Inspire the Science Leaders of Tomorrow by Building Science Foundations for Students Today

- ✓ All-Inclusive Phenomena-Based Science
- ✓ Three-Dimensional Learning Designed for the California NGSS
- ✓ Powerful Support for California's K–5 Teachers and Students

CAROLINA®
www.carolina.com

All-Inclusive Science—In More Ways Than One!

All-Inclusive Kits at All-Inclusive Prices

Unit Kits include:

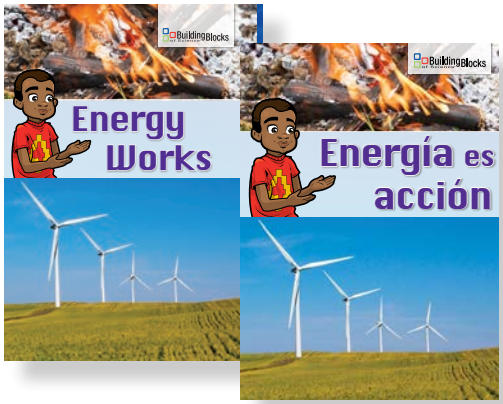
- Teacher's Guide (print and digital)
- Student Literacy Readers
- Lab equipment for investigations
- A robust library of digital resources

No yearly licensing fees!

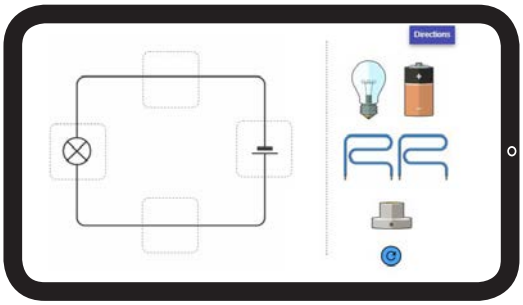
All-Inclusive Instruction—Three Ways to Learn

Active, hands-on investigations anchored in phenomena for all students

- Over **300 hands-on investigations** in which students **model, investigate, and explain phenomena**—in 30-minute lessons



- Student Literacy Readers
  - On Grade Level
  - Below Grade Level
  - Spanish

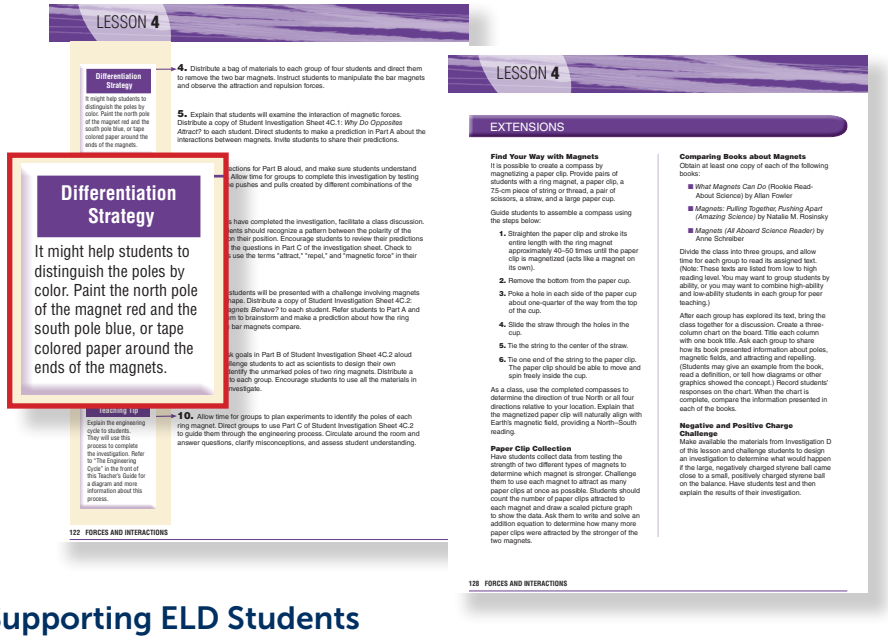


- Digital Resources—reinforce learning from active investigations and **promote discourse** for ALL students

All-Inclusive Student Support—All Students, All Learners

Differentiation

- **Remediation strategies** to support and motivate underperforming students
- **Enrichment strategies** for students ready for a challenge.
- Digital resources build and apply understanding using simulations, interactive readers, interactive whiteboard activities, and **Tell Me More formative assessment** for today's learners


LESSON 4

Differentiation Strategy

It might help students to distinguish the poles by color. Paint the north pole of the magnet red and the south pole blue, or tape colored paper around the ends of the magnets.

4. Distribute a bag of materials to each group of four students and direct them to remove the two bar magnets. Instruct students to manipulate the bar magnets and observe the attraction and repulsion forces.

5. Explain that students will examine the interaction of magnetic forces. Distribute a copy of Student Investigation Sheet 4C.1: *Why Do Opposites Attract?* to each student. Direct students to make a prediction in Part A about the interactions between magnets. Invite students to share their predictions.

Teaching Tip

Explain the engineering cycle to students. They will use this process to complete the investigation. Refer to "The Engineering Cycle" in the front of this Teacher's Guide for a diagram and more information about this process.

10. Allow time for groups to plan experiments to identify the poles of each ring magnet. Direct groups to use Part C of Student Investigation Sheet 4C.2 to guide them through the engineering process. Circulate around the room and answer questions, clarify misconceptions, and assess student understanding.

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LESSON 4

EXTENSIONS

Find Your Way with Magnets
It is possible to create a compass by magnetizing a paper clip. Provide pairs of students with a ring magnet, a paper clip, a 75-cm piece of string or thread, a pair of scissors, a straw, and a large paper cup.

Guide students to assemble a compass using the steps below:

1. Straighten the paper clip and stroke its entire length with the ring magnet approximately 40–50 times until the paper clip is magnetized (acts like a magnet on its own).
2. Remove the bottom from the paper cup.
3. Poke a hole in each side of the paper cup about one-quarter of the way from the top of the cup.
4. Slide the straw through the holes in the cup.
5. Tie the string to the center of the straw.
6. Tie one end of the string to the paper clip. The paper clip should be able to move and spin freely inside the cup.

As a class, use the completed compasses to determine the direction of true North or all four directions relative to your location. Explain that the magnetized paper clip will naturally align with Earth's magnetic field, providing a North–South reading.

Paper Clip Collection
Have students collect data from testing the strength of two different types of magnets to determine which magnet is stronger. Challenge them to use each magnet to attract as many paper clips at once as possible. Students should count the number of paper clips attracted to each magnet and draw a scaled picture graph to show the data. Ask them to write and solve an addition equation to determine how many more paper clips were attracted by the stronger of the two magnets.

Comparing Books about Magnets
Obtain at least one copy of each of the following books:

- *What Magnets Can Do* (Rookie Read-About Science) by Allan Fowler
- *Magnets: Pulling Together, Pushing Apart (Amazing Science)* by Natalie M. Rosinsky
- *Magnets (All Aboard Science Reader)* by Anne Schreiber

Divide the class into three groups, and allow time for each group to read its assigned text. (*Note:* These texts are listed from low to high reading level. You may want to group students by ability, or you may want to combine high-ability and low-ability students in each group for peer teaching.)

After each group has explored its text, bring the class together for a discussion. Create a three-column chart on the board. Title each column with one book title. Ask each group to share how its book presented information about poles, magnetic fields, and attracting and repelling. (Students may give an example from the book, read a definition, or tell how diagrams or other graphics showed the concept.) Record students' responses on the chart. When the chart is complete, compare the information presented in each of the books.

