- Develop and use models
- Communicate information
- Design solutions
- Obtain information
- Argue from evidence
- Use math and computational thinking
- Ask questions
- Evaluate information
- Analyze and interpret data

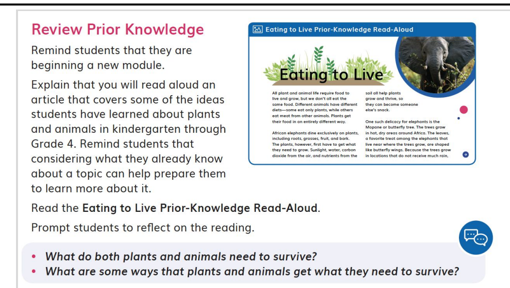
Grade 4 Module 4 DQ2L3 Connect TE p.70

Connections Across Units and Disciplines

Teachers using Twig Science are supported at the point of use in each lesson to raise the visibility of student thinking, making the connection for where their prior knowledge and growing mastery of the three dimensions across all disciplines (both within the module and in previous modules and grades) is helping them to make sense of the module phenomena and problems. This point of connection is often made in the Connect section of the lesson.

For example, in **Grade 5 Module 2**:

- Students engage with a Prior-Knowledge Read-Aloud about animals, plants, and matter **(DQ1L1 TE p. 8)**.


Review Prior Knowledge

Remind students that they are beginning a new module.

Explain that you will read aloud an article that covers some of the ideas students have learned about plants and animals in kindergarten through Grade 4. Remind students that considering what they already know about a topic can help prepare them to learn more about it.

Eating to Live Prior-Knowledge Read-Aloud

Eating to Live

All plant and animal life require food to live and grow, but we don't all eat the same food. Different animals have different diets—some eat only plants, while others eat meat from other animals. Plants get their food in an entirely different way.

African elephants dine exclusively on plants, including roots, grasses, fruit, and bark. The plants, however, first have to get what they need to grow. Sunlight, water, carbon dioxide from the air, and nutrients from the soil all help plants grow and thrive, so they can become someone else's snack.

One such delicacy for elephants is the Mopane or butterfly tree. The trees grow in hot, dry areas around Africa. The leaves, a favorite treat among the elephants that live near where the trees grow, are shaped like butterfly wings. Because the trees grow in locations that do not receive much rain,

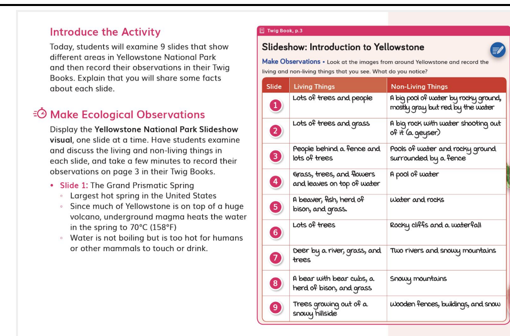
Read the **Eating to Live Prior-Knowledge Read-Aloud**.

Prompt students to reflect on the reading.

- *What do both plants and animals need to survive?*
- *What are some ways that plants and animals get what they need to survive?*

Grade 5 Module 2 DQ1L1 TE p. 8

- Students observe a series of slides from Yellowstone, activating their prior knowledge of the national park, its features, and some of the organisms that live there **(DQ1L1 TE p. 9)**.
- Students are prompted to think back of their use of Scale, Proportion, and Quantity (CCC-3) in Grade 5 Module 1, where they investigated where plants get their matter from **(DQ1L2 TE p. 19)**.


Introduce the Activity

Today, students will examine 9 slides that show different areas in Yellowstone National Park and then record their observations in their Twig Books. Explain that you will share some facts about each slide.

Make Ecological Observations

Display the **Yellowstone National Park Slideshow visual**, one slide at a time. Have students examine and discuss the living and non-living things in each slide, and take a few minutes to record their observations on page 3 in their Twig Books.

- Slide 1: The Grand Prismatic Spring
  - Largest hot spring in the United States
  - Since much of Yellowstone is on top of a huge volcano, underground magma heats the water in the spring to 70°C (158°F)
  - Water is not boiling but is too hot for humans or other mammals to touch or drink.

Twig Book, p.3

Slideshow: Introduction to Yellowstone

Make Observations • Look at the images from around Yellowstone and record the living and non-living things that you see. What do you notice?

