# More Picture-Perfect SCIENCE Lessons

## Using Children's Books to Guide Inquiry, K–4

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# Contents

# Foreword

In the mid-1980s, BSCS developed the 5E instructional model. At that time we adapted and extended a model from the Science Curriculum Improvement Study (SCIS) which was a contemporary science curriculum for elementary schools. The 5E model became a standard feature of BSCS programs, beginning with the program for which it was originally designed. That elementary program is now known as *BSCS Science Tracks: Connecting Science and Literacy.*

At the time we developed the BSCS 5E model, we had no idea about National Science Education Standards, the reemergence of inquiry, No Child Left Behind (NCLB) with its emphasis on reading literacy, and the dominating influence that assessment would have on science education. But, the decade of the 1990s did present changes and challenges for science education, especially programs in elementary schools. With NCLB we have witnessed more and more emphasis on reading in lower elementary grades with the result of less and less science. Of course, concerns mounted in the science education community. Statements about the worth and importance of science were heard. "Elementary should realize the importance of science." "Science can enhance literacy." But, the plea went unheard. Or, they were heard and acknowledged without any change in science instruction. Why was this? Teachers provided an answer to the question when they asked—"Where are the lessons?" The teaching community needed examples, in the form of curriculum materials, of how to incorporate literacy into science instruction. This book presents one response to the elementary teacher's question.

Karen Ansberry and Emily Morgan present the science education community with a refreshing and positive remedy to the reduction of science teaching in elementary schools. In *More Picture Perfect Science Lessons: Using Children's Books To Guide Inquiry, K–4,* they present an integrated instructional approach that addresses National Science Education Standards, inquiry, and the need for elementary teachers to enhance the reading skills of children. In short, the authors use the BSCS 5E instructional model to present science lessons. In doing so, they integrate reading strategies. The activities complement topics included in most school science programs—rocks, trees, magnets, and plants.

The authors have contributed to the goal of more and better science instruction in elementary schools in the United States. This book presents lessons that accommodate every elementary teacher's need to be efficient. You can teach so children learn science AND develop reading abilities.

Rodger W. Bybee
Executive Director, BSCS
Colorado Springs, Colorado

# Preface

A class of third-grade students laughs as their teacher reads Doreen Cronin's *Diary of a Worm*. Students are listening to the earthworm reading his diary, "June 15th: My older sister thinks she's so pretty. I told her that no matter how much time she spends looking in a mirror, her face will always look just like her rear end." The third-grade class giggles as the teacher continues to read the worm's hilarious diary entries. After the read aloud, the teacher leads students through a reading comprehension strategy called *questioning the author* (Beck et al. 1997) in which the students learn to think critically about what they are reading. The teacher models this by generating a list of questions to ask the author, such as "Is this accurate—a worm's head and tail look just alike? Can you tell a worm's head from its tail?" Students then observe live earthworms with hand lenses and read a nonfiction book about worms in an effort to find the answer. Through this exciting lesson, students construct their own understandings about earthworm adaptations, how earthworms help the earth, and how to design and conduct simple experiments to answer questions.

## What Is Picture-Perfect Science?

This scenario describes how a children's picture book can help guide students through an engaging, hands-on inquiry lesson. *More Picture-Perfect Science Lessons* contains 15 science lessons for students in kindergarten through grade four, with embedded reading comprehension strategies to help them learn to read and read to learn while engaged in inquiry-based science. To help you teach according to the National Science Education Standards, the lessons are written in an easy-to-follow format for teaching inquiry-based science: the Biological Sciences Curriculum Study 5E Instructional Model (Bybee 1997). This learning-cycle model allows students to construct their own understandings of scientific concepts as they cycle through the following phases: *engage, explore, explain, elaborate,* and *evaluate*. *More Picture-Perfect Science Lessons* is primarily a book for teaching science, but reading-comprehension strategies are embedded in each lesson. You can model these essential strategies throughout while you keep the focus of the lessons on science.

