Sample Grade K
Teacher's Guide and
Student Literacy

Push, Pull, Go II

A New Generation

Building Blocks of Science®

Materials List

Needed from the kit
1 class set, Kid K'NEX® building pieces
96 dominos
12 foam balls
36 Kid K'NEX® Instruction Cards
1 Literacy Series Big Book: *Push, Pull, Go*
12 plastic buckets
120 Unifix® cubes, blue
120 Unifix® cubes, red

Provided by the teacher
Chart paper
Crayons
Markers
Masking tape

Provided by the student
1 science notebook

LESSON NOTES

Push, Pull, Go

A New Generation

Teacher's Guide

Building Blocks of Science®

Unit and Lesson Summaries

Unit Summary

The Building Blocks of Science® unit *Push, Pull, Go* explores motion and the forces that make things move. Students build toys that move and investigate the forces that move them. Student-constructed toys are utilized to explore systems, how parts of a system interact, and how missing parts change a system. Students track the path of a moving ball and measure distance traveled with nonstandard measurement. Lessons link the invisible force of gravity to moving objects.

Assessment

This unit offers several ways to assess students, including a pre- and a post-unit assessment opportunity. Teachers can also use class discussions and charts to assess each lesson. Student Activity Sheets and Science notebook entries—including drawings, writings, and dictated statements—can be used to gauge individual understanding of objectives and key vocabulary throughout the unit. The Assessment Observation Sheets supplied with each lesson help teachers document and measure students' progress and knowledge using informal assessment. A general rubric is provided to help teachers evaluate individual students at any point in the unit. The rubric provides a progression of skills and understanding that covers exploration, vocabulary, concept building, and notebook entries. Finally, a summative assessment gives teachers the opportunity to evaluate students' understanding of the science concepts explored during the unit.

Lesson 1: Push, Pull, Roll

In Lesson 1, students explore force and motion using student-built toys made with Kid K'NEX® building pieces. Students observe the motion and path of a ball rolling down a ramp and record the distance using nonstandard measurement. Students complete three Student Activity Sheets during this lesson. Student Activity Sheet 1A: *Sort and Count* helps familiarize students with the building pieces. Student Activity Sheet 1B: *What I Built* allows students to document what they create, and Student Activity Sheet 1C: *How Far?* helps students record data as they explore measuring distance.

Lesson 2: Push, Pull, Swing

In Lesson 2, students build a toy swing set that moves, and use it to explore patterns of movement related to force. Student Activity Sheet 2: *Push, Pull, Swing* helps students describe the swing set and its motion.

Lesson 3: Push, Pull, Tumble

Students use dominos in Lesson 3 to explore the result of force transferred from one object to another. Student Activity Sheet 3: *Dominos and a Push* provides students with another opportunity to describe their setup and the motion of the system they build.

Lesson 4: Push, Pull, Spin

In Lesson 4, students explore force further as they build a toy top that spins and use the top to investigate spinning motion. Student Activity Sheet 4: *Spinning Tops* helps students record their ideas about the motion of spinning and how the top moves.

Lesson 5: Push, Pull, Invent

In Lesson 5, students have access to all the materials used in previous lessons to construct a model (an invention, Rube Goldberg–style) that is set in motion with a push or a pull. Students complete Student Activity Sheet 5A: *My Invention*, which documents the order of the steps they followed to design and build their invention. Student Activity Sheet 5B: *Forces and Motion* allows students to link a specific motion with one of the objects that they built during the unit. Both sheets are helpful assessment tools in this concluding lesson.