Slide	Living Things	Non-Living Things
1	Lots of trees and people	A big pool of water by rocky ground, mostly gray but red by the water
2	Lots of trees and grass	A big rock with water shooting out of it (a geyser)
3	People behind a fence and lots of trees	Pools of water and rocky ground surrounded by a fence
4	Grass, trees, and flowers and leaves on top of water	A pool of water
5	A beaver, fish, herd of bison, and grass.	Water and rocks
6	Lots of trees	Rocky cliffs and a waterfall
7	Deer by a river, grass, and trees	Two rivers and snowy mountains
8	A bear with bear cubs, a herd of bison, and grass	Snowy mountains
9	Trees growing out of a snowy hillside	Wooden fences, buildings, and snow

Grade 5 Module 2 DQ1L1 TE p. 9

- Students review all the evidence they have gathered throughout the DQ2 and use it to construct scientific explanations **(DQ2L6 TE p. 78, TB pp. 35–36)**.

Write Supporting Evidence

Ask students to independently write their scientific explanations on page 36 in their Twig Books. Encourage students to write in pencil so they can make revisions, as needed. Remind them to explain how the evidence supports their claim. They must provide their reasoning and include a conclusion that sums up their findings.

Stronger and Clearer Each Time (Language Routine)

Once their explanations have been drafted, have students work together to give and receive feedback. First, they will share with their current partners and then they will refine their work and share with two other partners in succession. Explain that during this process, they should be referring to the rubric on page 35 in their Twig Books.

1. Partner 1 tells their ideas while Partner 2 listens. Partner 2 asks questions and tries to get more detail, clarifications, and input from Partner 1. Give pairs 30–45 seconds for this step. Give Partner 1 time to revise.
2. Partner 2 tells their ideas while Partner 1 listens. Partner 1 asks questions and should try to get more details, clarifications, and input from Partner 2. Give pairs 30–45 seconds for this step. Give Partner 2 time to revise.
3. Students switch to a new partner. They follow the same process as in steps 1 and 2, but use what they heard from their first partner to strengthen what they share with their new partner (e.g., add more detail and be clearer).

Grade 5 Module 2 DQ2L6 TE p. 78

LESSON 6 Writing an Explanation

3D Performance Task

Scientific Explanation

Make a Claim • What do animals need in order to grow and heal?

In the box below, write a claim that answers the question.

Claim:

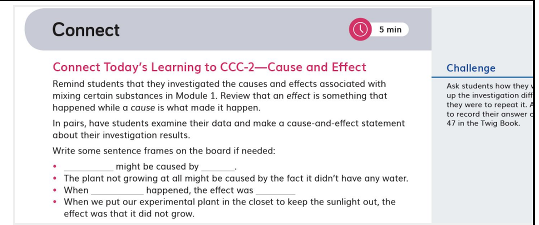
Obtain Information • Record **3** pieces of evidence that you will use to support your explanation. Include facts and details. In the left column, record the source of the evidence (where you got it.) In the right column, record the evidence.

Source	Evidence

35 www.twigscience.com

Grade 5 Module 2 DQ1L1 TB pp. 35–36

- Students are reminded of when they used Cause and Effect (CCC-2) in Grade 5 Module 1 while investigating what happens when certain substances are mixed. Students review the science tools they've used and add "Ask questions" to the Science Tools poster **(DQ3L1 TE p. 97)**.
- Students complete a diagnostic pre-assessment (Pre-Exploration) to elicit awareness of their prior knowledge and misconceptions of dead matter and decomposition **(DQ4L4 TB p. 88)**.



Connect 5 min

Connect Today's Learning to CCC-2—Cause and Effect

Remind students that they investigated the causes and effects associated with mixing certain substances in Module 1. Review that an *effect* is something that happened while a *cause* is what made it happen.

In pairs, have students examine their data and make a cause-and-effect statement about their investigation results.