## Use This Book Within Your Science Curriculum

We wrote *More Picture-Perfect Science Lessons* to supplement, not replace, your school's existing science program. Although each lesson stands alone as a carefully planned learning cycle based on clearly defined science objectives, the lessons are intended to be integrated into a complete curriculum in which concepts can be more fully developed. The lessons are not designed to be taught sequentially. We want you to use *More Picture-Perfect Science Lessons* where appropriate within your school's current science program to support, enrich, and extend it. And we want you to adapt the lessons to fit your school's curriculum, the needs of your students, and your own teaching style.

# Special Features of the Book

## 1 Ready-To-Use Lessons With Assessments

Each lesson contains background for the teacher, engagement activities, hands-on explorations, student pages, suggestions for student and teacher explanations, opportunities for elaboration, assessment suggestions, and annotated bibliographies of more books to read on the topic. Assessments range from poster sessions with rubrics to student-created books to formal multiple-choice and extended-response quizzes.

## 2 Reading Comprehension Strategies

Reading comprehension strategies based on the book *Strategies that Work* (Harvey and Goudvis 2000) and specific activities to enhance comprehension are embedded throughout the lessons and clearly marked with an icon (  ). Chapter 2 describes how to model these strategies while reading aloud to students.

## 3 Standards-Based Objectives

All lesson objectives were adapted from *National Science Education Standards* (NRC 1996) and are clearly identified at the beginning of each lesson. Chapter 5 outlines the National Science Education Standards for K–4 and shows the correlation between the lessons and the Standards.

## 4 Science as Inquiry

As we said, the lessons in *More Picture-Perfect Science Lessons* are structured as guided inquiries following the 5E model. Guiding questions are embedded throughout each lesson and marked with an icon ( ? ). The questioning process is the cornerstone of good teaching. A teacher who asks thoughtful questions arouses students' curiosity, promotes critical thinking skills, creates links between ideas, provides challenges, gets immediate feedback on student learning, and helps guide students through the inquiry process. Each lesson includes an Inquiry Place, a section at the end of the lesson that suggests ideas for developing open inquiries. Chapters 3 and 4 explore science as inquiry and the BSCS 5E Instructional Model.

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**Editors' Note:**

*More Picture-Perfect Science Lessons* builds upon the texts of 29 children's picture books to teach science. Some of these books feature animals that have been anthropomorphized—forest animals talk, a worm keeps a diary. While we recognize that many scientists and educators believe that personification, teleology, animism, and anthropomorphism promote misconceptions among young children, others believe that removing these elements would leave children's literature severely underpopulated. Further, backers of these techniques not only see little harm in their use but also argue that they facilitate learning.

Because *More Picture-Perfect Science Lessons* specifically and carefully supports scientific inquiry—"That Magnetic Dog" lesson, for instance, teaches students how to weed out misconceptions by asking them to point out inaccurate statements about magnetism—we, like our authors, feel the question remains open.

# Acknowledgments

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# About the Authors

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**Emily Morgan** is a science consultant for the Hamilton County Educational Service Center. She formerly taught second- through fourth-grade science lab at Mason City Schools in Mason, Ohio, and seventh-grade science at Northridge Local Schools in Dayton, Ohio. She has a Bachelor of Science in Elementary Education from Wright State University and a Master of Science in Education from the University of Dayton. Emily lives in West Chester, Ohio, with her husband, Jeff, and their dog and two cats.

Karen Ansberry and Emily Morgan are the authors of *Picture-Perfect Science Lessons: Using Children's Books to Guide Inquiry (Grades 3-6)* published by NSTA Press in 2005. In collaboration with language arts consultant Susan Livingston, they received a Toyota Tapestry Award for their *Picture-Perfect Science* grant proposal in 2002.

Emily and Karen share a passion for science, nature, animals, travel, teaching, and children's literature. They enjoy working together to facilitate Picture-Perfect Science teacher workshops. This is their second book.

