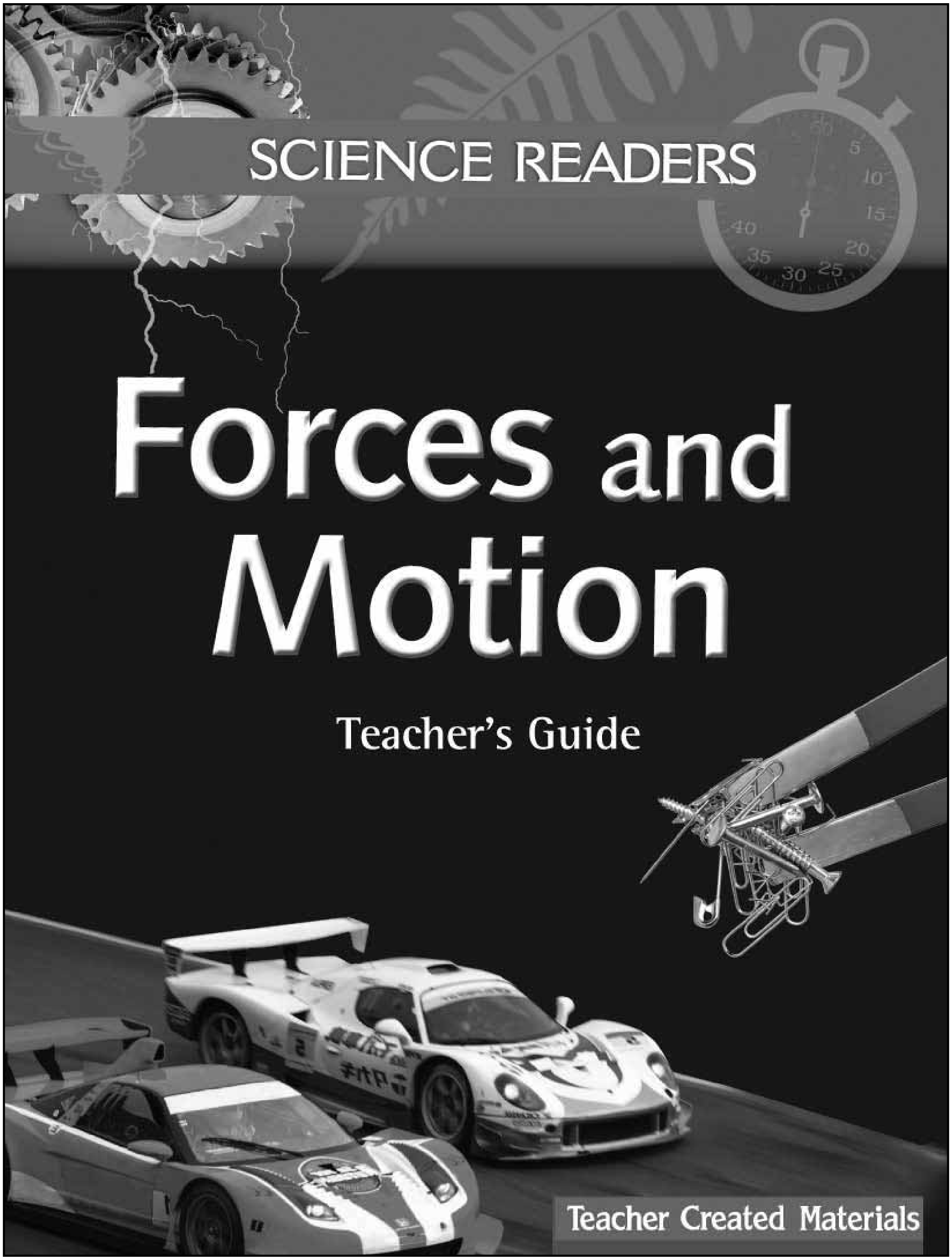

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Teacher Created Materials

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Why a Focus on Science?

