

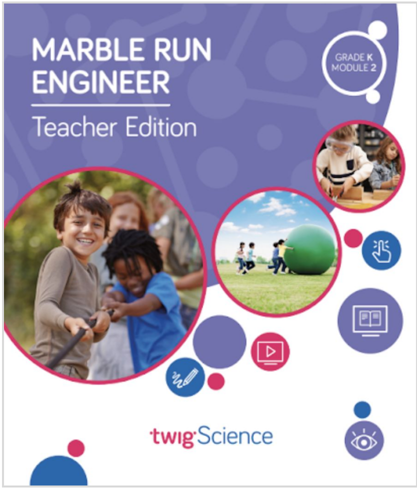
Science Made for the Next Generation

Twig Science was built from the ground up for the California NGSS by award-winning STEM education specialists. Reviewing our program, you'll find:

- A clear conceptual flow across the program, clearly set out in the program CA NGSS Framework Alignment
- Modules that bundle different scientific disciplines including engineering and environmental principles and concepts (as defined by the CDE), aligned 1:1 with the segments of the California Framework
- Phenomena and investigative problems at the heart of each module, with Grade Scope and Sequence tables that show how the dimensions flow and build in sophistication across each grade
- Module Contents that tell the story of how students apply the three dimensions in a module, with Driving Questions that scaffold their learning journey
- Three-dimensional lessons and assessments that clearly outline the dimensions applied.

This is why we score so highly on NGSS-based rubrics such as NextGen TIME Paper screen evaluation.

This rubric has been completed for Kindergarten Module 2 Marble Run Engineers and is designed to highlight where you can find evidence for the Designed for NGSS: Foundations Rubric. The rubric includes citations to the printed Teachers Edition and Twig Book (Student Edition).



Designed for the NGSS: Foundations	High Quality 5	Medium Quality 3	Low Quality 1
F1. Presence of Phenomena/Problem. The materials include phenomena/problems that have the ***potential*** to drive student learning toward the targeted learning goals in the following ways: • phenomena/problems in the materials are to be relevant to students; • explanations for phenomena connect to the three dimensions; and, • solutions to problems connect to the three dimensions.	The materials include phenomena/problems that have strong *potential* to drive student learning toward the targeted learning goals.	The materials include phenomena/problems that have some *potential* to drive student learning toward the targeted learning goals.	The materials include phenomena/problems that have limited *potential* to drive student learning toward the targeted learning goals.
F2. Presence of Three Dimensions. The materials include opportunities for students to develop and use the three dimensions, such that: • the DCIs, SEPs, and CCCs are present and have the potential to support student learning toward the targeted learning goals for each dimension; and, • when engineering design is a learning focus, it is integrated with other appropriate dimensions (i.e., engineering is not isolated).	The materials consistently provide opportunities for students to develop and use the three dimensions.	The materials occasionally provide opportunities for students to develop and use the three dimensions.	The materials rarely provide opportunities for students to use the three dimensions.
F3. Presence of Logical Sequence. Materials demonstrate appropriate sequencing of three dimensions when: • they include a targeted set of DCIs, SEPs, and CCCs within a sequence; • the sequence is clear and logical across the DCIs; and, • the SEPs and CCCs are potentially sufficient and appropriate for students to figure out the phenomena or problems.	The materials consistently exhibit a clear, logical, and appropriate sequence across the three dimensions.	The materials occasionally exhibit a clear, logical, and appropriate sequence across the three dimensions.	The materials rarely exhibit a clear, logical, and appropriate sequence across the three dimensions.

Designed for NGSS: Foundations Rubric

Analyze Evidence

Directions:

1. Review the Designed for NGSS: Foundations Rubric.
2. Reflect on the evidence (or lack of evidence) that you and your team gathered and represented.
3. Record strengths and limitations for each criterion based on your evidence. Cite specific examples.

