

twig Science

NEXT GEN

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PK-8 • ENGLISH/SPANISH • KITS • PRINT/DIGITAL • IN-PERSON/REMOTE



What makes

twig Science NEXT GEN

the best Middle School Science Program?

•ENGAGEMENT • SURPRISE • INCLUSION • NEW SCIENCE

3-Dimensional Investigational Shifts

Students investigate Phenomena through 3-Dimensional Investigational Shifts



Twig Science Next Gen is New Real-World Science!

Old Science

Pre-1900's
Science as a body of objective knowledge and facts to be learned

1989
Inquiry as a Hands-On and Minds-On Approach

1996
Less emphasis on "activities that demonstrate and verify science content"

2012
Inquiry no longer defined exclusively as "Hands-On" experiments

Ref. Scientific Methods

New Investigational Shifts

SCIENCE AND ENGINEERING PRACTICES

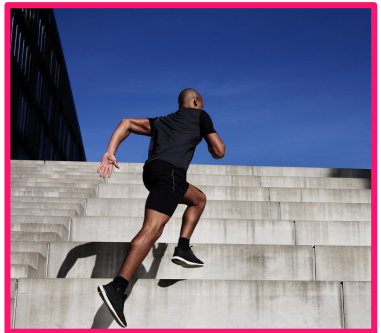
- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

What Students Do



The NRC Framework gives multiple reasons for shifting from previous scientific methods dating to pre-1900's to the the new science and engineering practices as used by today's scientists and engineers. These SEPs are your investigational shifts. They're key to student centered thinking and to succeeding on state and local 3-Dimensional Assessments interwoven with DCIs and CCCs.

Students Investigate and Experience
STEAM Roles



Sports Analytics Specialist



Industrial Engineer



Sky Diver



Farmer



Helmet Designer



Chemist



Documentary Maker



Marine Biologist

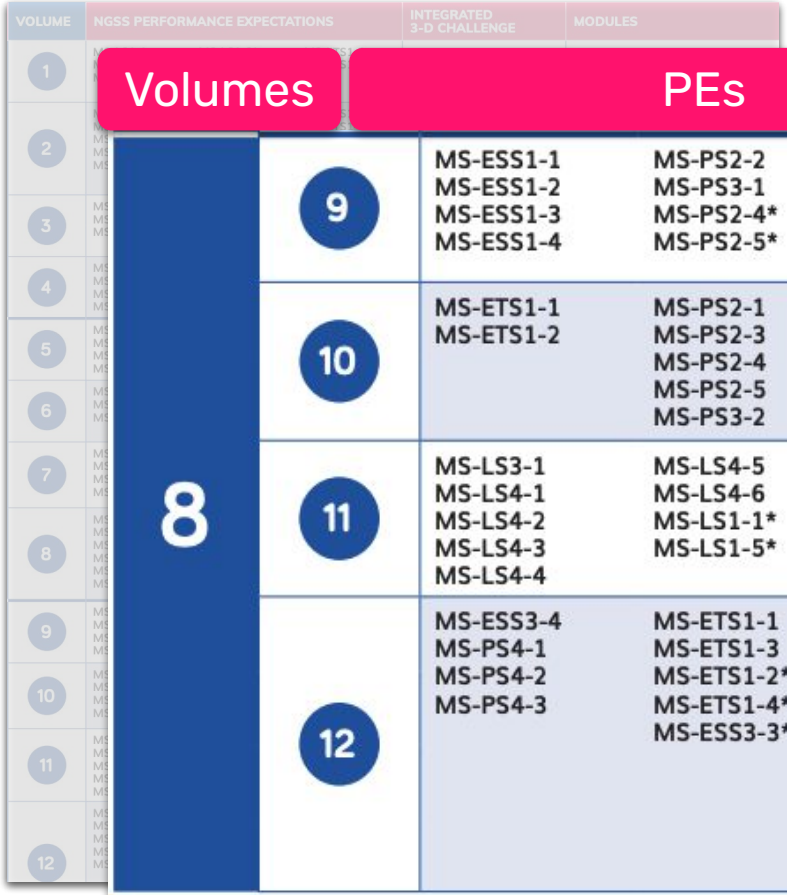
3-D NGSS Standards Alignment & Progressions

GRADE	VOLUME	NGSS PERFORMANCE EXPECTATIONS			INTEGRATED 3-D CHALLENGE	MODULES
6	1	MS-LS1-1 MS-LS1-2 MS-LS1-3	MS-ETS1-1 MS-ETS1-2	MS-ETS1-3 MS-ETS1-4	How to Mend a Broken Heart	Under the Microscope
						CreATe Network
	2	MS-ESS2-4 MS-ESS2-5 MS-ESS2-6 MS-PS3-3 MS-PS3-4	MS-PS3-5 MS-PS1-4* MS-PS4-2* MS-LS1-7*	MS-ETS1-1* MS-ETS1-2* MS-ETS1-3* MS-ETS1-4*	Polar Survival	The Great Air Race
						Model Earth
						Life Through a Lens
	3	MS-LS1-4 MS-LS1-5 MS-LS1-8	MS-LS3-2 MS-PS4-3* MS-ESS2-4*	MS-ETS1-4*	Killer Plants	North Island Rescue
						Landscape of Fear
	4	MS-ETS1-1 MS-ETS1-2 MS-ETS1-3 MS-ETS1-4	MS-ESS3-3 MS-ESS3-5 MS-LS2-4* MS-ESS3-2*		A Connection to Home	The Heat Is On
						Emergency Hydration
7	5	MS-PS1-1 MS-PS1-3 MS-PS1-4 MS-PS1-6*	MS-ESS3-1 MS-ESS1-4* MS-ESS2-1* MS-ESS3-4*	MS-LS2-3* MS-LS2-4* MS-ETS1-1* MS-ETS1-2*	Cell Phones: Unboxed	The Resource Race
						The Plastic Tide
	6	MS-ESS2-1 MS-ESS2-2 MS-ESS2-3	MS-ESS3-2 MS-ESS1-4*	MS-PS1-2* MS-PS3-1*	Supereruptions	Volcano Hunters
						Dinosaur Trail
	7	MS-ETS1-1 MS-ETS1-3 MS-ETS1-4	MS-PS1-2 MS-PS1-5 MS-PS1-6	MS-PS1-1* MS-PS1-4* MS-ETS1-2*	A Natural Glow	Science on the Main Stage
						Turtle SOS
	8	MS-LS1-6 MS-LS1-7 MS-LS2-1 MS-LS2-2 MS-LS2-3 MS-LS2-4	MS-LS2-5 MS-LS1-2* MS-ETS1-1 MS-ETS1-2 MS-ETS1-3*	MS-ETS1-4* MS-ESS3-3* MS-ESS3-5* MS-PS1-5* MS-PS1-2*	Stop the Rot	Future Food
						A Place Called Home
						The Green Monster
8	9	MS-ESS1-1 MS-ESS1-2 MS-ESS1-3 MS-ESS1-4	MS-PS2-2 MS-PS3-1 MS-PS2-4* MS-PS2-5*	MS-ETS1-1* MS-ETS1-2* MS-ETS1-3* MS-ETS1-4*	SOS from Space	Ocean Powered
						Asteroid Alert!
	10	MS-ETS1-1 MS-ETS1-2	MS-PS2-1 MS-PS2-3 MS-PS2-4 MS-PS2-5 MS-PS3-2	MS-LS1-3* MS-ESS1-2* MS-ESS1-3* MS-ETS1-3* MS-ETS1-4*	Mission to Mars	Collision Course
						Movie Magic
	11	MS-LS3-1 MS-LS4-1 MS-LS4-2 MS-LS4-3 MS-LS4-4	MS-LS4-5 MS-LS4-6 MS-LS1-1* MS-LS1-5*	MS-LS3-2* MS-ESS1-4* MS-ETS1-1*	Relative Giants	Are They Among Us?
						Survival Stories
	12	MS-ESS3-4 MS-PS4-1 MS-PS4-2 MS-PS4-3	MS-ETS1-1 MS-ETS1-3 MS-ETS1-2* MS-ETS1-4* MS-ESS3-3*	MS-LS1-4* MS-LS2-1* MS-LS2-4* MS-LS4-4*	A Vision of the Future	Amazon of the Oceans
						Into the Abyss
						Animal Tracks
						The Bees' Needs