LESSON NOTES

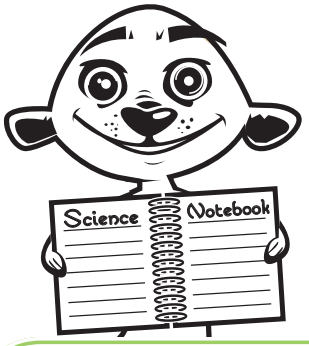
Lesson 5: Push, Pull, Invent

Lesson Essentials	Next Generation Science Standards*	Language Arts and Math Standards**
Objectives: • Apply concepts explored in Lessons 1–4 to build a motion invention (model) that works. • Describe how force and motion work together in the model. • Demonstrate the effect of missing or nonworking parts of a system. **Time Requirements:** **Teacher Preparation** **Part A:** 10 minutes **Part B:** 5 minutes **Part C:** 5 minutes **Part D:** 5 minutes **Lesson** **Part A:** 1 class session **Part B:** 1 class session **Part C:** 1 class session **Part D:** 1 class session **Essential Questions:** • How can we design a solution using force and motion? **Vocabulary:** • Invention	**Performance Expectations** • **K-PS2-1:** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. • **K-PS2-2:** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull. **Disciplinary Core Ideas** • **PS2.A:** Forces and Motion • **PS2.B:** Types of Interactions • **PS3.C:** Relationships between Energy and Forces • **ETS1.A:** Defining Engineering Problems **Science and Engineering Practices** • Planning and Carrying Out Investigations • Analyzing and Interpreting Data **Crosscutting Concepts** • Cause and Effect	**Language Arts** • **SL.K.2:** Comprehension and Collaboration • **SL.K.5:** Presentation of Knowledge and Ideas • **W.K.2:** Text Type and Purposes • **W.K.8:** Research to Build and Present Knowledge **Math** • **K.MD.A.1:** Describe and compare measurable attributes. • **K.MD.A.2:** Describe and compare measurable attributes.

Cross-Curricular Connections	Literacy	Assessment Strategies
Science Notebooks Science Technology Art Movement Education Engineering Design	**Literacy** ***Push, Pull, Go* Big Book*:** • "Career—Playground Builder," pg. 15 ** See Appendix E for Literacy Connections for before, during, and after reading.*	**Student Activity Sheets:** • Student Activity Sheet 5A: *My Invention* • Student Activity Sheet 5B: *Force and Motion* **Science Notebook Opportunity:** • This is what I built. (TG pg. 48) • This invention is ___. (TG pg. 49) • This is one problem we had. (TG pg. 50) • Today I learned ___. (TG pg. 51) **Formative Assessment:** **1.** The T-chart in Part C, "Our Problems and How We Fixed Them," provides valuable insight as students respond to design problems and how the problems were fixed. **2.** The class charts in Part D ("What We Know About Force" and "What We Know About Motion)" are intended as a post-unit assessment. Compare the class charts and student responses from Lesson 1 with those from the charts in Lesson 5. **3.** Student Activity Sheets 5A and 5B may also be utilized as assessment tools. **4.** Use Science Notebook Opportunities to formatively assess the class and adjust instruction as needed. **5.** Evaluate student understanding through class discussions. **6.** Use the Assessment Observation Sheet included for this lesson to formatively assess your class and adjust instruction as needed. **General Rubric:** • Refer to the General Rubric included in Appendix D to assess individual progress. **Summative Assessment** • Use the summative assessment included in Appendix F to help evaluate student understanding of key unit concepts.

Lesson 5

Push, Pull, Invent



MATERIALS

Student

- 1 science notebook*
- 1 Student Activity Sheet 5A: *My Invention*
- 1 Student Activity Sheet 5B: *Force and Motion*

Team of two students

- 1 foam ball
- 1 bucket of Kids K'NEX® building pieces
- 8 dominos
- 10 Unifix® cubes, blue
- 10 Unifix® cubes, red
- All the Kid K'NEX® Instruction Cards

Teacher

- Chart paper*
- Markers*
- General Rubric (Appendix D)

*These materials are needed but not supplied.

LESSON OVERVIEW

Students have access to all the materials from previous lessons to construct a model (an invention, Rube Goldberg style) that is set in motion with force.

OBJECTIVES

- Apply concepts explored in Lessons 1–4 to build a motion invention (model) that works.
- Describe how force and motion work together in the model.
- Demonstrate the effect of missing or nonworking parts of a system.

VOCABULARY

Describing Science

- First, second, third
- Next, then
- Plan
- Try

Science Words

- Invention

TIME CONSIDERATIONS

Teacher Preparation

Part A ..... 10 minutes
Part B ..... 5 minutes
Part C ..... 5 minutes
Part D ..... 5 minutes

Lesson

Part A ..... 1 class session
Part B ..... 1 class session
Part C ..... 1 class session
Part D ..... 1 class session

TEACHER PREPARATION

Part A

1. Add the following materials to the Kid K'NEX® building pieces in each team's bucket:

- 1 foam ball
- 8 dominos
- 20 Unifix® cubes (10 blue, 10 red)

2. Have the Ramp Instruction Cards available.

Part B

Have all of the Kid K'NEX® Instruction Cards within easy access of students.