Negative and Positive Charge Challenge
Make available the materials from Investigation D of this lesson and challenge students to design an investigation to determine what would happen if the large, negatively charged styrene ball came close to a small, positively charged styrene ball on the balance. Have students test and then explain the results of their investigation.

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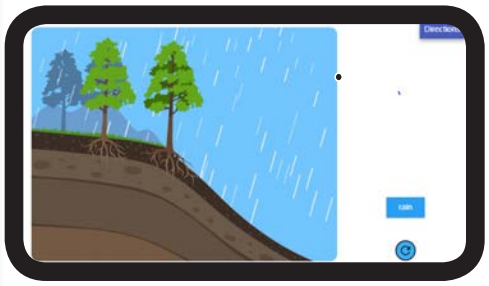
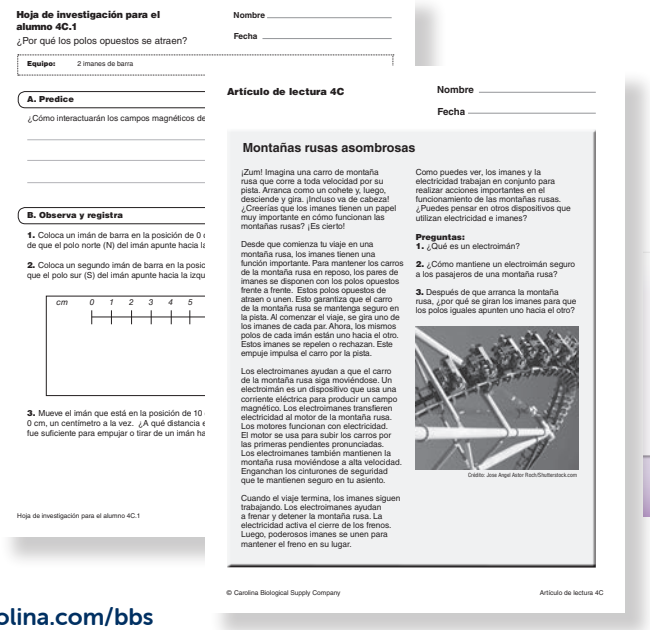


Supporting ELD Students

- Active investigation provides **all students** with equal, hands-on opportunities to investigate phenomena
- Proven, **integrated strategies and leveled readers** support ELD and ELL students
- **Spanish student resources** connect science concepts to support science vocabulary


Hoja de investigación para el alumno 4C.1

¿Por qué los polos opuestos se atraen?

Nombre _____

Fecha _____

Equipo: 2 imanes de barra

A. Predice

¿Cómo interactuarán los campos magnéticos de

B. Observa y registra

1. Coloca un imán de barra en la posición de 0 c de que el polo norte (N) del imán apunte hacia l

2. Coloca un segundo imán de barra en la posic que el polo sur (S) del imán apunte hacia la izqu

cm 0 1 2 3 4 5

3. Mueve el imán que está en la posición de 10 0 cm, un centímetro a la vez. ¿A qué distancia e fue suficiente para empujar o tirar de un imán ha

Hoja de investigación para el alumno 4C.1

Artículo de lectura 4C

Nombre _____

Fecha _____

Montañas rusas asombrosas

¡Zum! Imagina una carro de montaña rusa que corre a toda velocidad por su pista. Arranca como un cohete y, luego, desciende y gira. ¡Incluso va de cabeza! ¿Creerías que los imanes tienen un papel muy importante en cómo funcionan las montañas rusas? ¡Es cierto!

Desde que comienza tu viaje en una montaña rusa, los imanes tienen una función importante. Para mantener los carros de la montaña rusa en reposo, los pares de imanes se disponen con los polos opuestos frente a frente. Estos polos opuestos de atraen o unen. Esto garantiza que el carro de la montaña rusa se mantenga seguro en la pista. Al comenzar el viaje, se gira uno de los imanes de cada par. Ahora, los mismos polos de cada imán están uno hacia el otro. Estos imanes se repelen o rechazan. Este empuje impulsa el carro por la pista.

Los electroimanes ayudan a que el carro de la montaña rusa siga moviéndose. Un electroimán es un dispositivo que usa una corriente eléctrica para producir un campo magnético. Los electroimanes transfieren electricidad al motor de la montaña rusa. Los motores funcionan con electricidad. El motor se usa para subir los carros por las primeras pendientes pronunciadas. Los electroimanes también mantienen la montaña rusa moviéndose a alta velocidad. Enganchan los cinturones de seguridad que te mantienen seguro en tu asiento.

Cuando el viaje termina, los imanes siguen trabajando. Los electroimanes ayudan a frenar y detener la montaña rusa. La electricidad activa el cierre de los frenos. Luego, poderosos imanes se unen para mantener el freno en su lugar.

Como puedes ver, los imanes y la electricidad trabajan en conjunto para realizar acciones importantes en el funcionamiento de las montañas rusas. ¿Puedes pensar en otros dispositivos que utilizan electricidad e imanes?

Preguntas:

1. ¿Qué es un electroimán?

2. ¿Cómo mantiene un electroimán seguro a los pasajeros de una montaña rusa?

3. Después de que arranca la montaña rusa, ¿por qué se giran los imanes para que los polos iguales apunten uno hacia el otro?

Crédito: Jose Angel Astor Rach/Shutterstock.com

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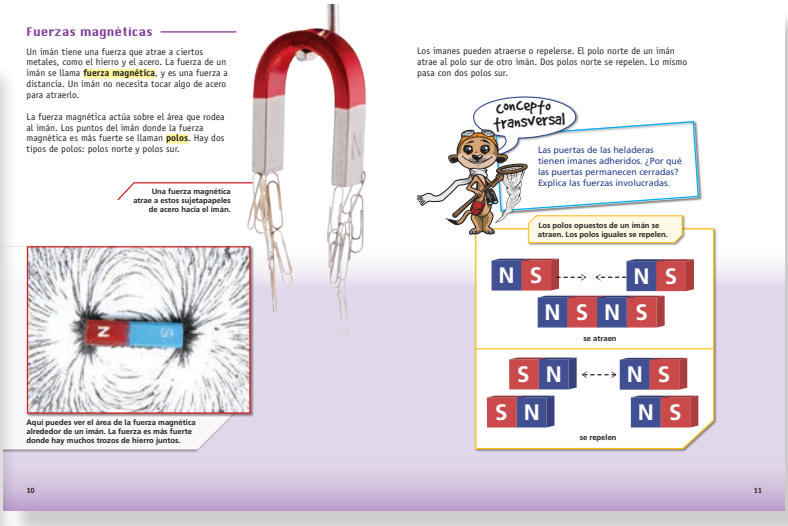
Artículo de lectura 4C


Fuerzas magnéticas

Un imán tiene una fuerza que atrae a ciertos metales, como el hierro y el acero. La fuerza de un imán se llama **fuerza magnética**, y es una fuerza a distancia. Un imán no necesita tocar algo de acero para atraerlo.

La fuerza magnética actúa sobre el área que rodea al imán. Los puntos del imán donde la fuerza magnética es más fuerte se llaman **polos**. Hay dos tipos de polos: polos norte y polos sur.

Una fuerza magnética atrae a estos sujetapapeles de acero hacia el imán.