VOLUMES		PEs			3D CHALLENGE	MODULES
8	9	MS-ESS1-1 MS-ESS1-2 MS-ESS1-3 MS-ESS1-4	MS-PS2-2 MS-PS3-1 MS-PS2-4* MS-PS2-5*	MS-ETS1-1* MS-ETS1-2* MS-ETS1-3* MS-ETS1-4*	SOS from Space	Ocean Powered
						Asteroid Alert!
	10	MS-ETS1-1 MS-ETS1-2	MS-PS2-1 MS-PS2-3 MS-PS2-4 MS-PS2-5 MS-PS3-2	MS-LS1-3* MS-ESS1-2* MS-ESS1-3* MS-ETS1-3* MS-ETS1-4*	Mission to Mars	Collision Course
						Movie Magic
	11	MS-LS3-1 MS-LS4-1 MS-LS4-2 MS-LS4-3 MS-LS4-4	MS-LS4-5 MS-LS4-6 MS-LS1-1* MS-LS1-5*	MS-LS3-2* MS-ESS1-4* MS-ETS1-1*	Relative Giants	Are They Among Us?
						Survival Stories
	12	MS-ESS3-4 MS-PS4-1 MS-PS4-2 MS-PS4-3	MS-ETS1-1 MS-ETS1-3 MS-ETS1-2* MS-ETS1-4* MS-ESS3-3*	MS-LS1-4* MS-LS2-1* MS-LS2-4* MS-LS4-4*	A Vision of the Future	Amazon of the Oceans
						Into the Abyss
						Animal Tracks
						The Bees' Needs

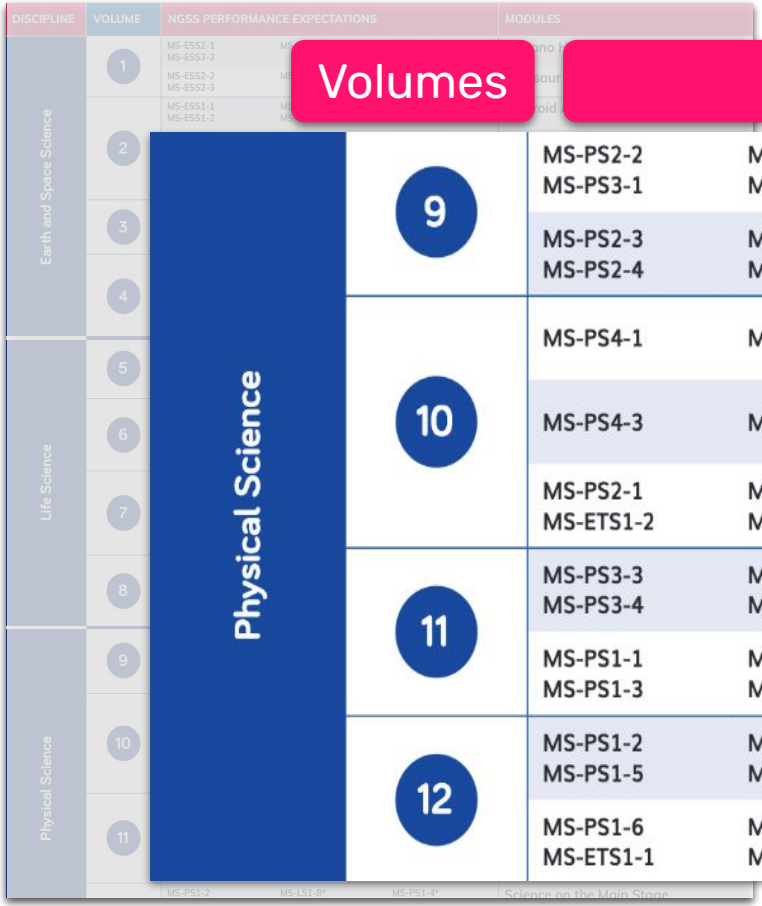
3D Performance Expectation Progressions

Integrated Model



Volumes		PEs			3D Challenge	Modules
8	9	MS-ESS1-1 MS-ESS1-2 MS-ESS1-3 MS-ESS1-4	MS-PS2-2 MS-PS3-1 MS-PS2-4* MS-PS2-5*	MS-ETS1-1* MS-ETS1-2* MS-ETS1-3* MS-ETS1-4*	SOS from Space	Ocean Powered Asteroid Alert!
	10	MS-ETS1-1 MS-ETS1-2	MS-PS2-1 MS-PS2-3 MS-PS2-4 MS-PS2-5 MS-PS3-2	MS-LS1-3* MS-ESS1-2* MS-ESS1-3* MS-ETS1-3* MS-ETS1-4*	Mission to Mars	Collision Course Movie Magic
	11	MS-LS3-1 MS-LS4-1 MS-LS4-2 MS-LS4-3 MS-LS4-4	MS-LS4-5 MS-LS4-6 MS-LS1-1* MS-LS1-5*	MS-LS3-2* MS-ESS1-4* MS-ETS1-1*	Relative Giants	Are They Among Us? Survival Stories
	12	MS-ESS3-4 MS-PS4-1 MS-PS4-2 MS-PS4-3	MS-ETS1-1 MS-ETS1-3 MS-ETS1-2* MS-ETS1-4* MS-ESS3-3*	MS-LS1-4* MS-LS2-1* MS-LS2-4* MS-LS4-4*	A Vision of the Future	Amazon of the Oceans Into the Abyss Animal Tracks The Bees' Needs

Discipline Specific Model



Volumes	PEs				Modules
Physical Science 9	MS-PS2-2 MS-PS3-1	MS-ETS1-1* MS-ETS1-2*	MS-ETS1-3* MS-ETS1-4*		Ocean Powered
	MS-PS2-3 MS-PS2-4	MS-PS2-5 MS-PS3-2	MS-ESS1-2* MS-ESS1-3*		Movie Magic
Physical Science 10	MS-PS4-1	MS-PS4-2	MS-LS4-4*		Into the Abyss
	MS-PS4-3	MS-LS1-4*	MS-ETS1-2*		Animal Tracks
	MS-PS2-1 MS-ETS1-2	MS-ETS1-4 MS-ETS1-1*	MS-ETS1-3* MS-LS1-3*		Collision Course
Physical Science 11	MS-PS3-3 MS-PS3-4	MS-PS3-5 MS-LS1-7*	MS-ETS1-1* MS-ETS1-2*	MS-ETS1-3* MS-ETS1-4*	Life Through a Lens
	MS-PS1-1 MS-PS1-3	MS-PS1-4 MS-LS2-3*	MS-LS2-4* MS-ETS1-1*	MS-ETS1-2*	The Plastic Tide
Physical Science 12	MS-PS1-2 MS-PS1-5	MS-LS1-8* MS-PS1-1*	MS-PS1-4*		Science on the Main Stag
	MS-PS1-6 MS-ETS1-1	MS-ETS1-3 MS-ETS1-4	MS-ETS1-2* MS-PS1-2*		Turtle SOS