Strengths
F1. Presence of Phenomena /Problems
The materials are High Quality 5 with regards to F1. There is high quality evidence of phenomenon and problems that with a strong potential to drive student learning towards targeted goal. The phenomena/problems are very relevant to students, explanations for phenomena connect to the three dimensions, and solutions to problems connect to the three dimensions.
Evidence Kindergarten Module 2: Marble Run Engineer Module Phenomenon: What happens when we push, pull, and drop objects? How can we change their speed and direction? Students tackle the problem in stages by following a sequence of Driving Questions (DQs) that drive a conceptual flow. • DQ1: How can we make an object move faster or move in a different direction? • DQ2: How can we get marbles where we want them? • DQ3: How do we understand and design a marble run? Over the course of all three DQs, students investigate a series of phenomena/problems, which progressively build in complexity, scaffolding students' acquisition of the necessary DCIs, SEPs, and CCCs until they are able to address the central problem. For example, in DQ1, students explore forces by observing and analyzing what happens when they push and pull different objects. Then, in DQ2, they investigate how they can use tools to alter and control the direction of a marble. In DQ3, students apply their learning by designing, building, testing, and revising marble runs. By the end of DQ3, students have figured out the answer to the Module Phenomenon. They understand what happens when objects are pushed, pulled, and dropped, and they have learned ways of changing an object’s speed and direction of motion.

F2. Presence of Three Dimensions

The materials are High Quality 5 with regards to F2.
They consistently provide opportunities for students to use and develop the three dimensions.

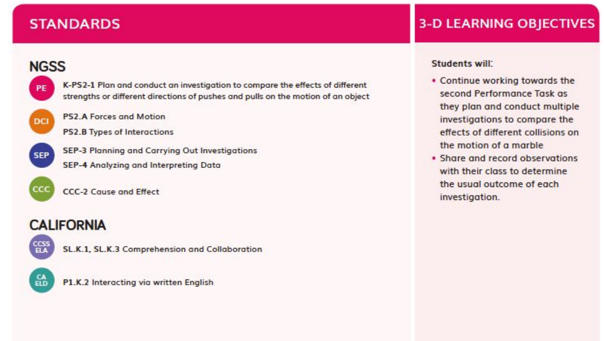
Evidence
In this module, students are supported to use the three dimensions with increasing sophistication to solve the Module Phenomenon, answer the DQ, and complete the assessment tasks.

Use and Development of Dimensions
For example, in DQ1 students explore the question: How can we make an object move faster or move in a different direction? Over ten lessons, students carry out hands-on investigations (SEP-3) into the motion of objects (PS2.A) and the relationship between energy and forces (PS3.C). They analyze and interpret their data (SEP-4), interrogate texts, watch videos, and apply the concept of cause and effect (CCC-2) to figure out the answer to the DQ—that they can make an object move, change direction, and stop with pushes and pulls, and that the strength of a push or pull affects the speed and distance an object will travel.

The 3-D Learning Objectives and dimensions that are addressed in every lesson are clearly identified at the start of each lesson. For example, in DQ2L6—where students are working to answer the DQ: How can we get marbles where we want them?—students use PS2.A, PS2.B, SEP-3, SEP-4, and CCC-2 to plan, carry out, and interpret the results of investigations into forces and motion **(Standards and 3-D Learning Objectives TE p. 116)**.

Science Tools Poster
Throughout the module, students use their class Science Tools poster to track their growing use of the SEPs. The poster is blank at the start of the year, and the eight SEPs are added when each one is used for the first time. In this module, students add:
- Ask questions (SEP-1)
- Use math (SEP-5)
- Share ideas (SEP-8)
- Make claims, and use evidence (SEP-7)
- Plan investigations (SEP-3)
- Design solutions (SEP-6)

Students revisit:
- Do investigations (SEP-3)
- Make observations (SEP-4)
- Read and listen (SEP-8)
- Share ideas (SEP-8)
- Make models (SEP-2)


STANDARDS

NGSS

PE K-PS2-1 Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object

DCI PS2.A Forces and Motion
PS2.B Types of Interactions

SEP SEP-3 Planning and Carrying Out Investigations
SEP-4 Analyzing and Interpreting Data

CCC CCC-2 Cause and Effect

CALIFORNIA

CCSS ELA SL.K.1, SL.K.3 Comprehension and Collaboration

CA ELD P1.K.2 Interacting via written English

3-D LEARNING OBJECTIVES

Students will:
- Continue working towards the second Performance Task as they plan and conduct multiple investigations to compare the effects of different collisions on the motion of a marble
- Share and record observations with their class to determine the usual outcome of each investigation.