Over three decades ago, the American Association for the Advancement of Science began a three-phase project to develop and promote science literacy: Project 2061. The project was established with the understanding that *more* is not *effective* (1989, p. 4). Shortly thereafter, in 1993, the Association developed benchmarks for science literacy. Since every state has its own science standards, these benchmarks were prepared as a tool to assist in the revision of the states' science, mathematics, and technology curricula (1993, p. XV).

Values, Attitudes, and Skills

Scientists work under a distinctive set of values. Therefore, according to the American Association for the Advancement of Science, science education should do the same (p. 133). Students whose learning includes data, a testable hypothesis, and predictability in science will share in the values of the scientists they study. Additionally, "science education is in a particularly strong position to foster three [human] attitudes and values: curiosity, openness to new ideas, and skepticism" (1989, p. 134). The *Science Readers* series addresses each of these recommendations by engaging students in thought-provoking, open-ended discussions and projects. Throughout their study, students continuously reflect on the contributions of important scientists and the advancements they have brought to society.

Within the recommendations of skills needed for scientific literacy, the American Association for the Advancement of Science suggests attention to computation, manipulation and observation, communication, and critical response. These skills are best learned through the process of learning, rather than in the knowledge itself (1989, p. 135). This is exactly what happens when students engage in lesson labs and review labs conducted by others in the *Science Readers* program. Students follow formulas and calculations to compute numbers; they use calculators to apply computation skills quickly and accurately; they manipulate common materials and tools to make scientific discoveries; they express findings and opinions both orally and in writing; they read tables, charts, and graphs to interpret data; they are asked to respond critically to data and conclusions; and they use information to organize their own data and draw their own conclusions.

Inquiry-based Learning

Project 2061 recommends pedagogical practices where the learning of science is as much about the process as the result or outcome (1989, p.147). Following the nature of scientific inquiry, students ask questions and are actively engaged in the learning process. They collect data and are encouraged to work within teams of their peers to investigate the unknown. This method of process learning refocuses the students' learning from knowledge and comprehension to application and analysis. Students may also formulate opinions (synthesis and evaluation) and determine whether their processes were effective or needed revision (evaluation). The National Academy of Science views inquiry as "central to science learning" (p. 2 of Overview). In this way, students may develop their understanding of science concepts by combining knowledge with reasoning and thinking skills. Kreuger and Sutton (2001) also report an increase in students' comprehension of text when knowledge learning is coupled with hands-on science activities (p. 52).

Teaching Scienti c Vocabulary

In learning science by doing science, students often find a stumbling block in scientific vocabulary. Scientists communicate with each other through publication of results and peer review; this communication is just as necessary to the scientific enterprise as gathering data or formulating hypotheses (Goldman & Bisanz 2002). This vital communication is information dense and often employs specialized scientific vocabulary. These unfamiliar and often polysyllabic words can slow science students' reading rates to a crawl as they struggle to understand each other, their texts, and even themselves.

Vocabulary activities common to language arts and social studies curricula can find decreased utility in the science classroom. Looking up the definition of a difficult word often yields the student a crop of additional difficult words and no better understanding. Paraphrasing passages of scientific text can lead to student paralysis as they cannot find a foundation from which to work. Additionally, given the specialized nature of scientific terminology, there is little opportunity for students to use the vocabulary in their ordinary lives and to gain familiarity.

Despite the aforementioned obstacles, science teachers can see positive results by making the development of scientific vocabulary a cornerstone of their curriculum. Vocabulary is a key variable in reader comprehension (National Institute of Child Health and Human Development 2000). The exploration of scientific vocabulary can also provide teachable moments and serve as a thematic hub around which learning may be organized. Perhaps most importantly, reading books rich in scientific vocabulary "fosters scientific understandings and teach(es) students how to express these ideas in scientific language" (Saul 2004).