Equip Rubrics

Criterion A. Explaining Phenomena or Designing Solutions

1. **Learn about the importance of explaining phenomena and designing solutions** in lessons designed for the NGSS here: www.nextgenscience.org/phenomena. Once you are comfortable with the role of explaining phenomena and designing solutions, use the table below to help gather evidence that either student problem-solving or sense-making of phenomena drives the lesson:

	NGSS designed lessons will look *less* like this:	NGSS designed lessons will look *more* like this:
Explaining Phenomena or Designing Solutions	Explaining phenomena and designing solutions are not a part of student learning or are presented separately from "learning time" (i.e. used only as a "hook" or engagement tool; used only for enrichment or reward after learning; only loosely connected to a DCI).	The purpose and focus of the lesson are to support students in making sense of phenomena and/or designing solutions to problems. The entire lesson drives toward this goal.
	The focus is only on getting the "right" answer to explain the phenomenon	Student sense-making of phenomena or designing of solutions is used as a window into student understanding of all three dimensions of the NGSS.
	A different, new, or unrelated phenomenon is used to start every lesson.	Lessons work together in a coherent storyline to help students make sense of phenomena.
	Teachers tell students about an interesting phenomenon or problem in the world.	Students get direct (preferably firsthand, or through media representations) experience with a phenomenon or problem that is relevant to them and is developmentally appropriate.
	Phenomena are brought into the lesson after students develop the science ideas so students can apply what they learned.	The development of science ideas is anchored in explaining phenomena or designing solutions to problems.

2. **Record evidence** about how explaining phenomena or designing solutions to problems are represented in the lesson. Describe in the response form below how this evidence is or is not an adequate indicator the criterion is being met. Include detailed suggestions for improvement.

Lessons designed for the NGSS include clear and compelling evidence of the following:	What was in the materials, where was it, and why is this evidence?	Evidence of Quality?	Suggestions for improvement
A. Explaining Phenomena or Designing Solutions: The lesson focuses on supporting students to make sense of a phenomenon or design solutions to a problem.		☐ None ☐ Inadequate ☐ Adequate ✅ Extensive	The design centers on an Anchor Phenomena per module. Students approach the anchor phenomena through a research-based approach, which breaks down the learning into 5 E's lessons which allow all students to investigate, explore, design and redesign like scientists and engineers.



A quick tour of

twig Science

NEXT GEN

What's Included?