Part C

Prepare a T-chart for the discussion. Title it "Our Problems and How We Fixed Them." Label the left column "Our Problem" and label the right column "How We Fixed It."

Part D

Prepare two class charts for the discussion. Title the first "What We Know About Force." Title the second "What We Know About Motion."

BACKGROUND INFORMATION

This culminating activity utilizes the concepts of force and motion presented in Lessons 1–4. As seen in Figure 5.1, students' models are set up in the Rube Goldberg style of whimsical contraptions and inventions. What sets the contraptions in motion? Force.

For more information about Rube Goldberg, his inventions, and the contests they inspire, visit www.rubegoldberg.com.

Rube Goldberg (roob gold'berg) n. A comically involved, complicated invention, laboriously contrived to perform a simple operation.
–Webster's New World Dictionary

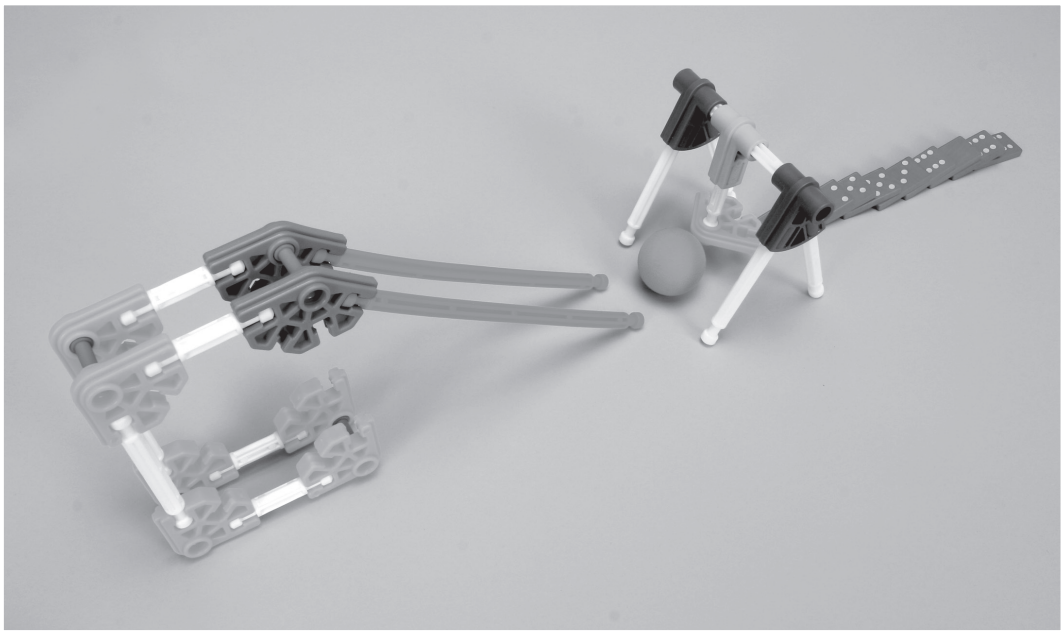


Figure 5.1
Example of a student invention

ACTIVITY INSTRUCTIONS

Part A

Ball and Dominos

1. **Students will work in teams of two using all of the materials from past lessons. Distribute a bucket of materials to each team of two students.**

2. **Direct students to remove the ball and the dominos from the bucket. Instruct students to set the remaining materials aside.**

3. **Ask one student in each team to hold a domino and the other student to hold the ball.**

4. **Review the properties of the ball and the domino. Use some or all of the guiding questions below to facilitate an active discussion.**
   - How are they the same? How are they different?
   - What does it take to move the ball? *(A push, a pull, a force)*
   - How does a ball move? *(It rolls or bounces.)*
   - Show how the ball moves. Where is the push? Where is the pull?
   - What is a force?
   - Does the domino move differently than the ball?
   - How do we get the domino to move?
   - Is there a way to move the domino without touching it?
   - How did we set up the dominos so that pushing one domino pushed all the others? (Allow students time to set up the dominos so that they fall in a line with one push.)