For more information on Picture-Perfect Science teacher workshops, go to:
*www.pictureperfectscience.com*

# About the Picture-Perfect Science Program

The Picture-Perfect Science program originated from Emily Morgan's and Karen Ansberry's shared interest in using children's literature to make science more engaging. In her 2001 master's thesis study involving 350 of Emily's third grade science lab students at Western Row Elementary, she found that students who used science trade books instead of the textbook scored significantly higher on district science performance assessments than students who used the textbook only. Convinced of the benefits of using picture books to engage students in science inquiry and to increase science understanding, Karen and Emily began collaborating with Sue Livingston, Mason's elementary language arts curriculum leader, in an effort to integrate literacy strategies into inquiry-based science lessons. They received grants from the Ohio Department of Education (2001) and Toyota Tapestry (2002) in order to train all third grade through sixth grade science teachers, and in 2003 also trained seventh and eighth grade science teachers with district support. The program has been presented both locally and nationally, including at the National Science Teachers Association national conferences in San Diego, Philadelphia, Dallas, and Nashville.

For more information on Picture-Perfect Science teacher workshops, go to: *www.pictureperfect-science.com*

# Why Read Picture Books in Science Class?

Think about a book you loved as a child. Maybe you remember the zany characters and rhyming text of Dr. Seuss classics like *One Fish Two Fish Red Fish Blue Fish* or the clever poems in Shel Silverstein's *Where the Sidewalk Ends*. Perhaps you enjoyed the page-turning suspense of *The Monster at the End of This Book* or the fascinating facts found in Aliki's *Digging Up Dinosaurs*. You may have seen a little of yourself in *Where the Wild Things Are, Ramona the Pest,* or *Curious George.* Maybe your imagination was stirred by the colorful illustrations in *The Very Hungry Caterpillar* or the stunning photographs in Seymour Simon's *The Moon*. You probably remember the warm, cozy feeling of having a treasured book like *Frog and Toad Are Friends* or *Charlotte's Web* being read to you by a parent or grandparent. But chances are your favorite book as a child was *not* your third-grade science textbook. The format of picture books offers certain unique advantages over textbooks and chapter books for engaging students in a science lesson. More often than other books, fiction and nonfiction picture books stimulate students on both the emotional and intellectual levels. They are appealing and memorable because children readily connect with the imaginative illustrations, vivid photographs, experiences and adventures of characters, engaging storylines, the fascinating information that supports them in their quest for knowledge, and the warm emotions that surround the reading experience.


*Teachers enjoy using picture books.*

What characterizes a picture book? We like what *Beginning Reading and Writing* says, "Picture books are unique to children's literature as they are defined by format rather than content. That is, they are books in which the illustrations are of equal importance as or more important than the text in the creation of meaning" (Strickland and Morrow 2000, p. 137). Because picture books are more likely to hold children's attention, they lend themselves

to reading comprehension strategy instruction and to engaging students within an inquiry-based cycle of science instruction. "Picture books, both fiction and nonfiction, are more likely to hold our attention and engage us than reading dry, formulaic text. … engagement leads to remembering what is read, acquiring knowledge and enhancing understanding" (Harvey and Goudvis 2000, p. 46). We wrote *More Picture-Perfect Science Lessons* (and the first volume, *Picture-Perfect Science Lessons*) so teachers can take advantage of the positive features of children's picture books by supplementing the traditional science textbook with a wide variety of high-quality fiction and nonfiction science-related picture books.

# The Research

## 1 Context for Concepts

Literature gives students a context for the concepts they are exploring in the science classroom. Children's picture books, a branch of literature, have interesting storylines that can help students understand and remember concepts better than they would by using textbooks alone, which tend to present science as lists of facts to be memorized (Butzow and Butzow 2000). In addition, the colorful pictures and graphics in picture books are superior to many texts for explaining abstract ideas (Kralina 1993). As more and more content is packed into the school day and higher expectations are placed on student performance, it is critical for teachers to teach more in the same amount of time. Integrating curriculum can help accomplish this. The wide array of high-quality children's literature available can help you model reading comprehension strategies while teaching science content in a meaningful context.