Aquí puedes ver el área de la fuerza magnética alrededor de un imán. La fuerza es más fuerte donde hay muchos trozos de hierro juntos.

10

Los imanes pueden atraerse o repelerse. El polo norte de un imán atrae al polo sur de otro imán. Dos polos norte se repelen. Lo mismo pasa con dos polos sur.

Concepto transversal

Las puertas de las heladeras tienen imanes adheridos. ¿Por qué las puertas permanecen cerradas? Explica las fuerzas involucradas.

Los polos opuestos de un imán se atraen. Los polos iguales se repelen.

N S N S

N S N S

se atraen

S N N S

S N N S

se repelen

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Three-Dimensional Learning Designed for the CA NGSS

The CA NGSS are clear: students need phenomena-based, three-dimensional learning experiences. Building Blocks of Science I 3D provides the learning your students need and supports your instruction.

Building Blocks OF SCIENCE 3D

Evidence of Instructional Scaffolding

Scaffolding is a crucial yet natural element in all classrooms. Building Blocks of Science strives to simplify this instructional strategy by integrating this guided process into each unit, systematically building upon student knowledge, using hands-on learning to reinforce concepts, and employing student-driven inquiry. These strategies introduce new concepts and, with practice and review, lead students toward mastery. It is important to integrate scaffolding not only throughout the unit but also throughout each lesson. As students demonstrate understanding of a concept, they should be encouraged to take a leadership role in class or to attempt assignments independently. Additionally, scaffolding reveals opportunities for differentiation. Below-level learners require more reinforcement as they learn new skills, so the process toward mastery will need to be adjusted. Above-level learners do not need as much support and achieve mastery more quickly; therefore, these students can be assigned more independent study.

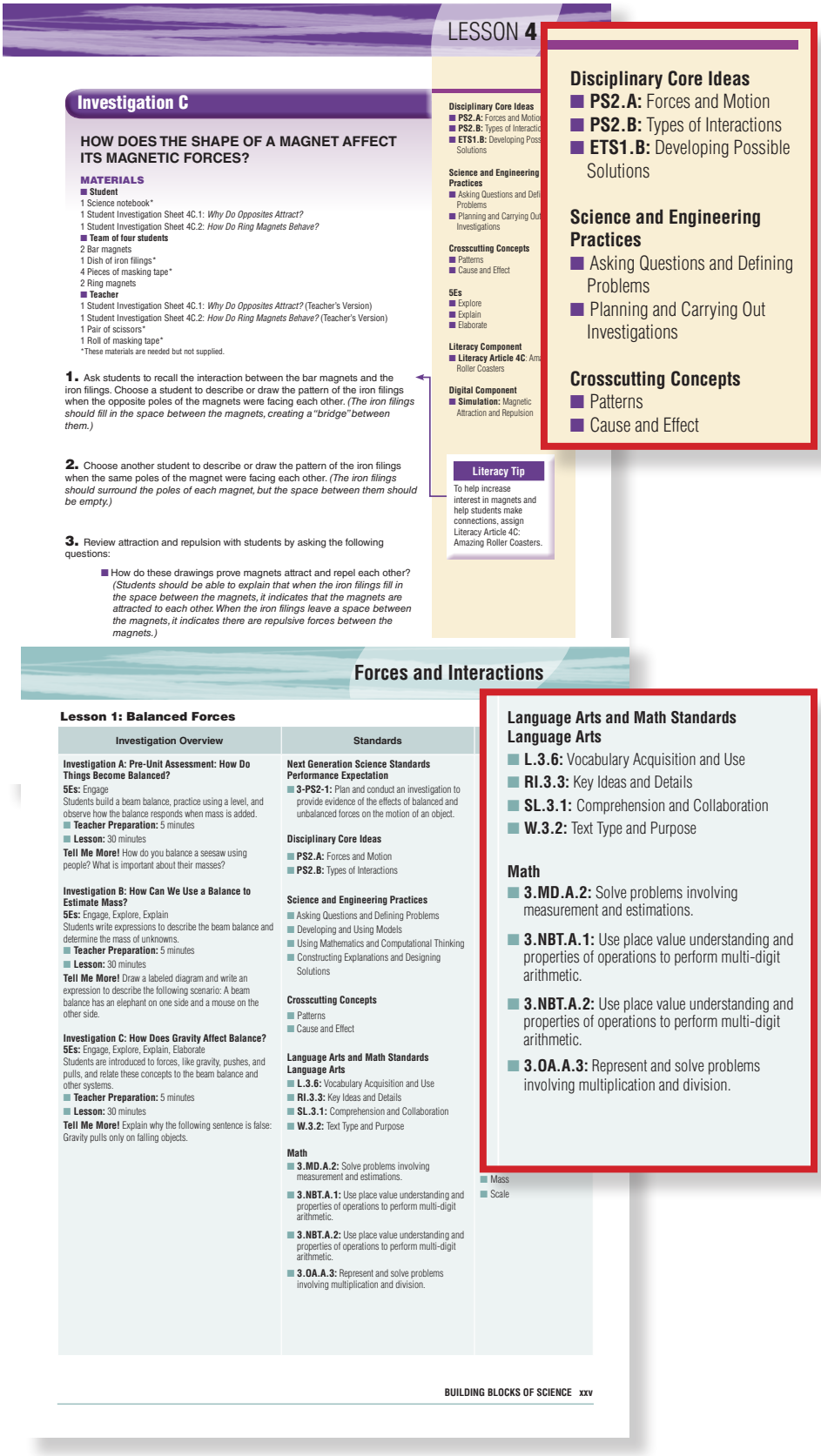
	Lesson 1 ▸	
OBJECTIVES	■ Use a beam balance model to investigate balanced forces. ■ Determine the relative mass of an object using a beam balance. ■ Define "force," and draw connections to the forces acting upon an object in motion and an object at rest. ■ Explain how the pull of gravity can result in balanced forces.	■ Use models to explain th ■ Explain how forces are r ■ Identify the cause-and-e ■ Predict how different tex
SCAFFOLDING	Students should know: ■ All objects experience forces, whether they are moving or still. ■ Gravity is a pulling force that all objects experience. ■ The forces acting on an object are balanced when the object is still. ■ The relative mass of an object can be determined using a beam balance. ■ Expressions can be used to describe the relative mass of an object.	Students should know: ■ Forces are unbalanced wh ■ Unbalanced forces result ■ Inertia is an object's resist ■ Objects at rest will stay at another force acts on then ■ The amount of force appli and the distance it travels ■ Friction is a force that cau ■ Friction is related to the te

Recommended by state review!