In order to reap such benefits, the science teacher must foster familiarity with scientific vocabulary and lead students in relating the concepts behind that vocabulary. A classroom comfortable with "big words" and adept in relating them can then use their continuing exploration of scientific language to fuel their inquiry process.

Fostering Familiarity with Scientific Vocabulary

It is an easy and common mistake to assume that the vocabulary that students bring with them to the classroom is not adequate for the discussion of science. This is an especially tempting assumption when students come from underprivileged backgrounds or homes where English is not the primary language. Teachers may believe that students need to learn an entirely new vocabulary for the science classroom. Students are understandably hostile to such a wholesale replacement of how they define and discuss the world around them.

Students may be uncomfortable with scientific vocabulary because they have no way to connect it to what they already know. Instead of guiding students in working from scientific knowledge "back" to their everyday language, science teachers can do the reverse, starting with everyday language and working towards scientific vocabulary. By treating students' experiences expressed in their own words as data, the class can use inquiry and exploration to develop hypotheses about the natural world. In such a way, students' colloquial vocabulary "can be generative and transformative in promoting scientific understandings and talk in the dialogically oriented read-alouds" (Kress 1999, Lemke 1990).

Unit 1: *How Toys Work* and *How Amusement Parks Work*

Timeline for the Unit

	How Toys Work	*How Amusement Parks Work*
Day 1	Complete the **Introductory Activity** (page 22) as a class.	
	Before Reading (pages 27–28) in reading groups Use: *Simple Machines in the Classroom* activity sheet (page 30; page30.pdf)	**Before Reading** (pages 35–36) in reading groups Use: *Follow the Bouncing Ball* activity sheet (pages 38–39; page38.pdf)
Day 2	**During Reading** (page 28) in reading groups Use: *A Shocking Discovery* activity sheet (page 31; page31.pdf) *A Shocking Discovery* PDF file (shocking.pdf)	**During Reading** (pages 36–37) in reading groups Use: *Take a Hike* activity sheet (pages 40–41; page40.pdf)
Day 3	**After Reading** (page 29) in reading groups Use: *Hard Work Made Easy* activity sheet (page 32; page32.pdf) *Reader Quiz* (page 33; page33.pdf)	**After Reading** (page 37) in reading groups Use: *Ride Like the Wind* activity sheet (pages 42–43; page42.pdf) *Ride Like the Wind* PDF file (ride.pdf) *Reader Quiz* (page 44; page44.pdf)
Day 4	Complete the **Lab** activity (pages 25–26; pinwheel.ppt) as a class.	
Day 5	Complete the **Concluding Activity** (page 23) as a class.	

Unit Learning Objectives

- Students use text features (glossary) to locate information. (Nonfiction Reading Objective)
- Students use strategies to write for a variety of purposes. (Writing Objective)
- Students know the relationship between the strength of a force and its effect on an object. (Science Objective)
- Students apply understanding of numeration, multiplication, and division. (Mathematics Objective)

Lab Lesson Plan: Make Your Own Pinwheel

Find full-color, step-by-step illustrations of the lab on the Teacher Resource CD.

Before the Lab

1 Review with students what they learned about simple machines and how they can make work easier.

2 Discuss different forces that move things by pushing or pulling (people, machines, wind, water, etc.). Explain that the students will make a pinwheel (wheel and axle) which is pushed by the wind.

Introduce the Lab

3 Read the introductory paragraph with students.

4 Read the list of materials. Provide each student or lab group with the necessary materials, or have the materials ready if you are going to complete the activity as a demonstration lesson in front of the class.

5 Read through all the procedures with the students at least once before they engage in the lab. Check their understanding of the required steps.