5. **Introduce the word *invention*. Ask students what they know about inventions. Explain that they will use the ball and the dominos together to build an invention that pushes the dominos over without touching them with their hands.**

Teacher Tip

Systems:
As students explore ways to use the ball to move the dominos, it is a good opportunity to ask key questions about systems and how systems work.

- What are the parts of your system?
- What would happen if we took this part away?
- How do you know?
- Is there a way to test your idea?
- What are the moving parts of this system?
- What is a force?
- How does a force change this system?

6 **Ask, Is there a way to use the ball to push down a row of dominos? Allow students to talk about their ideas, then try them out.**

7 **After students explore using the ball to push down the dominos, add another piece to students' motion inventions.**

8 **Distribute the Ramp Instruction Card. Ask the teams of students to build the ramp as they did in Lesson 1. Allow ample time for students to build the ramp and then continue their exploration.**

9 **Ask students if they think there is a way to use the ramp and the ball to move the dominos. Ask,**

- Is there a way to set up the ball, the ramp, and the dominos so that all are part of a system set up to tumble the dominos with only one push or pull?
- Think of a way to test your idea and then try it.

10 **Allow plenty of time for students to explore and complete the challenge.**

11 **After teams have had time to build and test their solutions, have each team share and demonstrate their construction for the class.**

Science Notebook Opportunity

Notebook Prompt:

This is what I built.

It works by _____.

Learning Center Opportunity

Students may have more ideas than can be tested in the amount of time allotted. Consider placing one or more buckets of materials in a learning center for further exploration.

Part B

More Motion

1 **Challenge students to build a bigger motion invention. Ask,**

- How many ways can you use the toys you built in this unit to knock down the dominos?
- Is there a way to use the ball, the ramp, and the swing set at the same time to move the dominos? What about the spinning top? Think of a way to test your idea and then try it.
- Build an invention that uses the ramp, the ball, the top, etc. to push down a row of dominos. *(Inventions may use some or all of the items built/used in earlier lessons. Have the instruction cards available for teams who would like to use them to rebuild the swing set and the top.)*

2 **Encourage students to share ideas with each other. Listen for a rich vocabulary that describes the toy setup and the motion as well as the force that makes the parts move. Allow students the luxury of time to build, test, and build again as they encounter problems and come up with solutions based on what they know and have learned about force and motion.**

Science Notebook Opportunity

1. **Notebook Prompts:**

   This invention is _____.

   Next I want to try _____.

2. **Student Activity Sheet 5A: *My Invention***

Learning Center Opportunity

Place the building pieces, ramps, balls, tops, etc. in a learning center for further exploration and problem solving. Big ideas benefit from the luxury of time to build, test, and build again.

Teacher Tip

Use this opportunity to ask key questions and encourage conversation about patterns of motion and other forces that start, stop, or change the direction of moving objects. Ask questions similar to these about any part of a team's invention.

- How does the swing set move? *(With a push or pull, a force)*
- Sometimes the swing moves a lot, sometimes just a little. Why is that? *(The greater the force, the greater the movement.)*
- How does the force of the swing set change the movement in the setup of the ball/ramp, dominos, etc.?

Part C

Problem-Solution Chart

Teacher Tip

Class charts are great opportunities for teachers to model different science notebook strategies. T-charts are modeled with the entire class in these early grades and stages of notebook use. With time, experience, and practice, students grow comfortable integrating these strategies in their individual science notebooks.

1. **Post the chart "Our Problems and How We Fixed Them." Ask teams to name a problem and then communicate how the problem was solved. Encourage a rich use of vocabulary to describe the problem and the solution.**

2. **Engage students in an active discussion about the problems they encountered as they worked together to set up their inventions.**

3. **Encourage students to verbalize how the action solved the problem. For example:**
   - **Problem: The swing set would not push the dominos down.**
   - **Solution: We moved the swing closer, we pushed the swing with more force.**

Science Notebook Opportunity

Notebook Prompt:

This is one problem we had.

This is the way we fixed the problem.

Part D

Post-Unit Assessment

1. **Post the class charts "Our Ideas About Force" and "Our Ideas About Motion."**

2. **Ask students to share their ideas about force and motion. Encourage an active discussion.**

3. **Record student responses on the charts. The student responses recorded in Lesson 1 are compared with responses at the end of the unit as part of the post-unit assessment.**

Science Notebook Opportunity

1. **Notebook Prompts:**

   Today I learned _____.