- Move from lesson to lesson following a **cohesive learning progression** developed for the CA NGSS

Forces and Interactions

	Lesson 3 ▸	Lesson 4 ▸	Lesson 5
OBJECTIVES	■ Use a model to determine how the strength of a force affects an object's motion. ■ Use a model to determine how an object's mass affects its ability to overcome inertia. ■ Observe a magnetic force and investigate how its strength can be changed.	■ Make connections between magnetism and the material an object is made from. ■ Identify attractive and repulsive charges. ■ Recognize attractive magnetic forces as pulls and repulsive magnetic forces as pushes. ■ Plan an investigation to prove that magnetic fields can differ based on the shape of the magnet. ■ Use a model to demonstrate how electric forces behave similarly to magnetic forces.	■ Reinforce previous learning and draw connections between forces, including gravity, magnetism, and electricity. ■ Design an efficient model of magnetism. ■ Evaluate a model to identify patterns related to forces and their interactions. ■ Evaluate learning from throughout the unit about forces and interactions, and compare that knowledge to initial ideas from the beginning of the unit.
SCAFFOLDING	Students should know: ■ The strength of a force will affect the resulting motion of an object. ■ The speed at which an object travels and the distance that object moves are dependent on the strength of the force applied to the object. ■ A strong force is needed to change the motion of an object with a great mass. ■ An object's inertia is affected by its mass. ■ Magnetic force is a pulling force. ■ The strength of a magnetic force can be changed by adding more magnets to a system.	Students should know: ■ Not all metals are magnetic. ■ Iron is a type of metal that is magnetic. ■ Magnets can have pulling and pushing forces, which relate to the terms "attract" and "repel." ■ Magnets have poles. Like poles repel and different poles attract. ■ All magnets have a magnetic field, which is the space in which magnetic objects can be attracted. ■ Magnetic fields vary based on the shape of the magnet. ■ Electric forces act similarly to magnetic forces and have poles, which are referred to as "charges." ■ Some materials can build a strong electric charge when they are rubbed.	Students should know: ■ A force can be a push or a pull. Gravity, friction, magnetism, and electric charges are different types of forces. ■ Forces can be balanced or unbalanced and have different strengths. ■ An object's inertia is dependent on its mass and on the strength of the applied force. ■ Applied forces can make an object change speed or direction. Without an applied force, objects at rest stay at rest and objects in motion stay in motion.



LESSON 4

Investigation C

HOW DOES THE SHAPE OF A MAGNET AFFECT ITS MAGNETIC FORCES?

MATERIALS

■ Student
1 Science notebook*
1 Student Investigation Sheet 4C.1: *Why Do Opposites Attract?*
1 Student Investigation Sheet 4C.2: *How Do Ring Magnets Behave?*
■ Team of four students
2 Bar magnets
1 Dish of iron filings*
4 Pieces of masking tape*
2 Ring magnets
■ Teacher
1 Student Investigation Sheet 4C.1: *Why Do Opposites Attract?* (Teacher's Version)
1 Student Investigation Sheet 4C.2: *How Do Ring Magnets Behave?* (Teacher's Version)
1 Pair of scissors*
1 Roll of masking tape*
*These materials are needed but not supplied.

1. Ask students to recall the interaction between the bar magnets and the iron filings. Choose a student to describe or draw the pattern of the iron filings when the opposite poles of the magnets were facing each other. *(The iron filings should fill in the space between the magnets, creating a "bridge" between them.)*

2. Choose another student to describe or draw the pattern of the iron filings when the same poles of the magnet were facing each other. *(The iron filings should surround the poles of each magnet, but the space between them should be empty.)*

3. Review attraction and repulsion with students by asking the following questions:

■ How do these drawings prove magnets attract and repel each other? *(Students should be able to explain that when the iron filings fill in the space between the magnets, it indicates that the magnets are attracted to each other. When the iron filings leave a space between the magnets, it indicates there are repulsive forces between the magnets.)*

Disciplinary Core Ideas
■ PS2.A: Forces and Motio
■ PS2.B: Types of Interactio
■ ETS1.B: Developing Poss Solutions

Science and Engineering Practices
■ Asking Questions and Defi Problems
■ Planning and Carrying Ou Investigations

Crosscutting Concepts
■ Patterns
■ Cause and Effect

5Es
■ Explore
■ Explain
■ Elaborate

Literacy Component
■ Literacy Article 4C: Am Roller Coasters

Digital Component
■ Simulation: Magnetic Attraction and Repulsion

Literacy Tip

To help increase interest in magnets and help students make connections, assign Literacy Article 4C: Amazing Roller Coasters.

Disciplinary Core Ideas
■ PS2.A: Forces and Motion
■ PS2.B: Types of Interactions
■ ETS1.B: Developing Possible Solutions

Science and Engineering Practices
■ Asking Questions and Defining Problems
■ Planning and Carrying Out Investigations

Crosscutting Concepts
■ Patterns
■ Cause and Effect

Forces and Interactions

Lesson 1: Balanced Forces

Investigation Overview	Standards
Investigation A: Pre-Unit Assessment: How Do Things Become Balanced? **5Es:** Engage Students build a beam balance, practice using a level, and observe how the balance responds when mass is added. ■ **Teacher Preparation:** 5 minutes ■ **Lesson:** 30 minutes **Tell Me More!** How do you balance a seesaw using people? What is important about their masses?	**Next Generation Science Standards Performance Expectation** ■ **3-PS2-1:** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. **Disciplinary Core Ideas** ■ **PS2.A:** Forces and Motion ■ **PS2.B:** Types of Interactions **Science and Engineering Practices** ■ Asking Questions and Defining Problems ■ Developing and Using Models ■ Using Mathematics and Computational Thinking ■ Constructing Explanations and Designing Solutions **Crosscutting Concepts** ■ Patterns ■ Cause and Effect **Language Arts and Math Standards** **Language Arts** ■ **L.3.6:** Vocabulary Acquisition and Use ■ **RI.3.3:** Key Ideas and Details ■ **SL.3.1:** Comprehension and Collaboration ■ **W.3.2:** Text Type and Purpose **Math** ■ **3.MD.A.2:** Solve problems involving measurement and estimations. ■ **3.NBT.A.1:** Use place value understanding and properties of operations to perform multi-digit arithmetic. ■ **3.NBT.A.2:** Use place value understanding and properties of operations to perform multi-digit arithmetic. ■ **3.OA.A.3:** Represent and solve problems involving multiplication and division.
Investigation B: How Can We Use a Balance to Estimate Mass? **5Es:** Engage, Explore, Explain Students write expressions to describe the beam balance and determine the mass of unknowns. ■ **Teacher Preparation:** 5 minutes ■ **Lesson:** 30 minutes **Tell Me More!** Draw a labeled diagram and write an expression to describe the following scenario: A beam balance has an elephant on one side and a mouse on the other side.	
Investigation C: How Does Gravity Affect Balance? **5Es:** Engage, Explore, Explain, Elaborate Students are introduced to forces, like gravity, pushes, and pulls, and relate these concepts to the beam balance and other systems. ■ **Teacher Preparation:** 5 minutes ■ **Lesson:** 30 minutes **Tell Me More!** Explain why the following sentence is false: Gravity pulls only on falling objects.	