Standards and 3-D Learning Objectives TE p. 116

This metacognitive activity grows students' awareness of which skills they are using **(DQ3L3 Science Tools poster TE p. 151)**.

Engineering
Engineering design is fully integrated into this module. Students are introduced to the role of an engineer and the concept of design in DQ1L1. After learning about and investigating forces in DQ1 and DQ2, students begin DQ3 and work towards answering the Driving Question: How do we understand and design a marble run? The first several lessons of DQ3 involve students investigating available materials, designing, predicting, building, and testing various marble run designs. The DQ, and module, culminates in an Engineering Design Challenge, where students define a problem that they want to solve with their marble run, and then design, build, test, revise, and present their final marble runs.

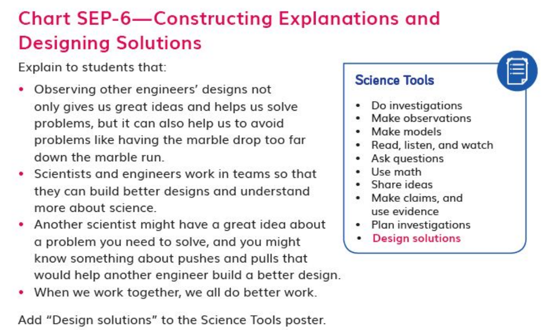


Chart SEP-6—Constructing Explanations and Designing Solutions

Explain to students that:

- Observing other engineers' designs not only gives us great ideas and helps us solve problems, but it can also help us to avoid problems like having the marble drop too far down the marble run.
- Scientists and engineers work in teams so that they can build better designs and understand more about science.
- Another scientist might have a great idea about a problem you need to solve, and you might know something about pushes and pulls that would help another engineer build a better design.
- When we work together, we all do better work.

Add "Design solutions" to the Science Tools poster.

DQ3L3 Science Tools poster TE p. 151

F3. Presence of Logical Sequence

The materials are High Quality 5 with regards to F3.
The materials consistently exhibit a clear, logical, and appropriate sequence across the three dimensions.

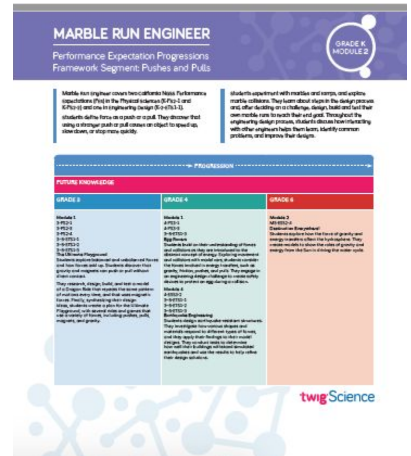
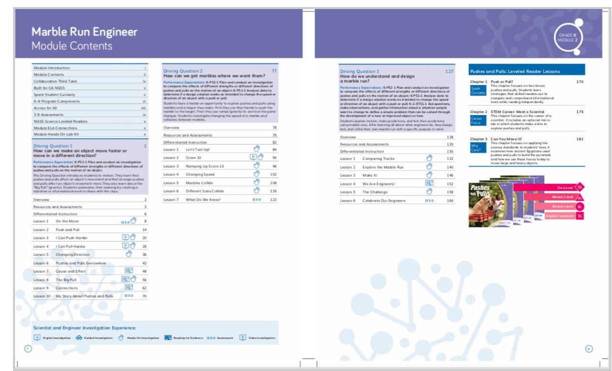
Evidence