## 2 More Depth of Coverage

Science textbooks can be overwhelming for many children, especially those who have reading problems. They often contain unfamiliar vocabulary and tend to cover a broad range of topics (Casteel and Isom 1994; Short and Armstrong 1993; Tyson and Woodward 1989). However, fiction and nonfiction picture books tend to focus on fewer topics and give more in-depth coverage of the concepts. It can be useful to pair an engaging fiction book with a nonfiction book to round out the science content being presented.

For example, "Be a Friend to Trees," the Chapter 12 lesson, features *Our Tree Named Steve,* a poignant story of a father's recounting memories of the family's special tree. It is paired with *Be a Friend to Trees*, a nonfiction book that explains the importance of trees as sources of food, oxygen, and other essential things. The emotion-engaging storyline in *Our Tree Named Steve* hooks the reader, and the book *Be a Friend to Trees* presents facts and background information. Together they offer a balanced, in-depth look at how trees are important to people and animals.

## 3 Improved Reading and Science Skills

Research by Morrow et al. (1997) on using children's literature and literacy instruction in the science program indicated gains in science as well as literacy. Romance and Vitale (1992) found significant improvement in both science and reading scores of fourth graders when the regular basal reading program was replaced with reading in science that correlated with the science curriculum. They also found an improvement in students' attitudes toward the study of science.

## 4 Opportunities to Correct Science Misconceptions

Students often have strongly held misconceptions about science that can interfere with their learning. "Misconceptions, in the field of science education, are preconceived ideas that differ from those currently accepted by the scientific community" (Colburn 2003, p. 59). Children's picture books, reinforced with hands-on inquiries, can help students correct their misconceptions. Repetition of the correct concept by reading several books, doing a number of experiments, and inviting scientists to the classroom can facilitate a conceptual change in children (Miller, Steiner, and Larson 1996).

But teachers must be aware that scientific misconceptions can be inherent in the picture books. Although many errors are explicit, some of the misinformation is more implicit or may be inferred from text and illustrations (Rice 2002). This problem is more likely to occur within fictionalized material. Mayer's (1995) study demonstrated that when both inaccuracies and science facts are presented in the same book, children do not necessarily remember the correct information.

Scientific inaccuracies in picture books can be useful for teaching. Research shows that errors in picture books, whether identified by the teacher or the students, can be used to help children learn to question the accuracy of what they read by comparing their own observations to the science presented in the books (Martin 1997). Scientifically inaccurate children's books can be helpful when students analyze inaccurate text or pictures after they have gained understanding of the correct scientific concepts through inquiry experiences.

For example, in the "That Magnetic Dog" lesson, Chapter 13, after using magnets and reading a nonfiction book about magnets, students analyze an inaccurate sentence in the book *That Magnetic Dog* and then rewrite the sentence in a way that is scientifically correct. This process requires students to think critically: They apply what they have learned to evaluate and correct the misinformation in the picture book.

## Selection of Books

Each lesson in *More Picture-Perfect Science Lessons* focuses on one or more of the National Science Education Standards. We selected fiction and nonfiction children's picture books that closely relate to the Standards. An annotated "More Books to Read" section is provided at the end of each lesson. If you would like to select more children's literature to use in your science classroom, try *The Outstanding Science Trade Books for Students K–12* listing, a cooperative project between the National Science Teachers Association (NSTA) and the Children's Book Council (CBC). The books are selected by a book review panel appointed by the NSTA and assembled in cooperation with the CBC. Each year a new list is featured in the March issue of NSTA's elementary school teacher journal *Science and Children.* See *www.nsta.org/ostbc* for archived lists.

When you select children's picture books for science instruction, you should consult with a knowledgeable colleague who can help you check them for errors or misinformation. You might talk with a high school science teacher, a retired science teacher, or a university professor. To make sure that the books are developmentally appropriate or lend themselves to a particular reading strategy you want to model, you could consult with a language arts specialist.

