twig Science



## Science Made for the Next Generation

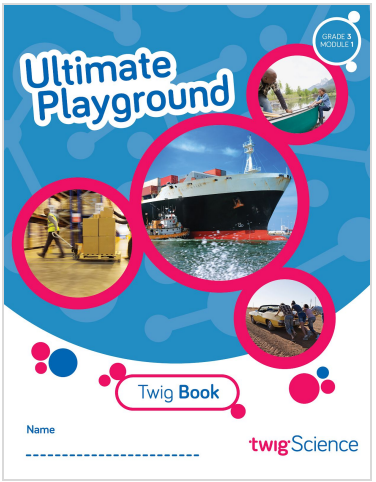
Twig Science was built from the ground up for the California NGSS by award-winning STEM education specialists.

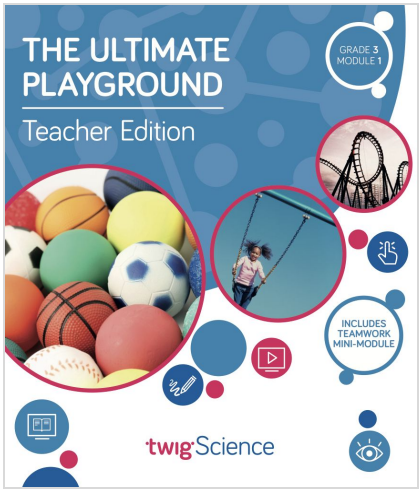
Reviewing our program, you'll find:

- 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 Grade 3 Module 1 The Ultimate Playground 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<br>5 | Medium Quality<br>3 | Low Quality<br>1 |
|---|---|---|---|
| **F1. Presence of Phenomena/Problem**. The materials include phenomena/problems that have the ***potential*** to drive students learning toward the targeted learning goals in the following ways:<br>• phenomena/problems in the materials are to be relevant to students;<br>• explanations for phenomena connect to the three dimensions;<br>• 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:<br>• the DCIs, SEPs, and CCCs are present and have the potential to support student learning toward the targeted learning goals for each dimension;<br>• 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:<br>• they include a targeted set of DCIs, SEPs, and CCCs within a sequence;<br>• the sequence is clear and logical across the DCIs;<br>• 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.**<br>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**<br>Grade 3 Module 1: The Ultimate Playground<br>Module Phenomenon: How are objects affected by the forces of push and pull?<br><br>Students work through a 3-D Team Challenge (The Pet Problem), and a series of Driving Questions (DQs) that require them to make sense of a subset of smaller phenomena/problems and then connect what they now know to the Module Phenomenon.<br><br>● 3-D Team Challenge—The Pet Problem<br>● DQ1: What happens when several different forces push or pull on an object at once?<br>● DQ2: How can an object be pushed or pulled but not move?<br>● DQ3: What do we need to know to predict the motion of objects?<br>● DQ4: How can some objects push or pull one another without even touching?<br>● DQ5: How can we solve a design problem by using magnets?<br><br>Over the course of the 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 Module Phenomenon.<br>For example, in DQ1, students review prior knowledge with class read-aloud about skateboarding (DQ1L1 Spark TE p. 56), and investigate the phenomena of the motion of playground equipment (DQ1L1), gravity (DQ1L4–L5), and forces in soccer (DQ1L6–L7). They apply the concept of cause-and-effect to the concept that forces have a direction and strength that affect objects' motion, and that gravity is a pulling force that acts on objects all the time.<br><br>In DQ2, students investigate the effects of balanced and unbalanced forces on the motion of objects. They play games of tug-of-war (DQ2L1 and L2), test roller coaster cars (DQ2L3 and L4), and observe the how balanced and unbalanced forces affect how amusement park rides moves. Finally, they write |

about one of the rides they have explored (DQ2L5), explaining phenomena such as speeding up, slowing and changing directions, connecting them to unbalanced forces.

In DQ3, students investigate the patterns in the motion of model swings in order to predict their motion (DQ3L3–L4). They use what they have learned to design the ultimate swing for the Ultimate Playground (DQ3L6).

In DQ4, students explore the phenomena of non-contact forces, focusing on magnets, and the forces of attraction and repulsion. They do so by investigating questions they have defined about how magnets exert push and pull forces on objects without touching (DQ4L3).

In DQ5, students use what they have learned about magnetic forces to solve the problem of how magnets can be used to design, make and test a fun game (DQ5L3–L4) and a ride (DQ5L5– L7) for the Ultimate Playground. They follow an engineering design process, and apply the concept of cause and effect, patterns in motion, the relationship between unbalanced forces and motion, and magnetic forces to demonstrate that they have figured out how objects are affected by forces of push and pull.