Three-Dimensional Success with Three Tools

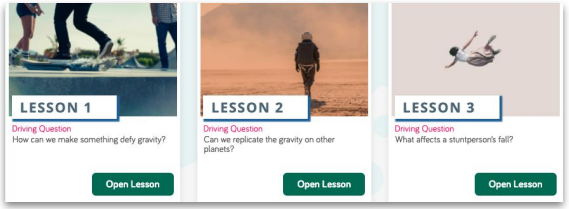
WHAT STUDENTS DO
SEPs

HOW STUDENTS THINK
CCCs

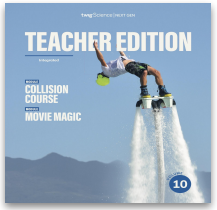
WHAT STUDENTS KNOW
DCIs

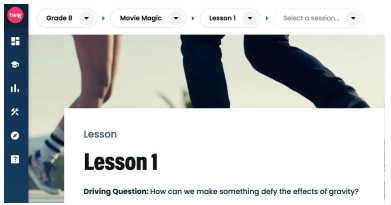
1 Twig Journal & Digital



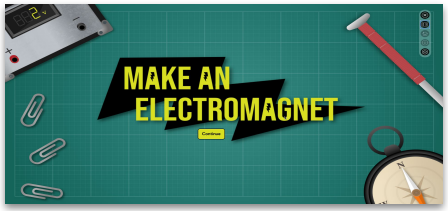


2 Teacher Print / Digital Multimedia Platform

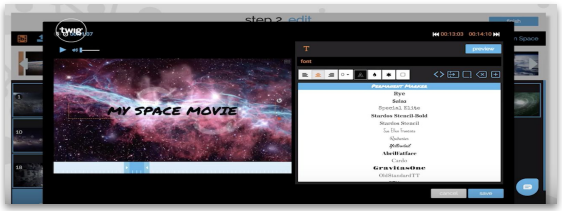




3 Science Kits and Digital Labs

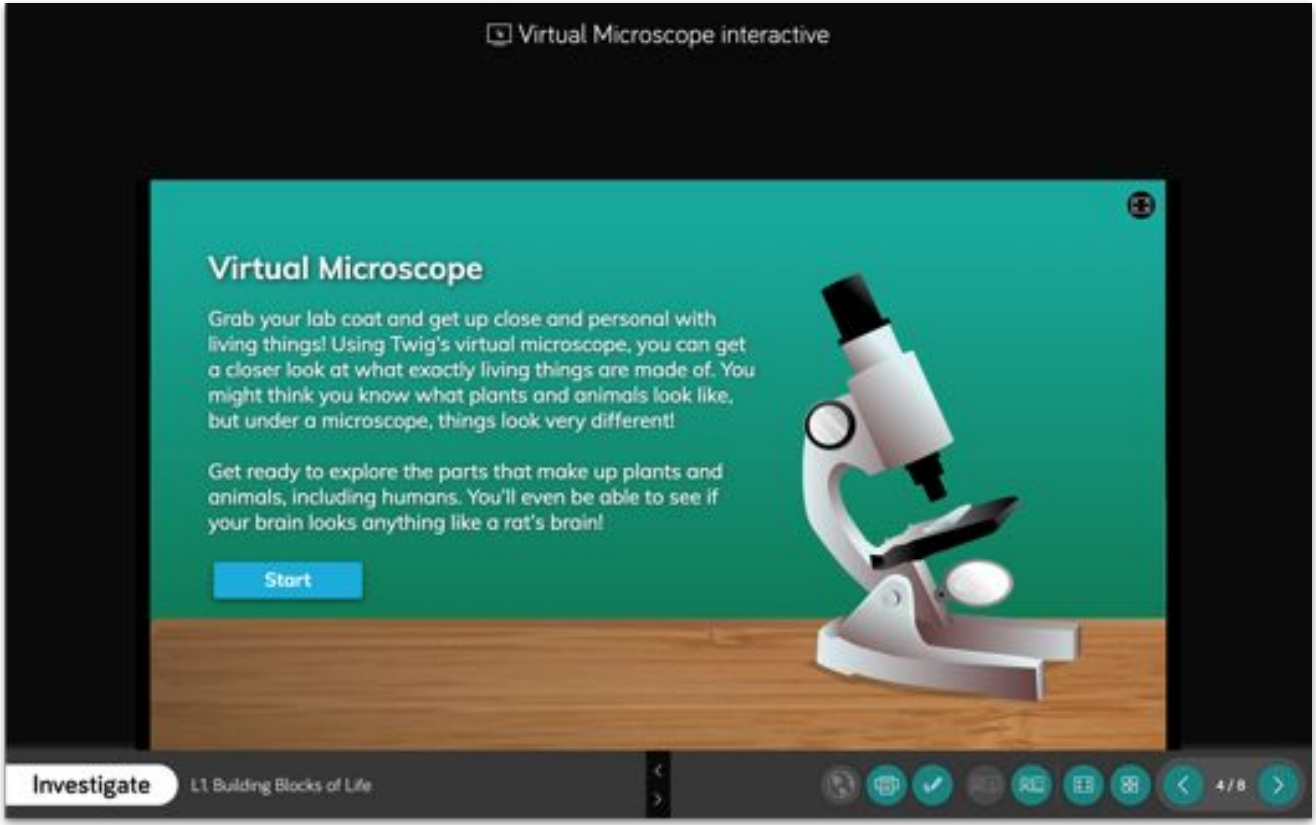


BONUS 3D Challenge Makerspace



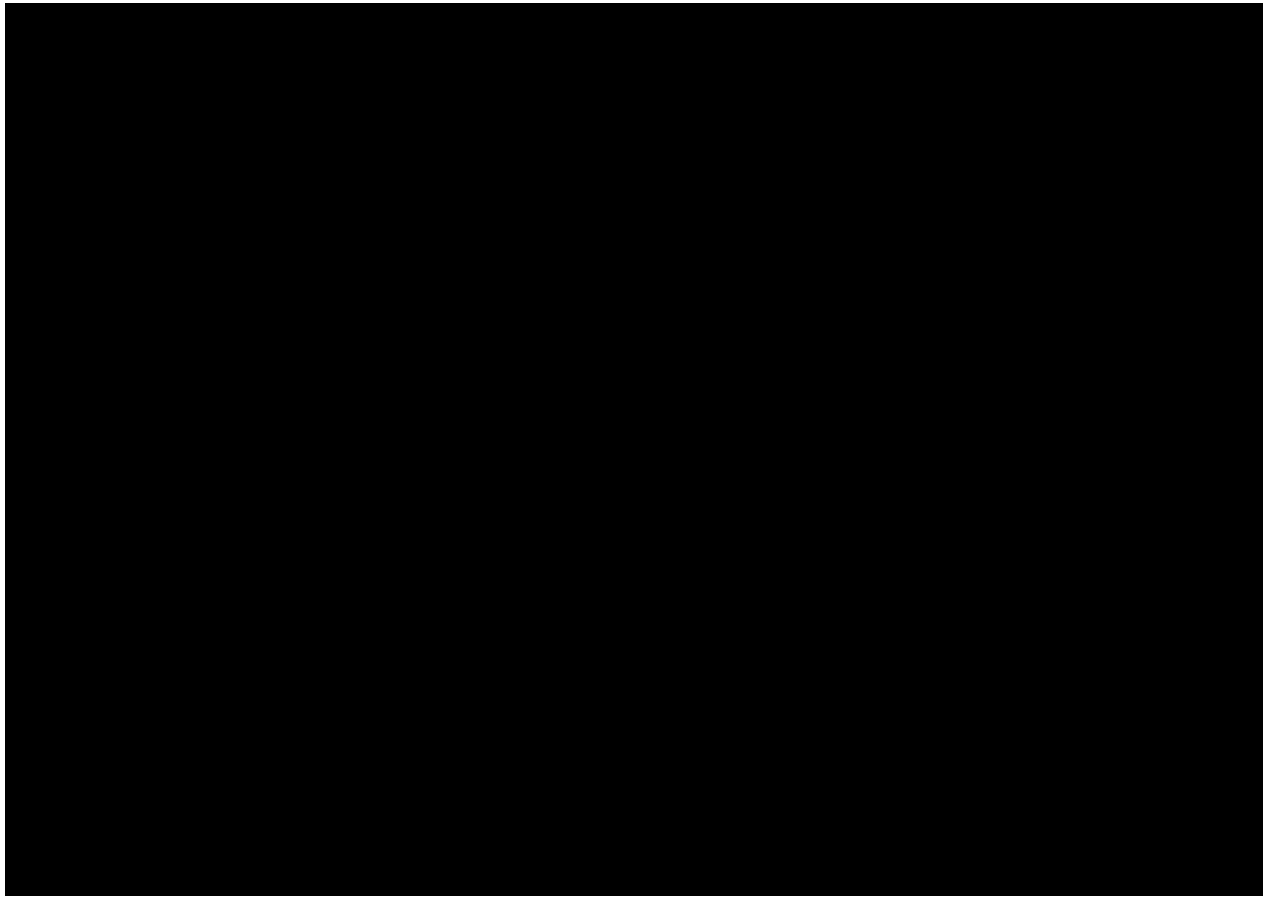
• ENGLISH/SPANISH • KITS • SIMULATIONS • PRINT/DIGITAL

Editable Slides/Presenter Views



3-D Challenge Multimedia Makerspace

- PE-Based filmmaking
- Student Voice
- 3-D learning of Science and Engineering domains
- Alternate Performance type to demonstrate understanding



Hands-On Labs with Pictorial Kit Lists



PART NUMBER: PI-5003-CON

 Wooden craft sticks, pack of 50 — 5 ☐	 Masking tape — 12 ☐	 Cardboard — 54 ☐	 Copper wire — 6 ☐
 Hex bolt, pack of 90 — 1 ☐	 D-cell battery — 27 ☐	 Sandpaper — 27 ☐	 Electrical tape — 9 ☐
Plastic bags with zippers, pack of 100 — 1 ☐	 Rubber bands (assorted pack) — 1 ☐	 Balloons, pack of 15 — 1 ☐	 Tissue paper, pack of 35 — 1 ☐

Lesson	1										2						3						
SESSION NUMBER	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	1	2	3	4	5	6	7
Wooden craft sticks	✓	✓																					
Masking tape	✓	✓																					
Cardboard		✓																					
Copper wire							✓			✓													
Hex bolts							✓																
D-cell batteries							✓			✓													
Sandpaper							✓			✓													
Electrical tape										✓													
Plastic bags with zippers											✓												
Rubber bands																			✓				
Balloons																				✓			
Tissue paper																				✓			

• MODULAR • LESSON ORGANIZATION • CLASSROOM MANAGEMENT



Multimodal Lessons for Generation Z 3-Dimensional Success

MIDDLE SCHOOL TWIG SCIENCE

Investigational Approach:
Engaging 3D STEM Experiences



Hands-On Labs

- Learn through inquiry-based investigations
- Experience a range of STEAM roles
- Develop higher-order thinking skills
- Apply SEPs, CCCs, and DCIs
- Solve problems and design solutions



Digital Interactives

- Engaging digital Interactives
- Real-world phenomena and authentic data
- Gamification with rewards
- Challenges to test and reinforce learning
- Stunning visuals



Virtual Field Trips

- Engaging digital Interactives
- Real-world phenomena and authentic data
- Gamification with rewards
- Challenges to test and reinforce learning
- Stunning visuals



Scientific Text Investigations

- Experience a variety of scientific text types: informations, narrative descriptive, and argumentative
- Use Claim-Evidence-Reasoning to improve writing skills
- Develop observational skills
- Use graphic organizers, infographics, and data sets