   Force is _____.

   Three motion words

   _____ _____ _____

2. **Student Activity Sheet 5B: *Force and Motion***

EXTENSIONS

Toys That Move

Ask students to bring in toys that move for circle time. Ask students to put the toy in front of them when they are seated in the circle. Ask guiding questions that encourage students to describe force and motion.

- What is one word that describes how your toy moves?
- How does the toy truck move? *(It rolls, we push it.)*
- Can the truck move faster? *(Yes, if we push it harder, or push with more force.)*
- If you see something that spins, put your hands on your head. What do you see that spins?
- Can you find a toy that has moving parts? Which parts move? How do you know?

Fun Machines That Move

Do an Internet search for Rube Goldberg machines. There are numerous videos and sites that children would enjoy watching. Share these videos with students and discuss how the Rube Goldberg machines use force and movement.

Ask students to share their ideas about the similarities between their machines and those seen in the video clips.

Note: Many high schools and colleges have Rube Goldberg contests. Perhaps you could persuade a team of inventors to visit your class.

Paint In Motion

1. Cut pieces of construction paper to fit the bottom of a small box.

2. Dip a marble in classroom-friendly paint.

3. Roll the marble in the box.

4. Students use gentle force to move the box. Gravity too will do its part.

5. Add more marbles with different colors of paint.

6. The result? A masterpiece created by motion.

Playground In Motion

See what kinds of toys and equipment you and your students can come up with to build a big "motion machine" on the playground.

Toys and/or equipment, a starter list:

- Hula hoops
- Assorted balls
- Riding toys
- Parachutes
- Scooter boards
- Jump ropes

Literacy Series Reader: *Push, Pull, Go*

As a class, in small groups, or in pairs, have students explore the informational text in the literacy reader for this unit. Refer to Appendix E for strategies for before, during, and after reading the lesson-specific chapters or for exploring the literacy reader as a whole after the unit.

EVALUATION/ASSESSMENT

1. The T-chart in Part C, "Our Problems and How We Fixed Them," provides valuable insight as students respond to design problems and how the problems were fixed.

2. The class charts in Part D ("What We Know About Force" and "What We Know About Motion)" are intended as a post-unit assessment. Compare the class charts and student responses from Lesson 1 with those from the charts in Lesson 5.

3. Student Activity Sheets 5A and 5B may also be utilized as assessment tools.

4. Use Science Notebook Opportunities to formatively assess the class and adjust instruction as needed.

5. Evaluate student understanding through class discussions.

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

7. Refer to the General Rubric in Appendix D to assess individual progress.

8. Use the summative assessment included in Appendix F to help evaluate student understanding of key unit concepts.

Name: _____ Date: _____

This is my invention.

First _____.

Next _____.

Then _____.

Name: _____ Date: _____

This **rolls.**

This **spins.**

Push this to move.

Pull this to move.

Push, Pull, Go!

Push, Pull, Go!

by Corinn Kintz

Table of Contents

CAROLINA®
www.carolina.com

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2

ISBN 978-1-4350-1589-0

Published by Carolina Biological Supply Company, 2700 York Road, Burlington, NC 27215.
Call toll free 800.334.5551.

1604

Careers

Playground Builder

Some builders make playgrounds.

They make plans for play areas.

They shape places where children can run and climb.

They make things to push or pull.

They build things that swing, spin, and slide.

Glossary

direction **Direction** is the path that an object takes.

distance **Distance** is how far something moves.

force **Force** is what makes an object change its position.

friction **Friction** is the force that slows down moving things that touch.

gravity **Gravity** is the force that pulls on objects near Earth.