■ Mass
■ Scale

BUILDING BLOCKS OF SCIENCE xxv

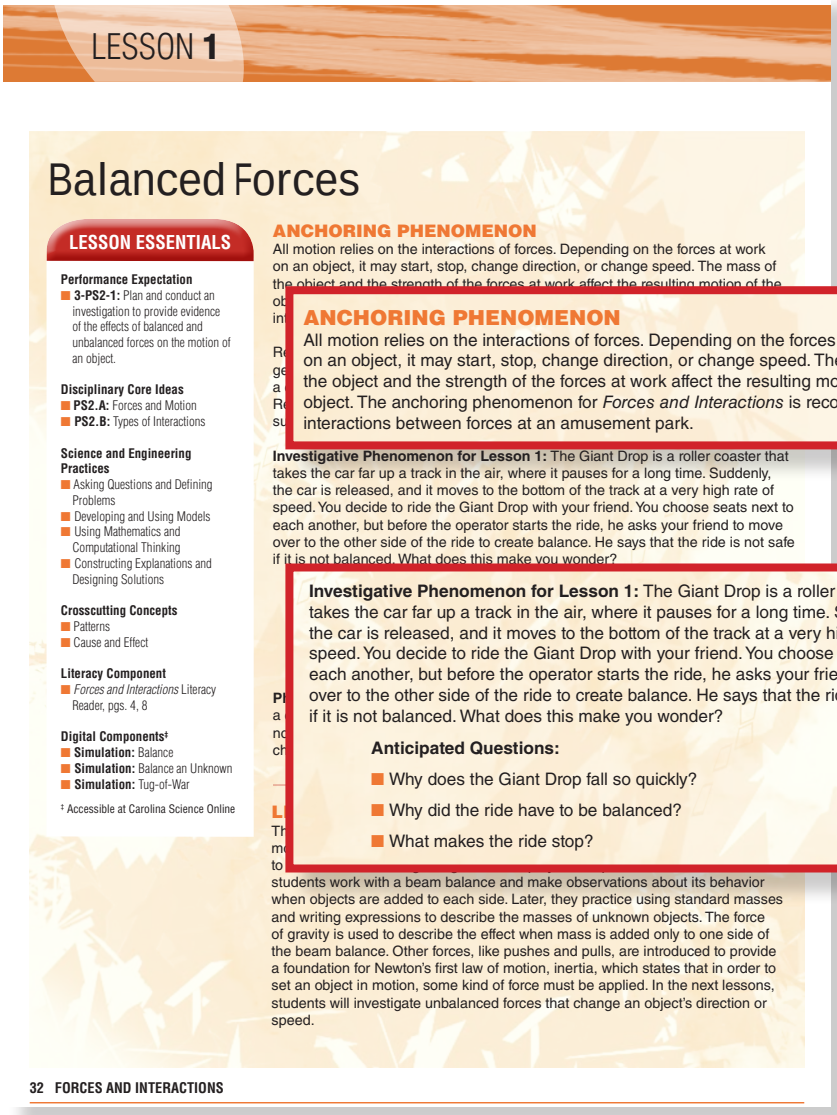
Language Arts and Math Standards
Language Arts
■ L.3.6: Vocabulary Acquisition and Use
■ RI.3.3: Key Ideas and Details
■ SL.3.1: Comprehension and Collaboration
■ W.3.2: Text Type and Purpose

Math
■ 3.MD.A.2: Solve problems involving measurement and estimations.
■ 3.NBT.A.1: Use place value understanding and properties of operations to perform multi-digit arithmetic.
■ 3.NBT.A.2: Use place value understanding and properties of operations to perform multi-digit arithmetic.
■ 3.OA.A.3: Represent and solve problems involving multiplication and division.

- Immerse students in a **three-dimensional experiential learning** that seamlessly integrates the DCIs, SEPs, and CCCs of the CA NGSS

- Integrate **English language arts and math** into investigations through student literacy and notebooking

Three-Dimensional Learning Designed for the CA NGSS



LESSON 1

Balanced Forces

LESSON ESSENTIALS

Performance Expectation
- **3-PS2-1:** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Disciplinary Core Ideas
- **PS2.A:** Forces and Motion
- **PS2.B:** Types of Interactions

Science and Engineering Practices
- Asking Questions and Defining Problems
- Developing and Using Models
- Using Mathematics and Computational Thinking
- Constructing Explanations and Designing Solutions

Crosscutting Concepts
- Patterns
- Cause and Effect

Literacy Component
- *Forces and Interactions* Literacy Reader, pgs. 4, 8

Digital Components‡
- **Simulation:** Balance
- **Simulation:** Balance an Unknown
- **Simulation:** Tug-of-War

‡ Accessible at Carolina Science Online

ANCHORING PHENOMENON

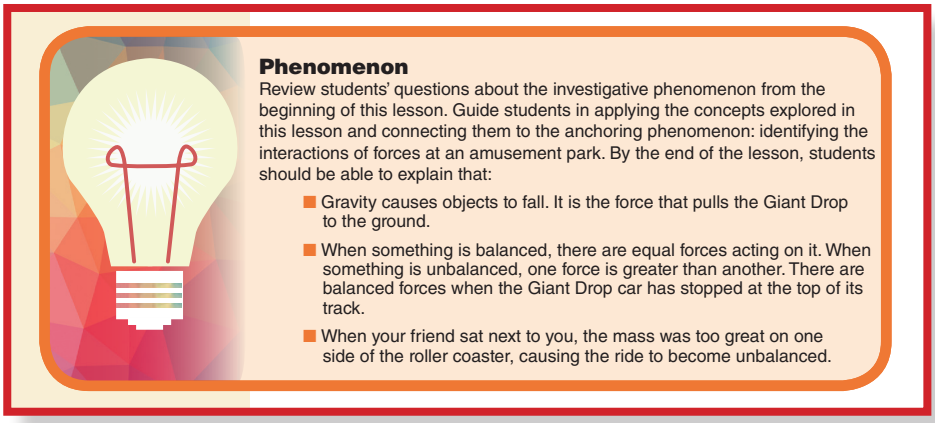
All motion relies on the interactions of forces. Depending on the forces at work on an object, it may start, stop, change direction, or change speed. The mass of the object and the strength of the forces at work affect the resulting motion of the object. The anchoring phenomenon for *Forces and Interactions* is recognizing the interactions between forces at an amusement park.

Investigative Phenomenon for Lesson 1: The Giant Drop is a roller coaster that takes the car far up a track in the air, where it pauses for a long time. Suddenly, the car is released, and it moves to the bottom of the track at a very high rate of speed. You decide to ride the Giant Drop with your friend. You choose seats next to each another, but before the operator starts the ride, he asks your friend to move over to the other side of the ride to create balance. He says that the ride is not safe if it is not balanced. What does this make you wonder?

Anticipated Questions:
- Why does the Giant Drop fall so quickly?
- Why did the ride have to be balanced?
- What makes the ride stop?

students work with a beam balance and make observations about its behavior when objects are added to each side. Later, they practice using standard masses and writing expressions to describe the masses of unknown objects. The force of gravity is used to describe the effect when mass is added only to one side of the beam balance. Other forces, like pushes and pulls, are introduced to provide a foundation for Newton's first law of motion, inertia, which states that in order to set an object in motion, some kind of force must be applied. In the next lessons, students will investigate unbalanced forces that change an object's direction or speed.

32 FORCES AND INTERACTIONS



Phenomenon

Review students' questions about the investigative phenomenon from the beginning of this lesson. Guide students in applying the concepts explored in this lesson and connecting them to the anchoring phenomenon: identifying the interactions of forces at an amusement park. By the end of the lesson, students should be able to explain that:
- Gravity causes objects to fall. It is the force that pulls the Giant Drop to the ground.
- When something is balanced, there are equal forces acting on it. When something is unbalanced, one force is greater than another. There are balanced forces when the Giant Drop car has stopped at the top of its track.
- When your friend sat next to you, the mass was too great on one side of the roller coaster, causing the ride to become unbalanced.

- Start each unit with an **Anchoring Phenomenon** discussion and video.

- Move to an **Investigative Phenomenon** in each lesson that is supported by hands-on learning.

- **Reflect** on the Investigative Phenomenon at the end of each lesson.