By the end of the module, students understand how balanced and unbalanced forces affect the motion of objects, predict motion of objects, and explain how magnetic forces work. They can apply what they have learned to solve engineering problems.

**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 figure out the Module Phenomenon, answer the Driving Questions, and complete the assessment tasks.

**Use and Development of Dimensions**
For example, in DQ1, students are introduced to the phenomena of how amusement park rides and games move in exciting ways (DCI PS2.A) and apply the concept of cause and effect (CCC-2), and develop models (SEP-2) to answer the question: What happens when several different forces push and pull an object?

The 3-D Learning Objectives and dimensions addressed in every lesson are clearly identified at the start of each lesson.

**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 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. This metacognitive activity grows students' awareness of which skills they are using.

**Engineering**
Engineering design is fully embedded in this module. Students build, test and optimize models in DQ3 (swing models) and DQ5 (magnetic games and rides).

## 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

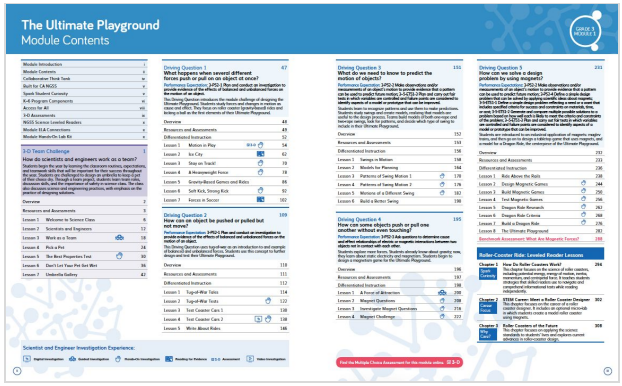
**Targeted Three Dimensions in a Logical Sequence**
**Grade Sequence**
The Grade 3 Scope and Sequence clearly identifies the three dimensions targeted in The Ultimate Playground. In Grade K, students have encountered K-PS2-1 and K-PS2-2. In Grade 2, they have encountered K-2ETS1-1, K-2-ETS1-2 and K-2-ETS1-3. They revisit these in this module, and will revisit them in Grades 4 and 5.

**Program Sequence**
The Performance Expectations Progressions table identifies where students have encountered relevant dimensions in previous grades.

Before Grade 3, students have investigated:
- Push and pull forces in Grade 2 Module 1: Marble Run Engineers, covering PE K-PS2-1, and K-PS2-2.
- Engineering tasks in Grade 1 Module 2: Shadow Town, covering SEP-3.
- Investigative 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)

**Module Sequence**
The **Module Contents (TE pp. ii–iii)** identifies the sequence of three dimensions addressed in the module and how they build on each other. For example, students investigate how balanced and unbalanced forces affect the motion of amusement park rides. They go on to build an increasingly sophisticated understanding of how engineers can design amusement park rides that use the effects of unbalanced forces to move in exciting and fun ways.

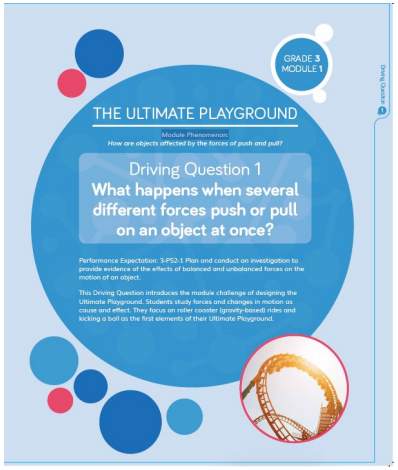



**Module Contents TE pp. ii–iii**

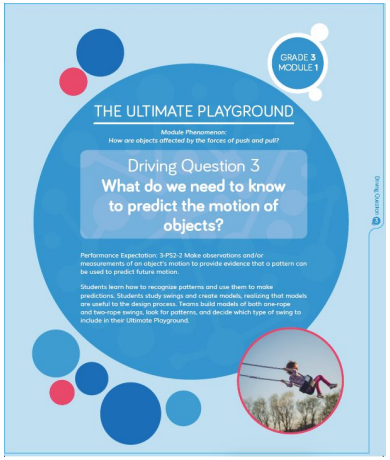
**Driving Question Sequence**

Each DQ Divider tells the story of how the students will sequentially use the three dimensions to answer the question posed. For example, in DQ1 **(Divider TE p. 47)**, students study forces and changes in motion as cause and effect. They focus on roller coaster (gravity-based) rides and kicking a ball as the first elements of their Ultimate Playground.

In **DQ3 Divider (TE p. 151)**, students learn how to recognize patterns and use them to make predictions. Students study swings and create models, realizing that models are useful to the design process.