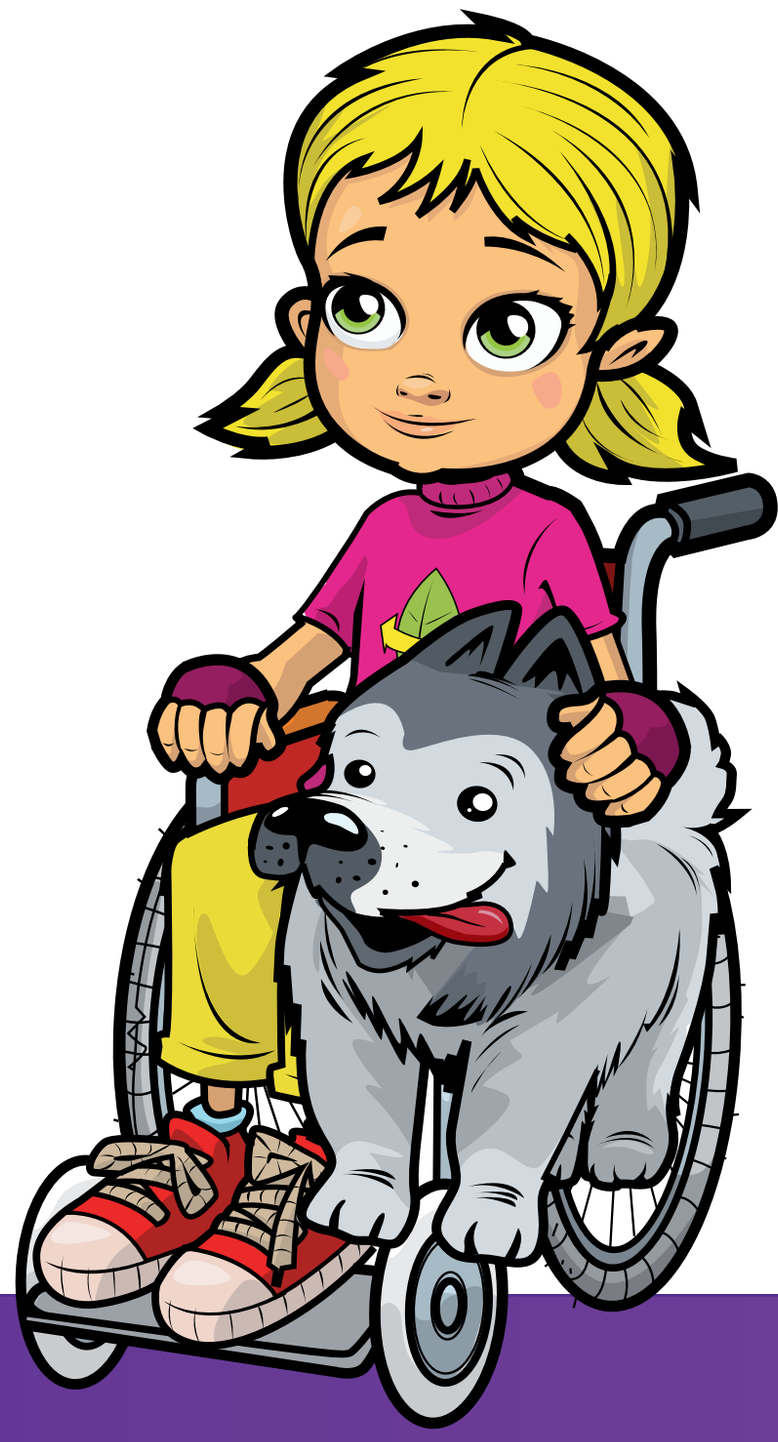
motion A **motion** is a change in an object's position.

pull A **pull** is the force that moves something toward you.

push A **push** is the force that moves something away from you.

speed **Speed** is how fast or slow an object moves.

p. 2: fotokostic/iStockphoto; **p. 3:** anatols/iStockphoto; **p. 4:** monkeybusinessimages/iStockphoto; **p. 4-5:** joshlaverty/iStockphoto; **p. 6:** mitgirl/iStockphoto; **p. 7:** SergioZacchi/iStockphoto; **p. 8:** DragonImages/iStockphoto; **pp. 8-9:** fotokostic/iStockphoto; **p. 9:** Innershadows/iStockphoto; **p. 10:** dmbaker/iStockphoto; Antonio_Diaz/iStockphoto; **p. 11:** Oliver Hoffmann/iStockphoto; jokerproproduction/iStockphoto; **p. 12:** SerrNovik/iStockphoto; **p. 13:** g-stockstudio/iStockphoto; **p. 14:** CynthiaAnnF/iStockphoto



LESSON NOTES

Building Blocks of Science®

Integrate opportunities to explore mathematics, technology, engineering, reading, and writing.

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