Targeted Three Dimensions in a Logical Sequence

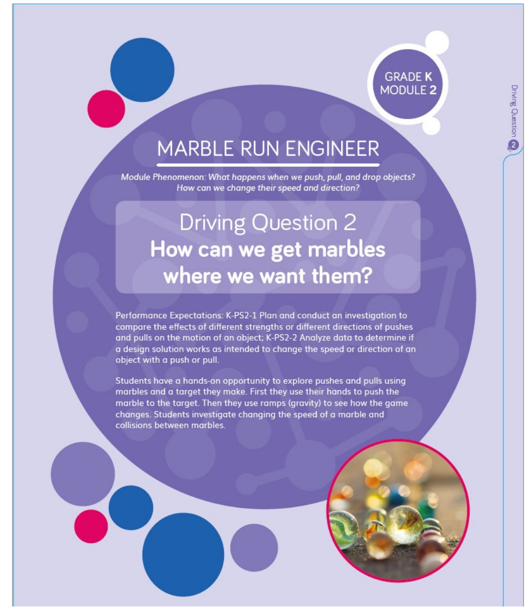
Grade Sequence
The **Kindergarten Scope and Sequence** clearly identifies the three dimensions targeted in Marble Run Engineer and where they fit into the sequence of dimensions that are addressed across the entire grade. For example, students will go on to revisit K–2-ETS1-1 in Module 3 and Module 4. The sequence of all the DCIs, SEPs, and CCCs targeted at Grade K is easy to see at a glance.

MODULES	MODULE PHENOMENON	STORYLINE	PERFORMANCE EXPECTATIONS *(Asterisked PEs integrate traditional science content with engineering through SEP or DCI)
1: My Big Nature Adventure CA Framework Segment: Plant and Animal Needs	Different plants and animals live in different places.	Hold on tight—you're going on an adventure! In this module, students travel the world looking at different environments—including deserts, grasslands, cities, and even their very own schoolyard. They observe some of the plants and animals that live in these places, and discover that each environment provides living things with everything they need to survive. Through hands-on exploration, videos, and books, students also learn that all living things share the same basic needs—whether you're a plant, a human, or a dung beetle!	**K-LS1-1** Use observations to describe patterns of what plants and animals (including humans) need to survive. **K-ESS3-1** Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places in which they live.
2: Marble Run Engineer CA Framework Segment: Pushes and Pulls	What happens when we push, pull, and drop objects? How can we change their speed and direction?	In this module, students become Marble Run Engineers. They explore forces by observing and analyzing what happens when they push and pull different objects. They use tools to alter and measure how far they can push a marble, and how precisely they can control its direction. Finally, students put all their knowledge into practice by designing, building, observing, and analyzing fun (and functional!) marble run tracks. Let's roll!	**K-PS2-1** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. **K-PS2-2** Analyze data to determine whether a design solution works as intended to change the speed or direction of an object with a push or a pull.* **K–2-ETS1-1** Ask questions, make observations, and gather information about a situation people want to change in order to define a simple problem that can be solved through the development of a new or improved object or tool.
3: Be Prepared CA Framework Segment: Weather Patterns	How do we observe weather and collect data to describe weather patterns over time?	What's the weather like? In this module, students find out by becoming amateur meteorologists! They observe weather patterns, learn to interpret weather forecasts, and use their knowledge to prepare for whatever the weather throws at them. Students explore the importance of staying protected from the Sun, build their own mini-umbrellas, and find out how meteorologists make and share their predictions about the weather. Finally, they create weather forecasts of their own—because whatever the weather, it pays to be prepared!	**K-ESS2-1** Use and share observations of local weather conditions to describe patterns over time. **K-ESS3-2** Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.* **K-PS3-1** Make observations to determine the effect of sunlight on the Earth's surface. **K-PS3-2** Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.* **K–2-ETS1-1** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. **K–2-ETS1-2** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. **K–2-ETS1-3** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
4: I Can CA Framework Segment: Animals and Plants Can Change Their Environment	How can I protect the environment from changes that harm it?	Animals can, plants can—and I can! In this module, students discover how living things can change their environments to meet their basic needs. Using videos and texts, students explore examples, such as earthworms, beavers, and trees, and consider the positive and negative impacts of the changes they make. Students consider how humans can change the environment too—how we can harm it, and how we can protect it. Finally, students identify one way they can help to protect the natural world, and invite other students to do the same.	**K-ESS2-2** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. **K-ESS3-3** Communicate solutions that will reduce the impact of humans on land, water, air, and/or other living things in the local environment.* **K–2-ETS1-1** Ask questions, make observations, and gather information about a situation people want to change in order to define a simple problem that can be solved through the development of a new or improved object or tool.