## Finding Out-of-Print Books

We have included the most up-to-date information we have, but children's picture books go in and out of print frequently. Check your school library, public library, or a used-book store for copies of out-of-print books. In addition, the following websites may be helpful:

- *www.abebooks.com*—abebooks.com is a large online marketplace for books that can locate new, used, rare, or out-of-print books through a community of more than 12,000 independent booksellers from around the world.
- *www.alibris.com*—Alibris connects people with books, music, and movies from thousands of independent sellers around the world. They offer more than 35 million used, new, and hard-to-find titles to consumers, libraries, and retailers.
- *www.bibliofind.com*—Bibliofind has combined with Amazon.com to provide millions of rare, used, and out-of-print books.
- *www.powells.com*—Powell's has an extensive list of both new and used books.

## Considering Genre

Considering genre when you determine how to use a particular picture book within a science

lesson is important. Donovan and Smolkin (2002) identify four different genres frequently recommended for teachers to use in their science instruction: story, non-narrative information, narrative information, and dual purpose. *More Picture-Perfect Science Lessons* identifies the genre of each featured book at the beginning of each lesson. Summaries of the four genres, a representative picture book for each genre, and suggestions for using each genre within the BSCS 5E learning cycle we use follow. (The science learning cycle known as the BSCS 5E Model is described in detail in Chapter 4.)

## Storybooks

Storybooks center on specific characters who work to resolve a conflict or problem. The major purpose of stories is to entertain, not to present factual information. The vocabulary is typically commonsense, everyday language. An engaging storybook can spark interest in a science topic and move students toward informational texts to answer questions inspired by the story. For example, "Bubbles," Chapter 6, uses Mercer Mayer's *Bubble, Bubble*, a story about a boy who buys a magic bubble maker that blows bubbles in the shapes of animals. The imaginative story hooks the learners and engages them in an investigation to find out if free-floating bubbles can really be different shapes or if they are always round.

Scientific concepts in stories are often implicit, so teachers must make the concepts explicit to students. As we mentioned, be aware that storybooks often contain scientific errors, either explicit or implied by text or illustrations. Storybooks with scientific errors can be used toward the end of a lesson to teach students how to identify and correct the inaccurate science. For example, "That Magnetic Dog," Chapter 13, features Bruce Whatley's *That Magnetic Dog*, a storybook that contains some scientific inaccuracies. Books like this can be powerful vehicles for assessing the ability of learners to analyze the scientific accuracy of a text.

## Non-narrative Information Books

Non-narrative information books are factual texts that introduce a topic, describe the attributes of the topic, or describe typical events that occur. The focus of these texts is on the subject matter, not specific characters. The vocabulary is typically technical. Readers can enter the text at any point in the book. Many contain features found in nonfiction such as a table of contents, bold-print vocabulary words, a glossary, and an index. Young children tend to be less familiar with this genre and need many opportunities to experience this type of text. Using non-narrative information books will help students become familiar with the structure of textbooks, as well as "real-world" reading, which is primarily nonfiction. Teachers may want to read only those sections that provide the concepts and facts needed to meet particular science objectives.

We wrote the articles included in some of the lessons (see chapters 4 and 12) in non-narrative information style to give students more opportunity to practice reading this type of text. For example, "Loco Beans," Chapter 9, includes an article written in an expository style that shows key words in bold print. Another example of non-narrative information writing is the book *Coral Reef Animals,* which contains nonfiction text features such as a table of contents, bold-print words, insets, a glossary, and an index. *Coral Reef Animals* is featured in "Over in the Ocean," Chapter 11. The appropriate placement of non-narrative information text in a science learning cycle is after students have had the opportunity to explore concepts through hands-on activities. At that point, students are engaged in the topic and are motivated to read the non-narrative informational text to learn more.

## Narrative Information Books

Narrative information books, sometimes referred to as "hybrid books," provide an engaging format for factual information. They communicate a sequence of factual events over time and sometimes

recount the events of a specific case to generalize to all cases. When using these books within science instruction, establish a purpose for reading so that students focus on the science content rather than the storyline. In some cases, teachers may want to read the book one time through for the aesthetic components of the book and a second time for specific science content. *Rachel Carson: Preserving a Sense of Wonder*, an example of a narrative information text, is used in "A Sense of Wonder," Chapter 20. This narrative chronicles the life and legacy of groundbreaking environmentalist Rachel Carson. The narrative information genre can be used at any point within a science learning cycle. This genre can be both engaging and informative.