- Connect investigations to **CA Environmental Principles and Concepts**

LESSON 6

ENVIRONMENTAL CONNECTIONS

Given the implications for the future, it is vital that students are aware of the interactions between natural systems and human activity. This lesson incorporates environmental principles and concepts that are important for students to recognize. Students focus on how natural processes of weathering, erosion, and deposition can impact humans. They think about how humans influence these processes and potentially affect the environment. Using stream tables as models, students examine the potential effects of soil erosion on living things and design solutions to limit the impact. They draw comparisons between their models and real-life methods for controlling soil erosion and consider which materials provide long-term protection and which might have an impact on the environment

ter/Shutterstock.com

EXTENSIONS

Plugging the Volcano
In science-fiction movies, brilliant scientists invent fanciful machines to solve outrageous problems. Have students think about the sci-fi movies they have seen. What are some of the problems the world faces, and how do the scientists solve them? As a class, make a list of these movies. Then list the problems and solutions presented in each. Put a check mark next to the solutions that students believe could someday happen and cross out those they think are too outrageous to ever happen. Next, discuss the possibility of some of these solutions.

ASSES

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- From *Changing Earth*, grade 4

LESSON 5

ENVIRONMENTAL CONNECTIONS

Given the implications for the future, it is vital that students are aware of the interactions between natural systems and humans. This lesson incorporates environmental principles and concepts that are important for students to recognize. In Investigation A, students examine their potential impact on different habitats and consider how their use of resources affects the living and nonliving things in those habitats. Each habitat has its own natural cycles and availability of resources, such as water, shelter, and food. When humans inhabit a region, they also require access to these resources and may disrupt the existing cycles. Sometimes human impact can be positive, but more often, humans negatively affect environments, impacting the survival, growth, and reproduction of plants and animals. Students are challenged to consider what changes they can make to limit the negative impacts and enhance the beneficial impact.

Credit: NPeter/Shutterstock.com

EXTENSIONS

Campus Beautification Day
Schedule a campus beautification day. Invite other students, teachers, parents, and community members to campus to pull weeds, plant a tree, plant flowers, create a garden, or start an on-campus composting project. Ask for donations from local businesses.

Credit: wavebreakmedia/Shutterstock.com

Recycled Art
Challenge students to create an art project using only "used" materials. You may even decide to collect materials for the project in your recycling bin in the classroom. Explain to the class that these items were thrown away but you will be giving them new life.

ASSESSMENT STRATEGIES

1. Investigation A

- Review Student Investigation Sheet 5A: *What If I Lived in a Different Habitat?* to determine if students can identify sources of food, water, and shelter in different habitats. Students should also demonstrate knowledge of human responses to different climates.

2. Investigation B

- Use each pair's Living Things Matrix to gauge their depth of knowledge about the interdependence of nonliving and living things in different habitats. Students should show deeper knowledge of habitats compared to the matrix from Lesson 1.

3. Use the Assessment Observation Sheet for this lesson to formatively assess your class, and adjust instruction as needed.

4. Use the General Rubric in Appendix A to assess individual progress.

5. Use the summative assessment to help evaluate students' understanding of key unit concepts.

- From *Ecosystem Diversity*, grade 2

Powerful Support for Teachers

Plant and Animal Structures

Lesson 1: Structures Used for Survival

Investigation Overview	Standards	Resources
Investigation A: Pre-Unit Assessment: How Are an Organisms' Structures Adapted for Its Environment? **5Es:** Engage As a pre-unit assessment, students consider how different structures are linked to the survival, growth, and reproduction of organisms. ■ **Teacher Preparation:** 10 minutes ■ **Lesson:** 30 minutes **Tell Me More!** A kangaroo keeps its baby in its pouch until the baby is old enough to walk and find food on its own. Is a kangaroo's pouch a structure for survival, growth, or reproduction? Explain. **Investigation B: Will Seeds Grow Inside a Plastic Bag?** **5Es:** Engage, Explore Students plant radish seeds in a plastic bag and make predictions about their growth. ■ **Teacher Preparation:** 20 minutes ■ **Lesson:** 30 minutes **Tell Me More!** Some plants grow faster than others. An oak tree can take more than 30 years to grow to its full size. A rose bush will take about six weeks to begin to flower. Does the same idea relate to animals? Do animals grow at the same rate? Provide examples.	**Next Generation Science Standards Performance Expectation** ■ **4-LS1-1:** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **Disciplinary Core Idea** ■ **LS1.A:** Structure and Function **Science and Engineering Practice** ■ Engaging in Argument from Evidence **Crosscutting Concept** ■ Systems and System Models **Language Arts and Math Standards** **Language Arts** ■ **RI.4.1:** Key Ideas and Details ■ **RI.4.2:** Key Ideas and Details ■ **RI.4.3:** Key Ideas and Details ■ **SL.4.1:** Comprehension and Collaboration ■ **W.4.1:** Text Types and Purposes ■ **W.4.2:** Text Types and Purposes **Math** ■ **4.OA.A:** Use the four operations with whole nu to solve problems.	**Student Investigation Sheets** ■ Student Investigation Sheet 1A: *Can You Sort the Structures?* ■ Student Investigation Sheet 1B: *Will the Radish Seeds Grow?* **Digital Components**

Effective science instruction that fits into your busy day

- Three units per grade level provides a complete year of instruction
- Lesson preparation averages 10 minutes
- Investigations average 30 minutes

LESSON 2

■ How do the different appearances of these structures provide evidence of animal adaptations? For example, think about a snake, an anteater, and a lion. *(Structures are shaped differently to help an animal survive in its environment. The shape of a mouth is directly related to what an animal eats, which is different for each animal and depends on which resources are found in an environment.)*

Differentiation Strategy

Students may struggle to distinguish between internal and external structures. Encourage them to copy the definition of each term into their science notebooks and circle the prefix for each ("In-" and "Ex-"). Remind students that "in-" refers to "inside" and "ex-" is similar to "exit."

3. Define "external structure" as a body part that is found on the outside of an organism. Explain that animals also have internal structures, which are found inside the organism. Identify lungs as an internal structure used for breathing. Allow time for students to individually develop a list of external and internal structures of animals.

4. Encourage students to share structures from their list to distinguish between internal and external structures. Emphasize that not all animals have the same structures. For example, not all animals have wings. Some animals have a heart, but other animals have more than one. Remind students that different animals have internal and external structures that are specially adapted to their environment.

5. Focus on the skeletal system. Ask students to feel their spine, wrist, and knee. Ask:

■ What are the hard structures you feel when you touch your spine, wrist, and knee? *(Bones)*

■ Do all animals have these structures? *(No, some animals, such as insects and some types of marine animals, do not have bones).*

■ What do bones do? Use evidence to explain your answer. *(Bones protect internal structures. We know this because the bones surround our organs.)*

■ How can an animal protect its insides if it doesn't have a skeleton? (Answers will vary. Students should recognize that shells or the hard outer covering of insects and marine animals work like a skeleton to protect internal organs.)

Differentiation Strategy

Assist below-level students by printing photos of different vertebrates and invertebrates. Ask students to categorize the photos. Challenge above-level students to argue which form of skeleton is better suited for protection.

Teaching Tip

Challenge students by asking them to think about how animals grow and develop differently with exoskeletons and endoskeletons. You may want to discuss molting, or shedding, which is common for animals with exoskeletons.

6. Explain that animals can be separated into two categories: **vertebrates** (with skeletons) and **invertebrates** (without skeletons). Display the chart titled "Vertebrates and Invertebrates" and instruct students to copy it into their science notebooks. Allow time for students to work with a partner to list examples of vertebrates and invertebrates.