Kindergarten Scope and Sequence

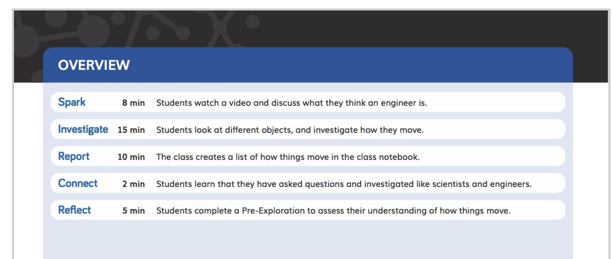
Program Sequence The **Performance Expectations Progressions table** identifies where students will revisit dimensions in future grades. For example, students will revisit engineering in Grade 4 Module 4, and forces in Grade 3 Module 1, Grade 4 Module 1, and Grade 6 Module 2.	 **Performance Expectations Progressions table**
Module Sequence The **Module Contents (TE pp. ii–iii)** identifies the sequence of three dimensions addressed in GK M2 and how they build on each other. For example, students are introduced to motion and learn about pushes and pulls in DQ1, before they investigate using pushes and pulls to change the speed and direction of an object in DQ2. In DQ3, they use their learning to predict and test how a marble will move in marble runs that they have designed.	 **Module Contents (TE pp. ii–iii)**

Driving Question Sequence
Each **Driving Question Divider** tells the story of how the students will sequentially use the three dimensions to answer the question posed. For example, in DQ2, students plan and carry out different investigations into pushes and pulls, and analyze their data to see how the results change between investigations. This knowledge helps them establish an answer to the DQ: How can we get marbles where we want them?



Driving Question Divider

Lesson Sequence
The five-part Twig Science **Lesson Overview** has been designed to support students to monitor **what** and **how** they have learned across the three dimensions on a daily basis.
Spark: An engaging hook activity 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, citing evidence and their use of the three dimensions.
Connect: Students make connections to the DQs and Module Phenomenon while building knowledge of CCCs and SEPs.
Reflect: Here 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

Spark	8 min	Students watch a video and discuss what they think an engineer is.
Investigate	15 min	Students look at different objects, and investigate how they move.
Report	10 min	The class creates a list of how things move in the class notebook.
Connect	2 min	Students learn that they have asked questions and investigated like scientists and engineers.
Reflect	5 min	Students complete a Pre-Exploration to assess their understanding of how things move.

Lesson Overview

Each Lesson Overview includes the lesson's targeted standards, the 3-D Learning Objectives, and a brief summary of each lesson section with suggested pacing.

For example, in **DQ1L2 (TE p. 14)** students will become motivated by listening to a read-aloud in the **Spark**, before they **Investigate** objects in the classroom that can be pushed or pulled. They will **Report** their findings to the class, **Connect** their learning to the Module Phenomenon and SEP-5, and use what they have learned to **Reflect** on which of two images shows a pull.