Conduct the Lab

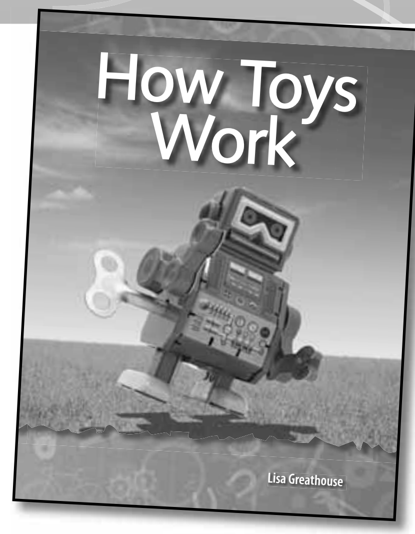
6 Allow time for students or lab groups to conduct the lab. You can also follow the steps as a class if you are conducting a demonstration lab.

After the Lab

7 Have students apply the terms *acceleration*, *deceleration*, *speed*, and *velocity* along with Newton's laws to answer these questions.

- For the pinwheel to spin faster, what must happen? *(A greater force must push it.)*
- As the pinwheel spins faster, it is __________________. *(accelerating)*
- As the pinwheel spins slower, it is __________________. *(decelerating)*
- If the students know how many times the pinwheel spins in one minute, they could calculate the pinwheel's __________________. *(speed)*
- If the pinwheel starts and stops in the same position, what is its velocity? *(Zero spins per minute)*

How Toys Work Reader



Learning Objectives

Students use text features (glossary) to locate information. (Nonfiction Reading Objective)

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Students know the relationship between the strength of a force and its effect on an object. (Science Objective)

Students apply understanding of numeration, multiplication, and division. (Mathematics Objective)

Materials

- *How Toys Work* Reader (toys.pdf; toys.ppt)
- a heavy object, such as a dictionary
- models or examples of simple machines
- drawing paper and drawing materials
- *Simple Machines in the Classroom* activity sheet (page 30; page30.pdf)
- *A Shocking Discovery* PDF file (shocking.pdf)
- *A Shocking Discovery* activity sheet (page 31; page31.pdf)
- *Hard Work Made Easy* activity sheet (page 32; page32.pdf)
- *Reader Quiz* (page 33; page33.pdf)
- materials for the Lab activity (page 26)

Before Reading

1. Complete the Introductory Activity (page 22) with the whole class. Then, divide the students into reading groups. Above-grade-level students should read this reader.

2. Next, introduce vocabulary words students will encounter in the text. Write on the board, the three boldface words below. Take time to discuss each word. Have students share what they think the words mean and have them try to use the words in sentences. Go over the additional vocabulary and use the glossary in the back of the reader as needed.

Vocabulary

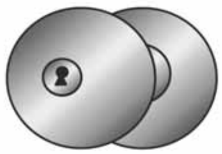
simple machine	work	pulley
magnetism	**force**	wheel and axle
atom	lever	motion
pole	inclined plane	**prototype**
repel	wedge	engineer
electron	screw	

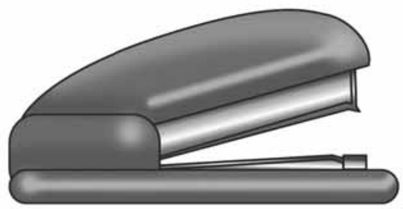
Name ____

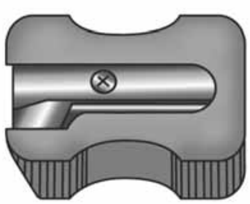
Simple Machines in the Classroom

Directions: Simple machines are all around you. They make work easier. Look at the pictures of common classroom items. Use the words below to label each simple machine.

lever	pulley	inclined plane	screw	wedge	wheel and axle







Keep looking! Find two more examples of simple machines in your classroom. List them here.