Whether you're a veteran or a first-year teacher, your Teacher's Guide has everything you need to support 30-minute lessons:

- Comprehensive **planning guide**
- **Background information**
- **Guiding questions**
- **Differentiation strategies** and teaching tips
- Lesson-by-lesson **teacher prep videos**

LESSON **5**

BACKGROUND INFORMATION

The human eye, like the eyes of most mammals, works somewhat like a camera. First, light needs to reflect off an object or be emitted from an object, like a lamp. Without light, it is not possible for us to see. When light bounces off an object, it enters the eye through the **cornea**. From there, the light passes through an opening called the **pupil**. The pupil can change size thanks to the muscular **iris**, the colored part that surrounds it. In low light, the iris relaxes and the pupil gets larger. This larger opening allows more light in and improves our ability to see objects in low light. If the light is bright, very little needs to be let into the eye, so the iris contracts and makes the pupil very small.

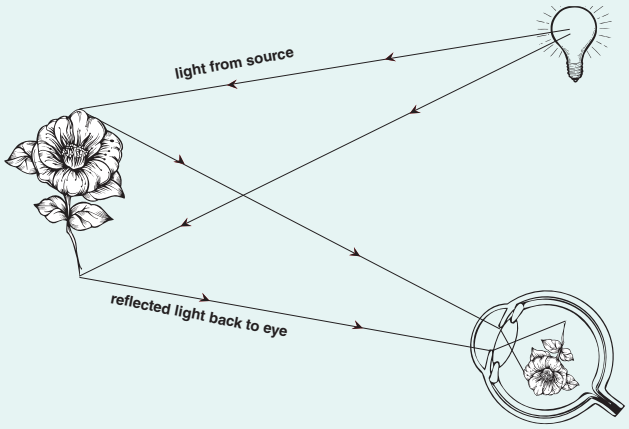
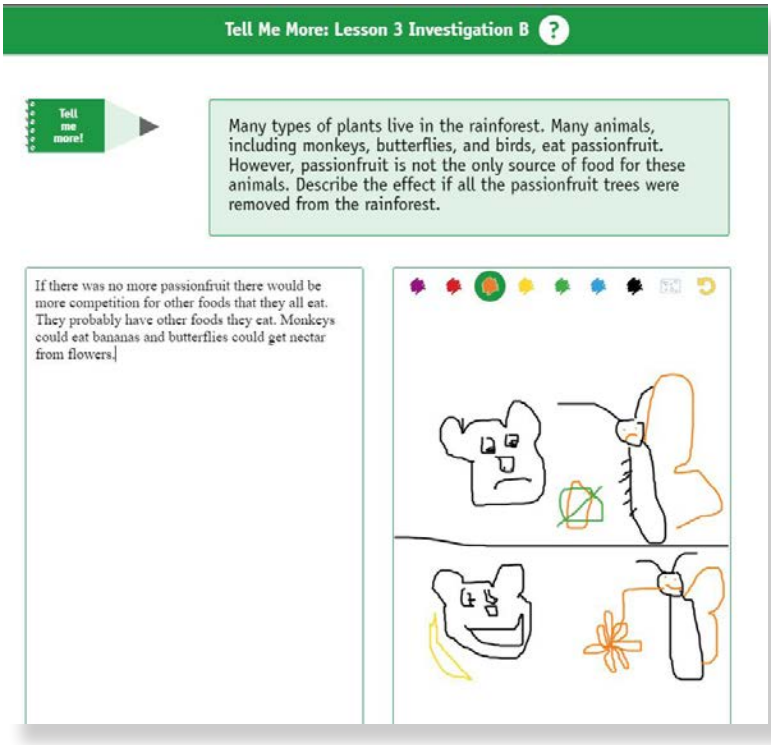


Figure 5.1: How light travels to the eye

After light passes through the pupil, it hits the **lens,** which is located directly behind the iris. The lens focuses all the light coming into the eye. The focused light then travels through a gelatinous material called the vitreous humor and hits the back of the eye, or the **retina**. The retina is made of rods and cones that allow us to see color and that change the image into something the brain can understand. The image that is created as light hits the retina is upside down and backward compared to the original. Refer to Figure 5.1 for reference.

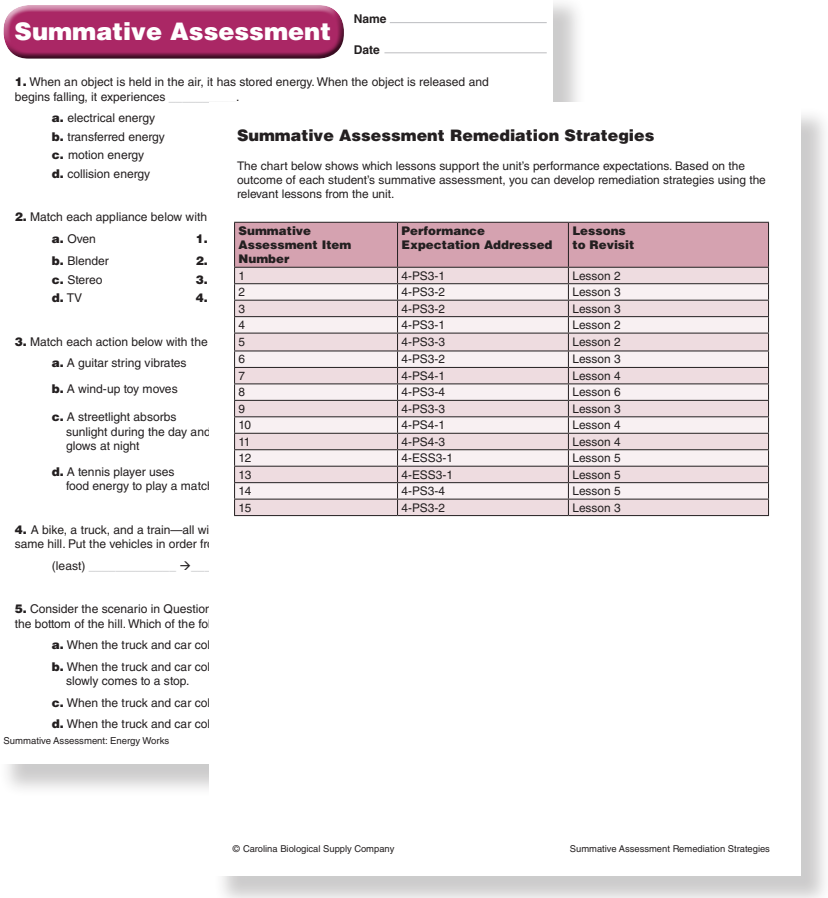
Powerful Support for Teachers

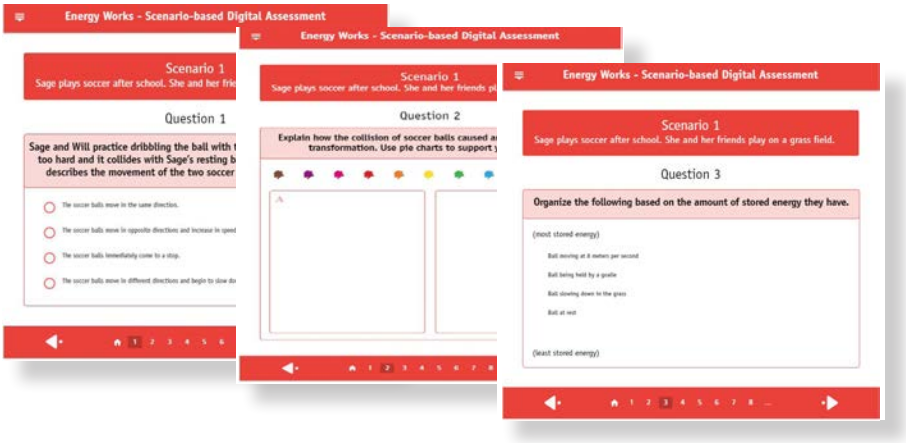


Three-Dimensional Assessment System

- **Pre-Unit and Formative Assessments**, including **Tell Me More** prompts, gauge levels of student understanding and guide instruction.