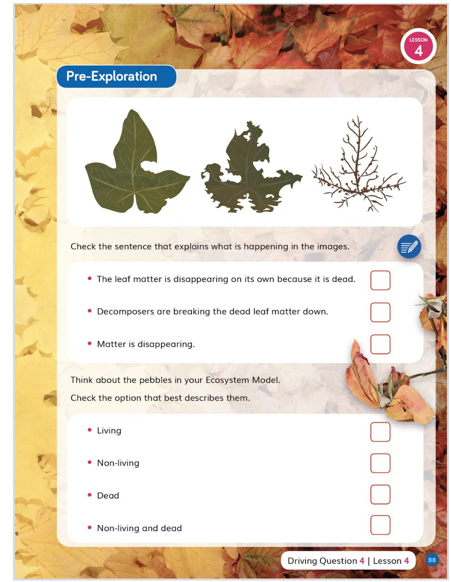
Write some sentence frames on the board if needed:

- ___________ might be caused by _______.
- The plant not growing at all might be caused by the fact it didn't have any water.
- When ___________ happened, the effect was _________
- When we put our experimental plant in the closet to keep the sunlight out, the effect was that it did not grow.

Challenge

Ask students how they v
up the investigation diff
they were to repeat it. A
to record their answer o
47 in the Twig Book.

Grade 5 Module 2 DQ3L1 TE p. 97



LESSON 4

Pre-Exploration

Check the sentence that explains what is happening in the images.

- The leaf matter is disappearing on its own because it is dead. ☐
- Decomposers are breaking the dead leaf matter down. ☐
- Matter is disappearing. ☐

Think about the pebbles in your Ecosystem Model.

Check the option that best describes them.

- Living ☐
- Non-living ☐
- Dead ☐
- Non-living and dead ☐

Driving Question 4 | Lesson 4 88

Grade 5 Module 2 DQ4L4 TB p. 88

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- Following a collaborative language routine, students revise their explanations about how matter moves through an ecosystem **(DQ5L4 TE p. 182/TB p. 110)**.

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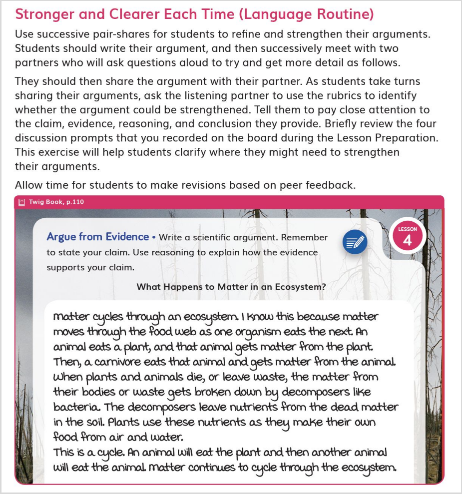


Stronger and Clearer Each Time (Language Routine)

Use successive pair-shares for students to refine and strengthen their arguments. Students should write their argument, and then successively meet with two partners who will ask questions aloud to try and get more detail as follows.

They should then share the argument with their partner. As students take turns sharing their arguments, ask the listening partner to use the rubrics to identify whether the argument could be strengthened. Tell them to pay close attention to the claim, evidence, reasoning, and conclusion they provide. Briefly review the four discussion prompts that you recorded on the board during the Lesson Preparation. This exercise will help students clarify where they might need to strengthen their arguments.

Allow time for students to make revisions based on peer feedback.

Twig Book, p.110

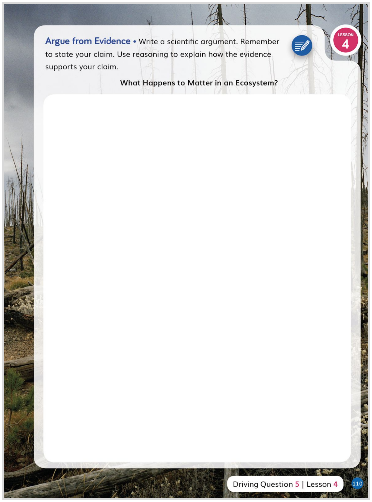
LESSON 4

Argue from Evidence • Write a scientific argument. Remember to state your claim. Use reasoning to explain how the evidence supports your claim.

What Happens to Matter in an Ecosystem?

Matter cycles through an ecosystem. I know this because matter moves through the food web as one organism eats the next. An animal eats a plant, and that animal gets matter from the plant. Then, a carnivore eats that animal and gets matter from the animal. When plants and animals die, or leave waste, the matter from their bodies or waste gets broken down by decomposers like bacteria. The decomposers leave nutrients from the dead matter in the soil. Plants use these nutrients as they make their own food from air and water.
This is a cycle. An animal will eat the plant and then another animal will eat the animal. Matter continues to cycle through the ecosystem.