## Dual-Purpose Books

Dual-purpose books are intended to serve two purposes: present a story and provide facts. They employ a format that allows readers to use the book like a storybook or to use it like a non-narrative information book. Sometimes information can be found in the running text, but more frequently it appears in insets and diagrams. Readers can enter on any page to access specific facts, or they can read the book through as a story. You can use the story component of a dual-purpose book to engage the reader at the beginning of the science learning cycle. For example, Chapter 9 features the book, *Lucas and His Loco Beans*, which is used to engage the students in an investigation of the life cycle of the Mexican Jumping Bean Moth.

Dual-purpose books typically have little science content within the story. Most of the informational ideas are found in the insets and diagrams. If the insets and diagrams are read, discussed, explained, and related to the story, these books can be very useful in helping students refine concepts and acquire scientific vocabulary *after* they have had opportunities for hands-on exploration. *Imaginative Inventions* is a dual-purpose book featured in Chapter 19. Each page contains a humorous poem about an invention with insets on the edge of the page that list facts about the invention.

## Using Fiction and Nonfiction Texts

As we mentioned previously, pairing fiction and nonfiction books in read alouds to round out the science content being presented can be useful. Because fiction books tend to be very engaging for students, they can be used to hook students at the beginning of a science lesson. But most of the reading people do in everyday life is nonfiction. We are immersed in informational text every day, and we must be able to comprehend it in order to be successful in school, at work, and in society. Nonfiction books and other informational text such as articles should be used frequently in the elementary classroom. They often include text structures that differ from stories, and the opportunity to experience these structures in read alouds can strengthen students' abilities to read and understand informational text. Duke (2004) recommends four strategies to help teachers improve students' comprehension of informational text. Teachers should

- increase students' access to informational text,
- increase the time they spend working with informational text,
- teach comprehension strategies through direct instruction, and
- create opportunities for students to use informational text for authentic purposes.

*More Picture-Perfect Science Lessons* addresses these recommendations in several ways. The lessons expose students to a variety of nonfiction picture books and articles on science topics, thereby increasing access to informational text. The lessons explain how anticipation guides, pairs reading, and using nonfiction features all help improve students' comprehension of the informational text by increasing the time they spend working with it. Each lesson also includes instructions for explicitly teaching comprehension strategies within the learning cycle. The inquiry-based lessons provide an authentic purpose for reading informational

text, as students are motivated to read or listen in order to find the answers to questions generated within the inquiry activities.

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# Imaginative Inventions

## Description

Learners explore the invention process by learning about inventions throughout history and how inventions fill needs or wants, by improving existing inventions, and by keeping a toy invention journal. They further their understandings of the risks and benefits of inventions by testing toys and comparing the fun rating and the safety rating of each toy.

## Suggested Grade Levels: 2–4

## Lesson Objectives Connecting to the Standards

**Content Standard E: Science and Technology Abilities of Technological Design**

- Identify a simple problem, and identify a specific task and solution related to the problem.
- Propose a solution to make something work better.
- Evaluate a product or design made by themselves or others.

**Content Standard E: Science and Technology Understanding About Science and Technology**

- Understand that people have always had problems and invented tools and techniques to solve problems.
- Understand that trying to determine the effects of solutions helps people avoid some new problems.

## Featured Picture Books



| | *Imaginative Inventions* | *Leo Cockroach, Toy Tester* |
|---|---|---|
| Title | | |
| Author | Charise Mericle Harper | Kevin O'Malley |
| Illustrator | Charise Mericle Harper | Kevin O'Malley |
| Publisher | Little, Brown | Walker |
| Year | 2001 | 1999 |
| Genre | Dual Purpose | Story |
| Summary | The who, what, where, when, and why of roller skates, potato chips, marbles, and pie told in rhyming verse. | Leo Cockroach, who secretly tests toys for the bug-hating president of a toy company, seeks a job with the competitor across the street and finds himself worse off than before. |

## Time Needed

This lesson will take several class periods. Suggested scheduling is as follows:

Day 1: **Engage** with *Imaginative Inventions* read aloud, and **Explore/Explain** with Improve an Invention.