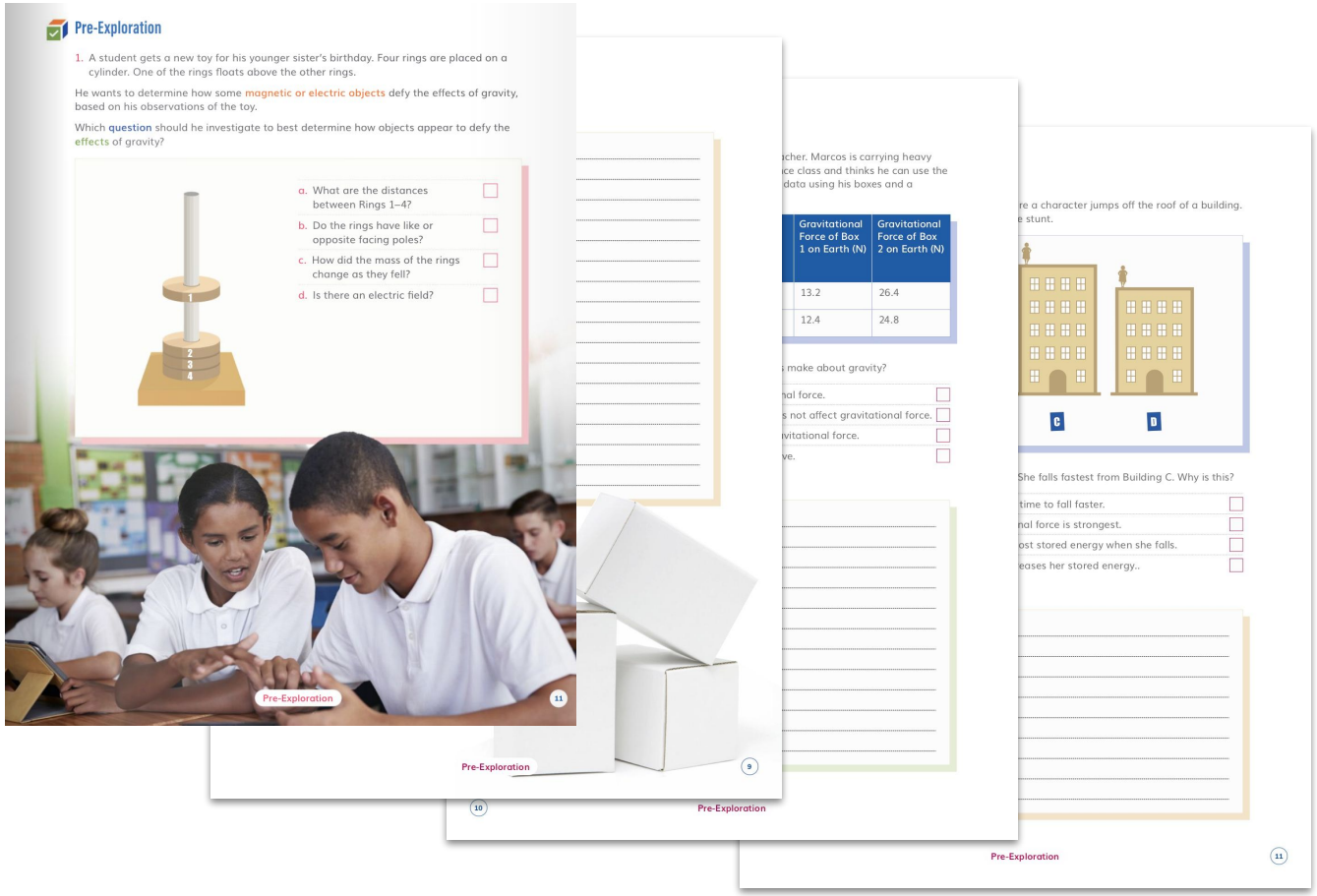
Video Investigations

- Experience high-quality, engaging video content
- Access high-impact phenomena
- Identify prior knowledge and misconceptions
- Develop vocabulary through audio cues
- Improve higher-order thinking

Virtual Field Trips of Phenomena Exploration



Twig Journal: Pre-Exploration Diagnostic



- Depth of Knowledge
- Identifies Preconceptions & Misconceptions

Standards Progressions



Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How can we make something defy gravity? (MS-PS2-5)*		
3-PS2-3 Motion and Stability: Forces and Interactions Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other **SEP-3** Planning and Carrying Out Investigations Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change **PS2.B** Types of Interactions Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other	**MS-PS2-5** Motion and Stability: Forces and Interactions Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact **SEP-3** Planning and Carrying Out Investigations Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation **CCC-2** Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems **PS2.B** Types of Interactions Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively)	**HS-PS2-5** Motion and Stability: Forces and Interactions Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current **SEP-3** Planning and Carrying Out Investigations Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible variables or effects and evaluate the confounding investigation's design to ensure variables are controlled **CCC-2** Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system **PS2.B.2** Types of Interactions Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields



Module Standards

Standards indicated in **bold** build to the module Performance Expectations.

	Standards		LESSON 1	2	3
SEP	**SEP-1**	**Asking Questions and Defining Problems**	✓	✓	
	SEP-2	**Developing and Using Models**	✓	✓	✓
	SEP-3	**Planning and Carrying Out Investigations**	✓	✓	
	SEP-4	Analyzing and Interpreting Data	✓		
	SEP-5	Using Mathematics and Computational Thinking		✓	✓
	SEP-6	Constructing Explanations and Designing Solutions	✓		
	SEP-7	**Engaging in Argument from Evidence**		✓	
	SEP-8	Obtaining, Evaluating, and Communicating Information	✓		
CNS	**CNS-2**	**Scientific Knowledge is Based on Empirical Evidence**		✓	
DCI	**PS2.B**	**Types of Interactions**	✓	✓	
	PS3.A	**Definitions of Energy**			✓
	PS3.C	**Relationship Between Energy and Forces**			✓
CCC	CCC-1	Patterns	✓	✓	
	CCC-2	**Cause and Effect**	✓	✓	
	CCC-4	**Systems and System Models**		✓	✓
	CCC-7	Stability and Change	✓		

	Standards		LESSON 1	2	3
Math	MP1	Make sense of problems and persevere in solving them	✓	✓	✓
	MP2	Reason abstractly and quantitatively	✓	✓	✓
	MP3	Construct viable arguments and critique the reasoning of others	✓	✓	
	MP4	Model with mathematics	✓		✓
	MP5	Use appropriate tools strategically	✓		
	MP6	Attend to precision	✓	✓	✓
	MP7	Look for and make use of structure	✓		
	MP8	Look for and express regularity in repeated reasoning	✓		
	6.EE.A	Apply and extend previous understandings of arithmetic to algebraic expressions		✓	
	6.EE.C	Represent and analyze quantitative relationships between dependent and independent variables		✓	✓
	7.EE.A	Use properties of operations to generate equivalent expressions		✓	
	7.EE.B	Solve real-life and mathematical problems using numerical and algebraic expressions and equations			✓
	8.EE.A	Expressions and equations work with radicals and integer exponents.		✓	
	8.F.B	Use functions to model relationships between quantities.		✓	✓
	8.SP.A	Investigate patterns of association in bivariate data.	✓		

Twig 5E Sessions

Sessions end with “Evaluate” to leverage student prior knowledge and experience related to the phenomena and problems using 3-Dimensional Learning. Please compare!

Engage

Explore/Explain

Elaborate

Evaluate



LESSON 1

Driving Question

How can we make something defy the effects of gravity?