Grade 5 Module 2 DQ5L4 TE p. 182



Grade 5 Module 2 DQ5L4 TB p. 110

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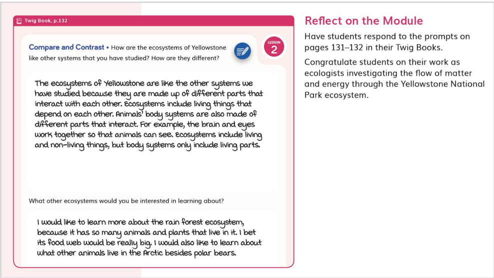
- Students reflect on their new understandings and ideas about ecosystems, comparing and contrasting the Yellowstone ecosystem with other ecosystems they've studied in science class **(DQ6L2 TE p. 208/TB p. 132)**.


Twig Book, p.132

Compare and Contrast • How are the ecosystems of Yellowstone like other systems that you have studied? How are they different?

LESSON 2

The ecosystems of Yellowstone are like the other systems we have studied because they are made up of different parts that interact with each other. Ecosystems include living things that depend on each other. Animals' body systems are also made of different parts that interact. For example, the brain and eyes work together so that animals can see. Ecosystems include living and non-living things, but body systems only include living parts.

What other ecosystems would you be interested in learning about?

I would like to learn more about the rain forest ecosystem, because it has so many animals and plants that live in it. I bet its food web would be really big. I would also like to learn about what other animals live in the Arctic besides polar bears.

Reflect on the Module

Have students respond to the prompts on pages 131–132 in their Twig Books.

Congratulate students on their work as ecologists investigating the flow of matter and energy through the Yellowstone National Park ecosystem.

Grade 5 Module 2 DQ6L2 TE p. 208


Compare and Contrast • How are the ecosystems of Yellowstone like other systems that you have studied? How are they different?

LESSON 2

What other ecosystems would you be interested in learning about?

Driving Question 6 | Lesson 2 132

Grade 5 Module 2 DQ6L2 TB p. 132

PROGRAM ASSESSMENT SYSTEM

The materials are High Quality 5

The materials use a program-level assessment system that has all or most of the quality characteristics

Evidence

The Twig Science Assessment System has been developed in partnership with Stanford University's SCALE team. It is designed to provide a three-dimensional assessment system that allows teachers to evaluate student attainment of the three dimensions and PEs of the NGSS.

The assessment strategies measure students' knowledge and ability. They favor Performance Tasks over rote memorization and include a rich variety of measures, such as written assignments, collaborative engineering design challenges, and oral presentations. There are also lots of informal ways to quickly evaluate student progress.

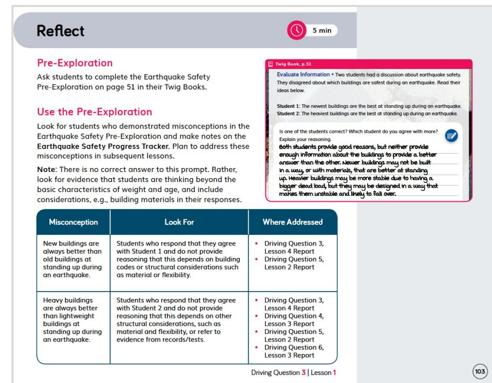
SCALE
Stanford Center for Assessment, Learning, & Equity

For example, near the start of each module, students complete a Pre-Exploration (Diagnostic Pre-Assessment). Pre-Explorations enable teachers to identify student prior knowledge of the three dimensions as well as any misconceptions students may hold.

Progress Trackers are provided to support teachers as they track how students address their misconceptions and demonstrate their growing mastery of the three dimensions and PEs targeted in each module. Guidance is also given in the Teacher Edition for how to tailor instruction for students whose misconceptions persist, or who need extra scaffold to reach the required grade proficiency of the standards. For example, **Grade 4 Module 4 (DQ3L1 Reflect TE p. 103)**.

Ongoing Formative Assessments, sometimes referred to as Informal Assessments, are woven into each lesson. These are quick ways to gauge student understanding, allowing teachers to tailor their instruction accordingly. They include a wide variety of formats with clear expectations that allow students to demonstrate their understanding of the learning goals in multiple ways.