Day 2: **Elaborate** with *Leo Cockroach, Toy Tester* read aloud and Toy Testing.

Day 3 and Beyond: **Evaluate** with Toy Invention Journal and Advertising Poster.

## Materials

One standard Frisbee flying disc

One pie tin

Several "new and improved" versions of flying discs (or pictures of them) such as a foam flying disc, the Glow in the Dark Frisbee, or an Aerobie ring

Other examples of inventions from the book *Imaginative Inventions*, such as eyeglasses, high-heeled shoes, roller skates, flat-bottomed paper bags, marbles, and piggy banks

2 types of inexpensive simple toys to test (1 of each per student or pair), such as blow ball pipes, finger traps, jumping frogs

Fun Ratings overhead

Safety Ratings overhead

## Student Pages

My Improved Invention

Toy Testing

My Toy Invention Journal

**Inexpensive toys are available from**

*www.orientaltrading.com*

and

WorldWise Sheridan

*www.classroomgoodies.com*

## Background

The design process in technology is the parallel to inquiry in science. In scientific inquiry, students explore ideas and propose explanations about the natural world, whereas in technological design students identify a problem or need, design a solution, implement a solution, evaluate a product or design, and communicate the design process. In grades K–4, the standards suggest studying familiar inventions to determine function and to identify problems solved, materials used, and how well the product does what it is supposed to do. The purpose of this lesson is to encourage students' creativity, imagination, and problem-solving skills with activities that focus on the technological design process.

In today's fast-growing, highly competitive global marketplace, innovative thinking is more important than ever. Technology involves using science to solve problems or meet needs, and the understanding of technology can be developed by challenging students to design a solution to solve a problem or invent something to meet a need. Simply stated, inventors try to solve problems. They think about peoples' *needs* and come up with a solution. Inventions don't have to be entirely new ideas. Sometimes they can be add-ons or improvements to existing inventions. All inventions have *benefits* (good things that result from using them) and *risks* (possible hazards that may result from using them). Inventors must be sure the benefits of their inventions outweigh the risks.

# Engage

## *Imaginative Inventions* Read Aloud

### Making Connections: Text to World

Show the cover of the book, *Imaginative Inventions,* and introduce the author and illustrator. Ask

- What is an invention? (Something that is made to meet a need or solve a problem.)
- What is the difference between an invention and a discovery? (An invention is something that is created; a discovery is something that is found for the first time. For example, Ben Franklin discovered that lightning is electrical current, but he invented the lightning rod.)
- What do inventors do? (They think about people's needs or problems and come up with solutions.

Build connections to the author by reading the inside flap of the book about Charise Mericle Harper's favorite invention ("… muffins, which taste a lot like cake, but you get to eat them for breakfast!") Ask

- What do you think is the greatest thing ever invented? Turn and talk to a partner.

### Inferring: Stop and Jot

Select several of the inventions in the book to read about. As you read each two-page spread, leave out the name of the invention and instead say "this invention." Have students make inferences about the identity of each invention using clues from the text and illustrations. They can stop and jot their guesses on sticky notes as you read. After reading each description, reveal the name of the invention and then have students identify the need or want that the invention filled.

# Explore/ Explain

## Improve an Invention

Explain that instead of coming up with completely new inventions, inventors often think of ways to make an old one better. A good example of this involves the improvements made to a very popular toy, the Frisbee. Make a T-chart with the words *benefit* and *risk* on the board. Discuss that all inventions can have both benefits (good results) and risks (bad results) for people and the environment. Ask the following questions, and write the students' responses on the T-chart:

- What are the possible benefits of a Frisbee? (Answers might include: You can have fun with it and get exercise using it.)
- What are the possible risks of a Frisbee? (Answers might include: You could get hurt if hit by a Frisbee, you could lose it outside, creating litter and making Frisbees in factories could cause pollution.)