In this lesson, students are introduced to the module and use storyboards to think about the forces in movie scenes. Students learn that they will design a hoverboard for Weave Studios, a movie production company, and begin by developing a model. They investigate ways to strengthen magnetic repulsion, then model magnetic fields and their interactions. They investigate the effect of different variables on the strength of an electromagnet using a digital interactive and apply their ideas in a hands-on investigation. Students present their hoverboard design arguments supported by data from their investigations. Then, they consider mass and magnetic strength as they design electromagnetic boots. Finally, they develop a storyboard model for a helicopter stunt to show their understanding of mass and magnetic strength.

Performance Expectations

MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electric and magnetic forces

MS-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact

Vocabulary

- electrical current
- electromagnet
- force
- levitation
- magnet
- magnetic attraction
- magnetic field
- magnetic force
- magnetic pole
- magnetic repulsion
- magnetic strength
- magnetism
- permanent magnet
- voltage

5E Instructional Flow

Engage	**Session 1** Cinematic Forces Pre-Assessment	p.14 p.17	50 min	Students activate thinking and ask questions about non-contact forces, and brainstorm possible forces occurring in the Anchor Phenomenon. Students complete a Pre-Assessment for the module.
Explore/ Explain	**Session 2** Hovering Pencil	p.19	50 min	Students explore magnets and design a model to make something hover. They discover and draw three-dimensional magnetic fields, and use cause and effect to determine how to make magnetic fields stronger.
	Session 3 Measuring Magnetic Strength	p.23	50 min	
	Session 4 Magnetic Field Lines	p.27	50 min	
	Session 5 Building Better Hoverboards	p.31	50 min	Students are introduced to electromagnets by reading a scientific text on the forces required to create a working hoverboard. They extend their understanding of electromagnets by manipulating variables in digital and hands-on investigations.
	Session 6 Helicopter Stunt	p.34	50 min	
	Session 7 Building Better Electromagnets	p.39	50 min	
	Session 8 Visualizing Data	p.43	50 min	Students analyze their collected data and use graphs to explain cause and effect and how to strengthen the electromagnet. They develop investigative questions that demonstrate their observations
Elaborate	**Session 9** Boots Made for Walking	p.47	50 min	Students apply their understanding of electromagnets to design a technology to walk up walls.
Evaluate	**Session 10** Helicopter Stunt Designs	p.51	50 min	Students are evaluated with a summative performance task and they answer the Driving Question.

Built-in Special Needs and ELL Accommodations

Special Needs

Fine Motor Skills

Pair students with a peer who can carry out the hands-on activity and encourage them to take on an instructional role while the materials are being manipulated. Students can either share or lead in recording data and observations.

Below-Level Learners

For students who struggle with the hovering pencil activity, provide some prompt questions.

- ***How do the magnets need to interact to get the pencil to hover?***
- ***Can the pencil hover without magnets attached to it?***
- ***What happens if the magnets opposite the pencil are moving?***

If needed, provide students with a copy of the **Hovering Pencil Instructions**.

Above-Level Learners

Challenge students to modify their design in two ways:

1. How high can you make the pencil levitate?
2. How much weight can the pencil hold while levitating?

Distribute the **Hoverboard Challenge handout** for students to complete as they work.

Productive Discussion Language Routine

Find detailed instruction for this language routine, including talk moves, online.

Co-Craft Questions Language Routine

Find detailed instruction for this language routine online.

Special Needs

Visual-Spatial Processing

Allow students to use paper or a book to screen out competing visual information in the storyboards. Encourage them to analyze the storyboards one scene at a time in order to answer the prompt questions.

Above-Level Learners

Have students compare and contrast how gravity is being defied in the three storyboard scenes and make a recommendation for how to improve the overall effect (e.g., change set up, adjust perspective).

English Learners

Ensure students fully understand the type of responses required by eliciting example responses from the class. Write these examples on the board.

Guide students with specific areas to focus on, e.g., the cause-and-effect relationship between forces and objects and the consequent success of the storyboard effect. Where necessary, provide question stems or fragmented questions for students to expand on.

Below-Level Learners

Support students by playing the **Force Glossary video** before discussing forces as a class.

English Learners

To support students in understanding the trailer video and the Twig Journal storyboards, highlight these cognates:

- *acción (action)*
- *efectos especiales (special effects)*
- *gravedad (gravity)*
- *escena (scene)*
- *escenario (scenario)*

Help ELs identify and pronounce words with similar units of sound as in *scenario* and *escenario* and focus on syllable stress in the English equivalents. Teach unfamiliar vocabulary and provide a word wall ELs can build on throughout the lesson. Model using cognates in sentences before students are expected to do the same.

Emerging Proficiency

Provide sentence prompts with cloze and/or frame sentences to support ELs in practicing the use of cognates in a relevant context, for example:

- The _____ in the _____ shows _____.

Expanding Proficiency

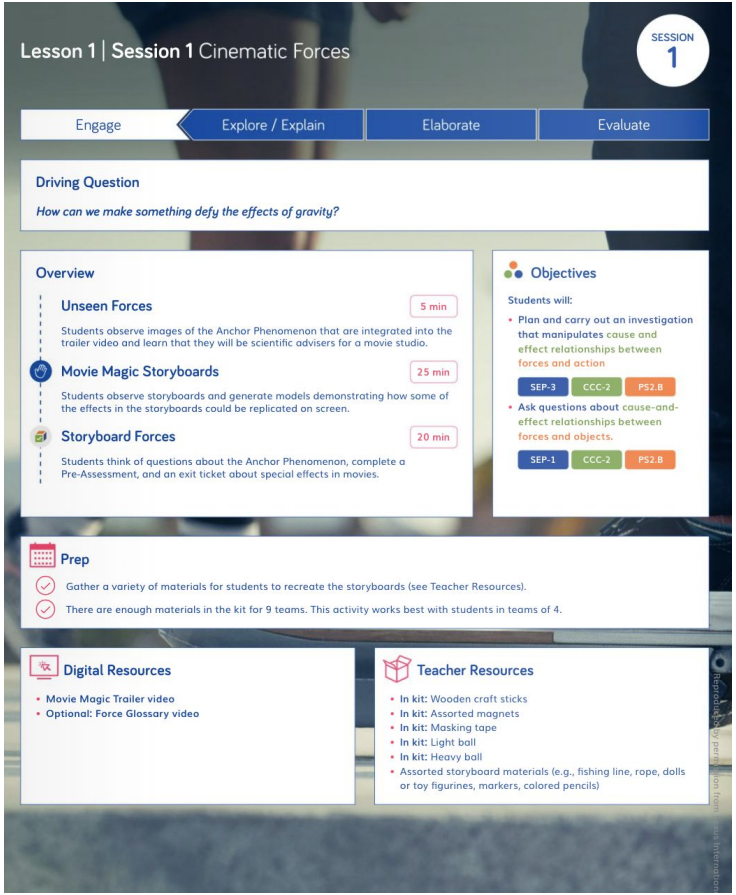
Assist ELs in using the word wall and cognates to help them respond to the question prompts.

- In the scene, _____ are needed to make the _____ look natural.

Bridging Proficiency

Invite students to work with proficient English speakers and encourage them to use all of the cognates in their responses.

3D Session Structure



- Lesson Anchor Phenomenon
- Session Investigative Phenomena
- 3-D Learning Objectives
- Lesson Prep
- Digital Resources
- Kit Resources

a Great Balance of Hands-on Labs!