Summative Performance Tasks are rich and highly engaging activities designed to motivate students to demonstrate their mastery of the expected grade-level proficiency for the PEs. Rubrics support easy grading.



Reflect — 5 min

Pre-Exploration

Ask students to complete the Earthquake Safety Pre-Exploration on page 51 in their Twig Books.

Use the Pre-Exploration

Look for students who demonstrated misconceptions in the Earthquake Safety Pre-Exploration and make notes on the **Earthquake Safety Progress Tracker.** Plan to address these misconceptions in subsequent lessons.

Note: There is no correct answer to this prompt. Rather, look for evidence that students are thinking beyond the basic characteristics of weight and age, and include considerations, e.g., building materials in their responses.

Twig Book, p.51

Evaluate Information • Two students had a discussion about earthquake safety. They disagreed about which buildings are safest during an earthquake. Read their ideas below.

Student 1: The newest buildings are the best at standing up during an earthquake.
Student 2: The heaviest buildings are the best at standing up during an earthquake.

Is one of the students correct? Which student do you agree with more? Explain your reasoning.

Both students provide good reasons, but neither provide enough information about the buildings to provide a better answer than the other. Newer buildings may not be built in a way, or with materials, that are better at standing up. Heavier buildings may be more stable due to having a bigger dead load, but they may be designed in a way that makes them unstable and likely to fall over.

Misconception	Look For	Where Addressed
New buildings are always better than old buildings at standing up during an earthquake.	Students who respond that they agree with Student 1 and do not provide reasoning that this depends on building codes or structural considerations such as material or flexibility.	• Driving Question 3, Lesson 4 Report • Driving Question 5, Lesson 2 Report
Heavy buildings are always better than lightweight buildings at standing up during an earthquake.	Students who respond that they agree with Student 2 and do not provide reasoning that this depends on other structural considerations, such as material and flexibility, or refer to evidence from records/tests.	• Driving Question 3, Lesson 4 Report • Driving Question 4, Lesson 3 Report • Driving Question 5, Lesson 2 Report • Driving Question 6, Lesson 3 Report

Driving Question 3 | Lesson 1 103

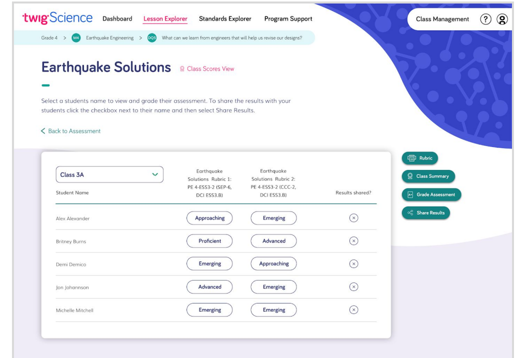
Grade 4 Module 4 DQ3L1 Reflect TE p. 103

Modules in Grades 3–6 include SCALE Benchmark Assessments, which assess students' ability to apply the knowledge and skills gained throughout the module to new contexts. Leveled rubrics support easy grading with sample student answers provided in the form of "Look Fors."

Grades 3–6 also include 3-D Multiple Choice Assessments, which quickly assess student understanding of a range of dimensions covered in the module. An extended section (Part C) has been designed to stretch GATE students.

Support for Teachers to Make Program Level Decisions

The assessment items in the Pre-Explorations, Performance Tasks, Benchmark Assessments, and Multiple Choice Assessments are tied to specific dimensions and/or PEs. The data generated by this system of assessments can then provide a picture of student and class progression across a module, grade, or, over time, the full K–6 program.



Grade 4 Module 4 Earthquake Solutions Benchmark Assessment

Driven by an assessment framework that provides a structured conceptual map of student learning along with details of how achievement of the outcomes can be measured.

The K–6 NGSS Alignment table details the conceptual flow of student learning across Twig Science. It's clear to see where each of the NGSS PEs are addressed. The grade-level Assessment Overview provides details on where each of these PEs are assessed, along with details of how achievement of the outcomes can be measured.

A more detailed map of the assessment opportunities (both formal and informal) of all dimensions in each module are provided in the Module Assessment Overviews. For example, Grade 3 Module 1.

All assessments in Twig Science are tied to specific learning goals, with tools provided for how to measure student success. Details of the tools are provided at point of use and in the Module Assessment Overview.