Flow of DCIs

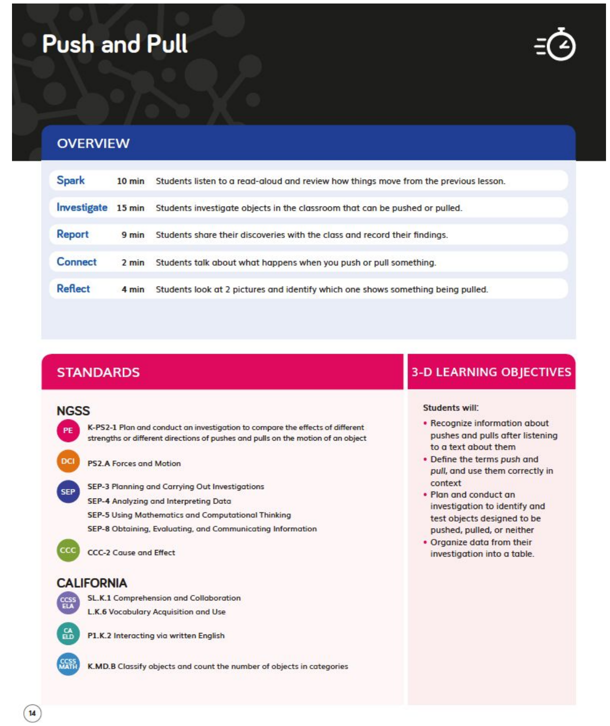
The DCIs follow a logical sequence, supporting students to gain the knowledge they need to address the Module Phenomenon.

- In DQ1, students define and delimit an engineering problem (ETS1.A), before investigating forces and motion (PS2.A) and the relationship between energy and forces (PS3.C).
- In DQ2, students continue investigating forces and motion (PS2.A) and the relationship between energy and forces (PS3.C). They also investigate and analyze different types of interactions (PS2.B).
- In DQ3, students define and delimit an engineering problem (ETS1.A) and utilize their knowledge of forces and motion (PS2.A), types of interactions (PS2.B), and the relationship between energy and forces (PS3.C) to solve the problem.

Flow of SEPs and CCCs

The SEPs and CCCs follow a logical sequence supporting students to gain expertise of the practices and concepts they need to address the Module Phenomenon.

- In DQ1, students ask questions and define problems (SEP-1) relating to motion, and plan and carry out investigations (SEP-3). They analyze and interpret their data (SEP-4), using mathematics and computational thinking (SEP-5), and consider cause and effect (CCC-2). They obtain, evaluate, and communicate information (SEP-8) about forces and motion.
- In DQ2, students plan and carry out further investigations (SEP-3) into forces and motion. They analyze and interpret their data (SEP-4), relating their results to cause and effect (CCC-2). They use their investigation results to engage in argument from evidence (SEP-7). Finally, they develop and use models (SEP-2) to communicate information (SEP-8) that they have learned during the DQ.
- In DQ3, students plan and carry out investigations (SEP-3) and analyze and interpret their data (SEP-4), relating it to cause and effect (CCC-2). They use their learning to construct explanations and design solutions (SEP-6). They ask questions and define problems (SEP-1) and develop and use models (SEP-2) as they design and build their marble runs. Finally, they communicate their learning (SEP-8).



Push and Pull

OVERVIEW

Spark	10 min	Students listen to a read-aloud and review how things move from the previous lesson.
Investigate	15 min	Students investigate objects in the classroom that can be pushed or pulled.
Report	9 min	Students share their discoveries with the class and record their findings.
Connect	2 min	Students talk about what happens when you push or pull something.
Reflect	4 min	Students look at 2 pictures and identify which one shows something being pulled.

STANDARDS

NGSS

PE K-PS2-1 Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object

DCI PS2.A Forces and Motion

SEP SEP-3 Planning and Carrying Out Investigations
SEP-4 Analyzing and Interpreting Data
SEP-5 Using Mathematics and Computational Thinking
SEP-8 Obtaining, Evaluating, and Communicating Information

CCC CCC-2 Cause and Effect

CALIFORNIA

CCSS ELA SL.K.1 Comprehension and Collaboration
L.K.6 Vocabulary Acquisition and Use

CA ELD P1.K.2 Interacting via written English

CCSS MATH K.MD.B Classify objects and count the number of objects in categories

3-D LEARNING OBJECTIVES

Students will:

- Recognize information about pushes and pulls after listening to a text about them
- Define the terms *push* and *pull*, and use them correctly in context
- Plan and conduct an investigation to identify and test objects designed to be pushed, pulled, or neither
- Organize data from their investigation into a table.

14

DQ1L2 TE p. 14