SESSION 2

HOVERING PENCIL



INVESTIGATIVE PHENOMENON

Magnets exert force on other magnets. Can we use magnets to create a model hoverboard?

VIDEOS



Riding on Air video

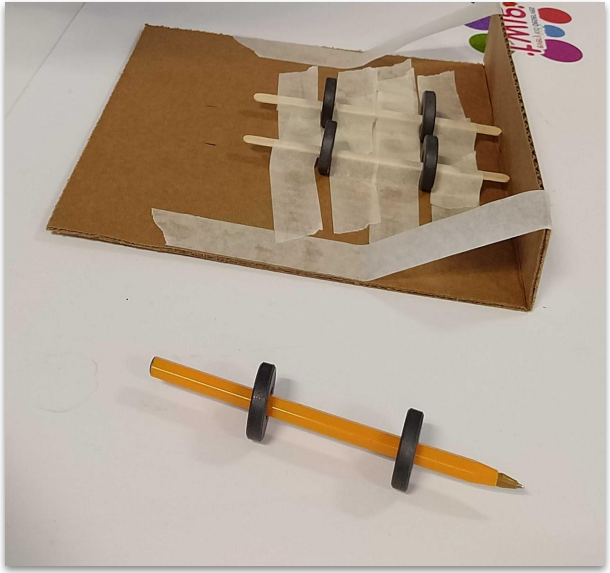
HOVERBOARD CHALLENGE

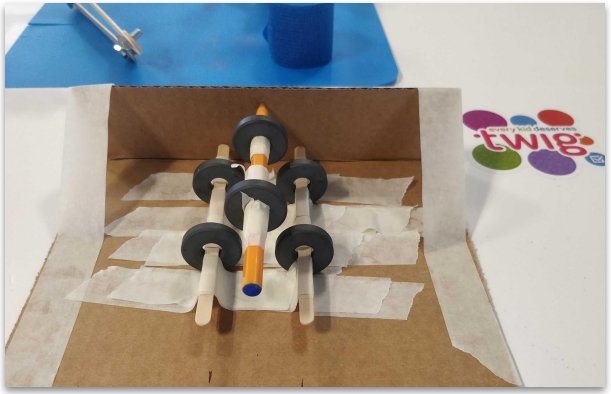
Carry Out Investigations • Investigate the materials.

Materials

- Piece of cardboard
- 6 ceramic ring magnets
- 4 wooden craft sticks
- Masking tape
- Ruler
- Pencil

Use different combinations of the materials to make different interactions. Record the outcomes of the interactions you observe. Consider how these interactions might help you make a working hoverboard.





Twig Journal: Informational Text Investigations



Session 5 Building Better Hoverboards

HOVERBOARDS: FLYING INTO THE FUTURE

Science fiction has long inspired real-world scientists to wonder: Could that actually work?

Marty McFly in Back to the Future II

Reproduced by permission from Universal Studios Licensing LLC

On the big screen, the protagonist jumps onto the board that's hovering over the sidewalk. In an instant, they're zooming down the road, soaring up over traffic jams, dodging every obstacle in their path. And each and every member of the audience is thinking the same thought: "I want one of those!" Well, the wait could soon be over—the era of the hoverboard may soon be upon us...

Floating fans

As it turns out, designing a hovering vehicle has been a work-in-progress for over a century. But it wasn't until the 1960s that a design was sufficiently refined for commercial travel. Known as the "hovercraft", it used fans and a flexible fabric skirt to glide over water. Fans pushed air beneath the vehicle to create air currents, and the skirt, found at the hovercraft's base, prevented the air currents from escaping. The pressurized air lifted the hovercraft up off the water.

The original hovercraft was large, clunky, and much more similar to a boat than a board. The ArcaBoard, however, looks a bit more like the futuristic hoverboards we've always pictured. Launched in 2015, the ArcaBoard doesn't use a fabric skirt to hoist itself into the air, but it does use 36 high-powered electric fans. It's a hefty, solid, cuboid creation that might not be the hovercraft of movie-goers' dreams, but it's definitely a step closer.



Jumping Jets

Other offshoots of the hovercraft are the Flyboard and the Flyboard Air. Created in 2012 by the French inventor Franky Zapata, each mechanism is equipped with jet engines to propel the user into the air. At first glance, the Flyboard and the Flyboard Air simply look like pairs of boots on top of pieces of metal. They are both relatively small devices, yet they feature powerful engines that allow the user to soar.

The Flyboard is attached to a personal watercraft (known as a PWC) with a long hose. A PWC is a small, often speedy water vessel that you might see in the chase scene of a spy movie. The speed and altitude of the Flyboard are typically controlled by an operator who rides in the PWC. The thrust, a force that pushes jet engines forward, is taken in by the Flyboard's hose, sucking up water in the process. This water is then pushed downward to create lift.

THE FLYBOARD'S SUPER-POWERFUL JET ENGINES MEAN AN EXPERIENCED RIDER CAN PERFORM SOME AWESOME TRICKS IN THE AIR.

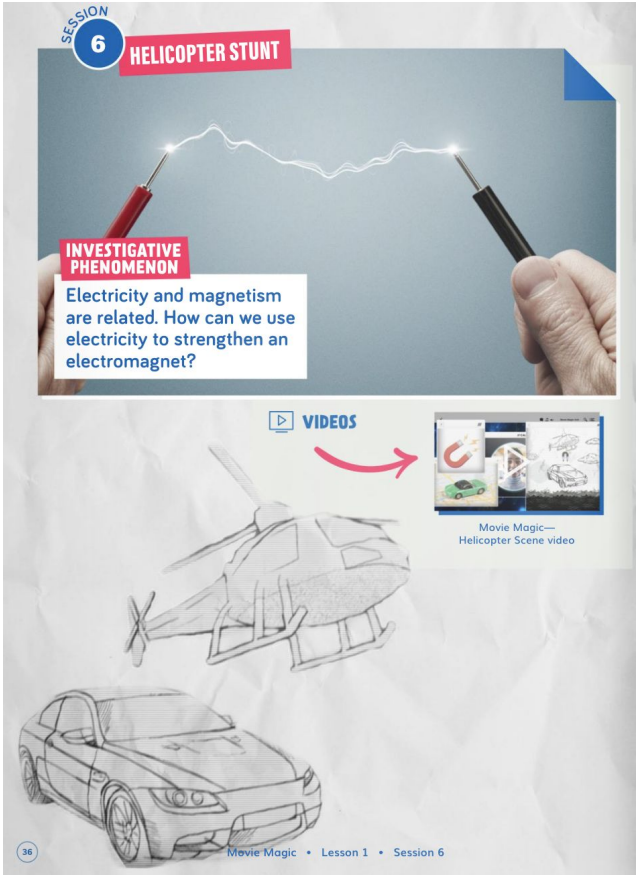
The Flyboard Air follows the same process, but it uses air instead of water. The Flyboard Air user is also strapped into a pair of boots, but they're not attached to a PWC. Instead, the user wears a backpack filled with jet fuel and controls their movement with a remote. Four tiny turbo jet engines take in huge volumes of air, heating and compressing it before forcing it through spinning blades. As it's pushed back through the engine, the air turns into super-hot streams, allowing the user to fly.