____

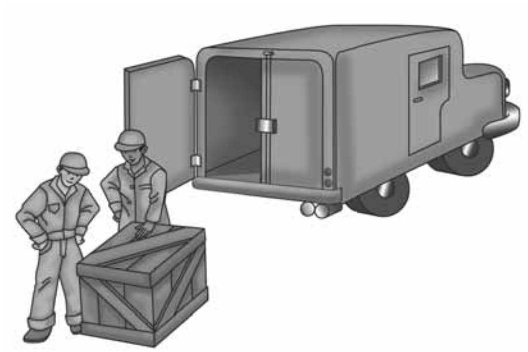
____

Name ______________________________

Reader Quiz

Directions: Circle the best answer.

1. A toy inventor used magnetism to move the parts of his toy made of iron (a metal). Will it work?
   a. Yes. Magnets are attracted to iron.
   b. Yes. Magnets are attracted to all metals.
   c. No. Magnets are not attracted to iron.
   d. No. Magnets only work with electricity.
2. A stopper and steel tube are magnetic. Henry cannot push the stopper into the top of the tube. The best explanation for this is:
   a. The stopper is upside down.
   b. The stopper is for another tube.
   c. The stopper expanded and now it won't fit.
   d. There is no explanation for this.
3. Jenna wants to move a box of books from her room to her sister's room. To make this work easier, Jenna might:
   a. carry small stacks of books over to her sister's room one at a time.
   b. get her older brother to carry the box.
   c. put the books on a cart and wheel them over.
   d. attach the books to a pulley and pull them over.
4. To make a toy move, someone must
   a. apply a force.
   b. install batteries.
   c. roll it down an inclined plane.
   d. use a magnet.
5. Look at the picture. These men want to move the crate to the truck. The best thing for them to do is
   a. put the crate on wheels.
   b. take whatever is in the crate out of the crate and carry it to the truck.
   c. install a pulley and hoist the crate to the truck.
   d. place an inclined plane between the truck edge and road.



Directions: On the back of this page, write two to three sentences to answer this question. Use information and examples from the reader to explain your answer.

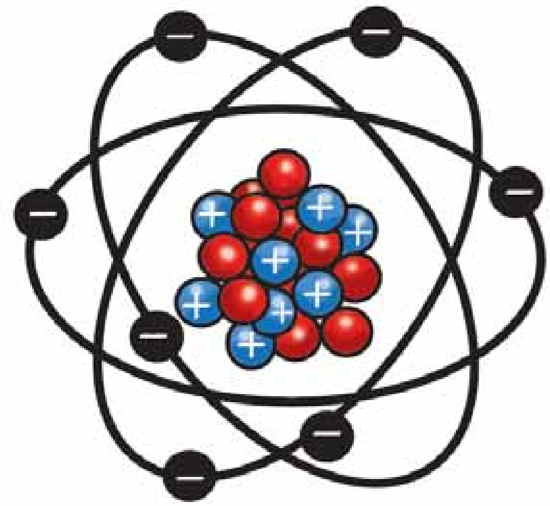
6. Plastic coating usually surrounds electric wires. Is this an important step in making toys?

Unit 1: How Toys Work

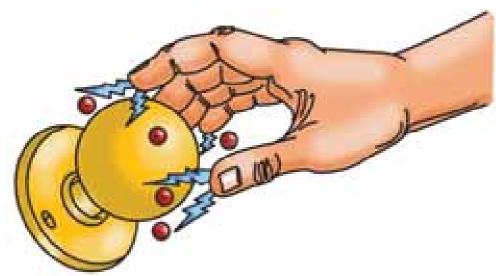
A Shocking Discovery

All About Atoms

Atoms are the smallest parts of matter. They have protons with positive charges and electrons with negative charges. Although in motion, the protons and electrons follow a certain order. When in order, they have no charge. They are neutral.



Atoms in Matter



All matter is made of atoms. The charge of some matter can be changed by rubbing it. When you drag your foot on a carpet, it picks up extra electrons. That makes a negative charge. When you touch something, the extra electrons move to the object. This makes an electric shock.

When you remove a knit cap, you send negative charges from your hair to the hat. Now each hair has a positive charge. Positive charges repel each other, so each hair stands up and away from the hair around it.