**DQ1 Divider TE p. 47**



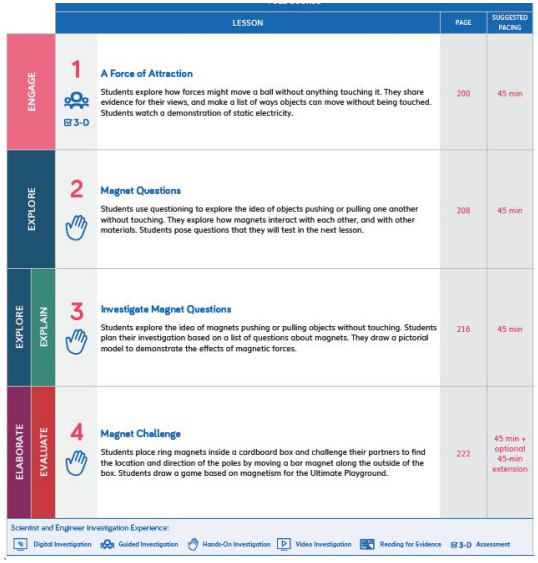

**DQ3 Divider TE p. 151**

**Lesson Sequence**
The five-part Twig Science lesson structure 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 Driving Questions and Module Phenomenon 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.

**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:**

- The **DQ4 Overview (TE p. 196)** explains that students will explore non-contact forces (Lesson 1), explore how magnets interact with one another (Lesson 2), plan an investigation about how magnetic forces affect objects' motion (Lesson 3), and design a magnetic game for The Ultimate Playground.



| | | LESSON | PAGE | SUGGESTED PACING |
|---|---|---|---|---|
| ENGAGE | 1 | **A Force of Attraction** Students explore how forces might move a ball without anything touching it. They share evidence for their views, and make a list of ways objects can move without being touched. Students watch a demonstration of static electricity. (3-D) | 200 | 45 min |
| EXPLORE | 2 | **Magnet Questions** Students use questioning to explore the idea of objects pushing or pulling one another without touching. They explore how magnets interact with each other, and with other materials. Students pose questions that they will test in the next lesson. | 208 | 45 min |
| EXPLORE / EXPLAIN | 3 | **Investigate Magnet Questions** Students explore the idea of magnets pushing or pulling objects without touching. Students plan their investigation based on a list of questions about magnets. They draw a pictorial model to demonstrate the effects of magnetic forces. | 216 | 45 min |
| ELABORATE / EVALUATE | 4 | **Magnet Challenge** Students place ring magnets inside a cardboard box and challenge their partners to find the location and direction of the poles by moving a bar magnet along the outside of the box. Students draw a game based on magnetism for the Ultimate Playground. | 222 | 45 min + optional 45-min extension |

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

DQ4 Overview TE p. 196

- The **DQ4L4, 3-D Learning Objectives (TE p. 222)** explicitly state that students will summarize what they have learned to answer the Driving Question: How can some objects push or pull one another without even touching?

**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 explore how forces make playground equipment move, and revisit K-PS2.A.
- In DQ2, students plan and conduct investigations to figure out how balanced and unbalanced forces affect the motion of roller coaster cars. (3-PS2.A)
- In DQ3, students apply what they have learned about forces and cause and effect to develop models and identify patterns in the motion of swings. (PS2.A)
- In DQ4, students explore non-contact forces, focussing on magnets and how the motion of objects can be affected by forces of repulsion and attraction. (PS2.B)
- In DQ5, the module culminates in students applying what they have learned to complete a sophisticated Performance Task, using three-dimensional thinking to build, test and refine an amusement park ride using magnets. (PS2.A, PS2.B, ETS1.A and ETS1.B, ETS1.C)

**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 apply the concept of cause and effect to describe observations of playground equipment. (CCC-2, SEP-3)
- In DQ2, students plan and conduct investigations, and apply the concept of cause and effect to write about an amusement park ride. (CCC-2, SEP-3,SEP-7)
- In DQ3, students apply what they have learned about forces and cause and effect to develop models and identify patterns in the motion of swings. (SEP-2, SEP-3, CCC-1, CCC-2)
- In DQ4, students explore non-contact forces, focussing on magnets and how the motion of objects can be affected by forces of repulsion and attraction. (SEP-1, SEP-3, CCC-2)
- In DQ5, the module culminates in students applying what they have learned to complete a sophisticated Performance Task, using three-dimensional thinking to build, test and refine an amusement park ride using magnets (SEP-1, SEP-2, SEP-3, SEP-6, CCC-1, CCC-2).

**3-D LEARNING OBJECTIVES**

**Students will:**

- Investigate the effects of magnetic fields and magnetic poles on two magnets
- Understand the interactions between two magnets, use them to locate a hidden magnet, and determine the magnet's orientation
- Summarize ideas about magnetic forces and form a response to the Driving Question.

**DQ4L4 3-D Learning Objectives TE p. 222**