In August of 2019, Zapata successfully traveled from France to England on the Flyboard Air—a distance of 35 km (21.7 mi.) across The English Channel. His greatest challenge was refueling halfway, which involved landing on a boat. A previous attempt to do this had led to him falling into the sea, but this time, the boat had a larger landing platform. Oh, we should mention that this incredible achievement is probably not something most of us could do, since Zapata is not only an inventor—he is also a professional skier!



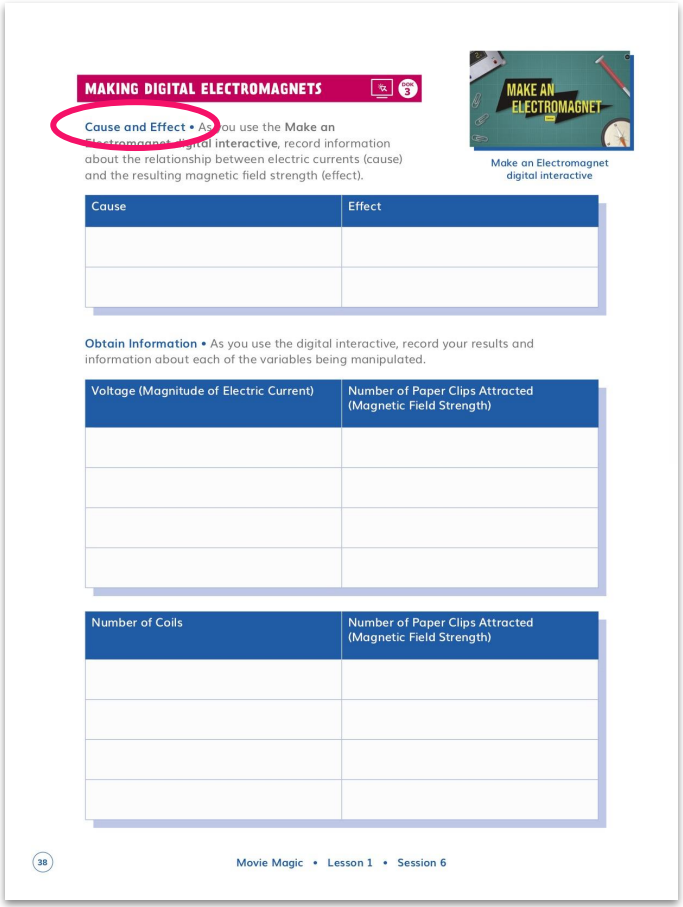
- Variety of NonFiction Texts
- Infographics & Visuals
- Collect Evidence and Reasoning
- Article Glossaries

Twig Journal: Video Investigations



- High quality multimedia
- Use with multiple sources and modalities
- Engaging and relevant
- Extend learning

Twig Journal: Digital Labs



MAKING DIGITAL ELECTROMAGNETS

Make an Electromagnet digital interactive

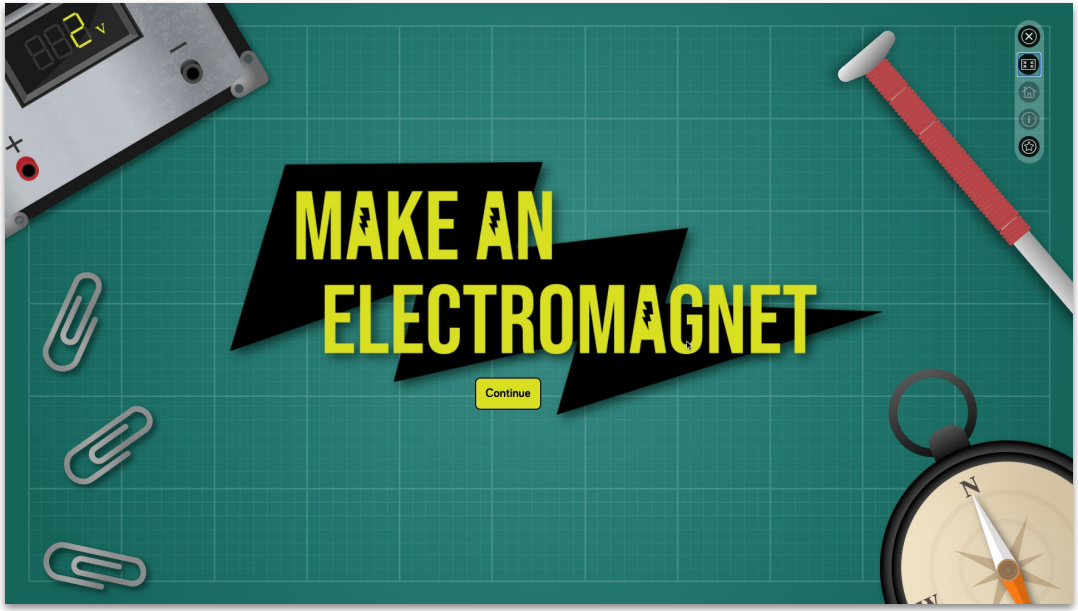
Cause and Effect • As you use the **Make an Electromagnet digital interactive**, record information about the relationship between electric currents (cause) and the resulting magnetic field strength (effect).

Cause	Effect

Obtain Information • As you use the digital interactive, record your results and information about each of the variables being manipulated.

Voltage (Magnitude of Electric Current)	Number of Paper Clips Attracted (Magnetic Field Strength)

Number of Coils	Number of Paper Clips Attracted (Magnetic Field Strength)



Interactive

Use instructional shifts to reflect in Twig Journal

Manipulate variables

Build models

Twig Science 3-D Assessment & Performances

Diagnostic Pre-Assessment

SESSION 1 CINEMATIC FORCES

VIDEOS



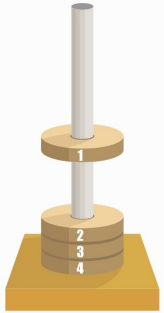
Movie Magic Trailer video

Pre-Exploration

1. A student gets a new toy for his younger sister's birthday. Four rings are placed on a cylinder. One of the rings floats above the other rings.

He wants to determine how some magnetic or electric objects defy gravity based on his observations of the toy.

Which question should he investigate to best determine how objects appear to defy gravity?



a. What are the distances between Rings 1–4? ☐
b. Do the rings have like or opposite facing poles? ☐
c. How did the mass of the rings change as they fell? ☐
d. Is there an electric field? ☐

8 Pre-Exploration

Formative Assessment

STRONGER ELECTROMAGNETS

Collect Evidence • Carry out two tests and record your findings.

Test 1

Variable	Magnetic Strength	Magnetic Field	Analysis

Summative Performance Tasks

Construct an argument using evidence about how your prop demonstrates the **gravitational interaction** between **objects** and **Mars**.



Summative Assessment 83

Summative Benchmark Assessments

SESSION 10 HELICOPTER STUNT DESIGNS

HELICOPTER STUNT STORYBOARDS

3-D Assessment • Make a storyboard to show the **interaction between** an **electromagnet** on a helicopter and the stunt car. On your diagram, show **evidence of forces acting between objects that are not in contact**. Sketch your ideas below, then use the materials to create the storyboard for Weave Studios.

Summative Assessment 51

Teacher Click & Tour

Click: Explore Integrated Specific Components and Design

Click: Explore Discipline Specific Components and Design

Click: Twig Science Next Gen “Log-in” & “Launch Platform”

District ID:

Teacher Username: Passcode:

CONTACT LOCAL REP FOR TRIALS



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