- **Final Lesson's Assessment** evaluates students' mastery of the Performance Expectations with a performance task.
- **Summative Assessments** students demonstrate their understanding of content by answering questions in a variety formats that are aligned to the Performance Expectations.





- **Scenario-Based Digital Assessment** challenges students to apply their understanding of content to questions presented in a variety of contexts.

Teacher Sheet 6C

My Energy Experiment Rubric

	Plan	Question	Conclude
4	Group's planning reflects a high level of interest and a problem-solving mindset.	Group expresses questions that demonstrate interest and curiosity and frames questions so that they can be answered through experimentation.	Group's conclusions reflect a clear (yet age-appropriate) grasp of both the content and how experimentation reinforces understanding of the content.
3	Group shows confidence in the prospect of engaging with materials to explore concepts.	Group demonstrates curiosity with open-ended "why" and "how" questions.	Group completes "because" answers with confidence and little prompting.
2	Group makes some connection between questions and possible uses of materials to answer them. Group may require prompting to move forward.	Group can consider and expand upon question prompts but does not engage in self-driven inquiry.	Group records observations but struggles to process them into applicable conclusions.
1	Entries reflect little or no recognition of experimentation as a means to answer questions.	Group has difficulty formulating self-originating questions related to science inquiry.	Group does not record logical connections between observations of outcomes and their relevance.

Teacher Sheet 6C

General Rubric

	Exploration	Vocabulary	Concept Building	Science Notebook
4	Student displays a high level of interest by asking questions, building on concepts, and testing ideas. Provides input and participates in group settings.	Student uses a rich and varied vocabulary that includes appropriate scientific vocabulary that is used in an accurate manner. Writing displays a deep level of understanding of a concept.	Student's responses indicate a higher level of thinking by drawing connections between unit concepts and phenomena. Claims are supported with strong evidence and reasoning.	Student's entries display informative, in-depth responses that demonstrate an understanding of the content. Diagrams are detailed and labeled when applicable. Student draws strong conclusions.
3	Student remains engaged by participating, building on concepts, and testing ideas. Rarely asks questions but is cooperative in group settings.	Student uses a varied vocabulary that includes appropriate scientific vocabulary. Writing accurately describes a concept or experience.	Student's responses during investigations, conversations, and class discussions reflect growth of knowledge. Student understands concepts but may not be able to make strong connections. Claims are supported with evidence and reasoning.	Student's entries provide accurate and descriptive responses. Visual aids, such as data tables and diagrams, are included when applicable. Student draws a conclusion.
2	Student participates in investigations but does not appear to be building on concepts, asking questions, or providing input in a group setting.	Student's vocabulary is limited. Appropriate scientific vocabulary is used occasionally but may not be in the correct context. Writing describes an experience but may not be accurate or detailed.	Student's responses indicate knowledge of the material but do not demonstrate growth. Connections are not readily made, and misconceptions may be noted. Claims are supported, but sometimes evidence and reasoning have inaccuracies.	Student's entries lack accuracy. Student misses key ideas and struggles to form in-depth responses and conclusions. Visual aids are missing detail.
1	Student may not participate in investigations and/or may struggle with building upon concepts. Student rarely asks questions or provides input.	Student struggles to describe experiences in writing. Appropriate scientific vocabulary is missing or used incorrectly.	Student's responses do not indicate knowledge of the material. Concepts are misunderstood, and connections are inaccurate or nonexistent. Claims are not supported by accurate evidence and reasoning.	Student's entries poorly or inaccurately address the concepts. Student does not provide support for responses.

- **Rubrics** provide guidance to gauge student performance and understanding.

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Learning Framework

Kindergarten	**Push, Pull, Go** *K-PS2-1; K-PS2-2; K-2-ETS1-1;K-2-ETS1-2*	**Living Things and Their Needs** *K-LS1-1; K-ESS2-2;K-ESS3-1;K-ESS3-3; K-2-ETS1-2*	**Weather and Sky** *K-PS3-1;K-PS3-2;K-ESS2-1; K-ESS3-2; K-2-ETS1-1; K-2-ETS1-2*
1st Grade	**Light and Sound Waves** *1-PS4-1; 1-PS4-2; 1-PS4-3; 1-PS4-4; K-2-ETS1-1; K-2-ETS1-2*	**Exploring Organisms** *1-LS1-1; 1-LS1-2; 1-LS3-1; K-2-ETS1-2*	**Sky Watchers** *1-ESS1-1; 1-ESS1-2*
2nd Grade	**Matter** *2-PS1-1; 2-PS1-2; 2-PS1-3; 2-PS1-4; K-2-ETS1-1; K-2-ETS1-2*	**Ecosystem Diversity** *2-LS2-1; 2-LS2-2; 2-LS4-1; K-2-ETS1-2; K-2-ETS1-3*	**Earth Materials** *2-PS1-1; 2-ESS1-1; 2-ESS2-1; 2-ESS2-2; 2-ESS2-3; K-2-ETS1-1; K-2-ETS1-2*
3rd Grade	**Forces and Interactions** *3-PS2-1; 3-PS2-2; 3-PS2-3; 3-PS2-4; 3-5-ETS1-1; 3-5 ETS1-2*	**Life in Ecosystems** *3-LS1-1; 3-LS2-1; 3-LS3-1; 3-LS3-2; 3-LS4-1; 3-LS4-2; 3-LS4-3; 3-LS4-4; 3-5-ETS1-2*	**Weather and Climate Patterns** *3-ESS2-1; 3-ESS2-2;3-ESS3-1; 3-5-ETS1-2*
4th Grade	**Energy Works** *4-PS3-1; 4-PS3-2; 4-PS3-3; 4-PS3-4; 4-PS4-1; 4-PS4-3; 4-ESS3-1; 3-5 ETS1-2; 3-5-ETS1-3*	**Plant and Animal Structures** *4-LS1-1; 4-LS1-2; 4-PS4-2; 3-5-ETS1-2*	**Changing Earth** *4-ESS1-1; 4-ESS2-1; 4-ESS2-2; 4-ESS3-2; 3-5-ETS1-2*
5th Grade	**Structure and Properties of Matter** *5-PS1-1; 5-PS1-2; 5-PS1-3; 5-PS1-4; 3-5-ETS1-2*	**Matter and Energy in Ecosystems** *5-PS3-1; 5-LS1-1; 5-LS2-1; 5-ESS2-1; 5-ESS3-1; 3-5-ETS1-3*	**Earth and Space Systems** *5-PS2-1; 5-ESS1-1; 5-ESS1-2; 5-ESS2-1; 5-ESS2-2; 5-ESS3-1; 3-5-ETS1-2*

Need more information?
Contact us at cascience@carolina.com or visit carolina.com/cascience

For Immediate Assistance Contact:
Fabienne Conrad
fabienne.conrad@carolina.com
336-266-3744

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