*Comparing flying toys*

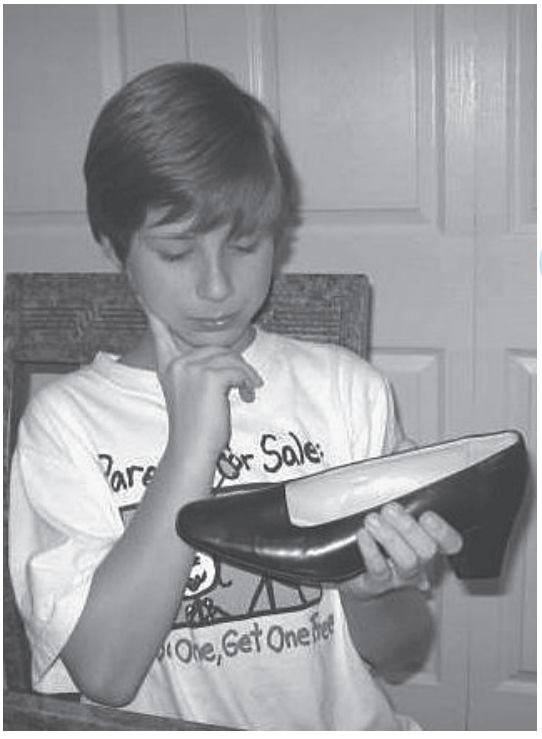
Explain that the original Frisbee had a serious risk: It was made of a very hard plastic that could really hurt if it hit you! Inventors improved upon this by making it from a softer material so the Frisbee was less risky to use. Demonstrate the evolution of Frisbee design by showing students a pie tin as well as several "new and improved" versions of flying discs such as lightweight foam versions, the Glow-in-the-Dark Frisbee, or an Aerobie ring. (You may want to take students outside to test some of the improved versions and compare them to the original.) Ask

? How are the new and improved Frisbees more fun or useful than the original?

? What are the benefits of the new and improved Frisbees?

? What are the possible risks of the new and improved Frisbees?

Explain that inventors try to improve products by increasing their benefits and reducing their risks.




*Brainstorming ways to improve an invention*

Now go back to *Imaginative Inventions* and write the names of the other inventions from the book on the board. Provide examples of several of these for students to look at, such as eyeglasses, high-heeled shoes, roller skates, flat-bottomed paper bags, and marbles. Have each student or group choose one of the inventions from the book and brainstorm ways that the invention could be improved upon.

Pass out the My Improved Invention student page. Have students select one of their ideas for improving an invention, draw a labeled picture of it, and give it a clever or descriptive name. They should also explain how their improved invention is more fun or more useful than the original and describe its risks and benefits. Student directions for the My Improved Invention page are as follows:

1. Which invention would you like to improve?
2. Draw and label your improved invention in the box below, and give it a new name.
3. How is your improved invention more fun or useful than the original?
4. What are the benefits of your improved invention?
5. What are the risks of your improved invention?

# elaborate

## *Leo Cockroach, Toy Tester* Read Aloud and Toy Testing

Introduce the author and illustrator of the book *Leo Cockroach, Toy Tester.* Kevin O'Malley first decided he wanted to illustrate children's books when he was in the fourth grade! He was in "time out" one day when he started reading *Where the Wild Things Are* by Maurice Sendak, and that book inspired him to write and illustrate humorous books for kids. (For more information on this author and illustrator, go to *http://mywebpages.comcast.net/komalley.*)


*Thumbs down for "The Pointy Stick"*

## Inferring

Ask students to look at the cover and title of the book and make an inference.

? What do you think this book is about?

? Do you think toy testing is a real job? (Toy companies have to test their toys for safety. Many toy companies also give children toys to test and observe their reactions to them.)

## Determining Importance

Before you begin reading the book, ask students to give a thumbs up for any toy in the book they think would be fun and safe and a thumbs down for any toy that they think would be boring or dangerous. Then read aloud *Leo Cockroach, Toy Tester*, making sure to read the name of each toy in the illustrations. After reading ask

? Why do companies need to test toys? (To see if the toys are both fun and safe.)

Discuss how most toys come with warning labels and/or directions for using the toy safely. Discuss the possible risks of various toys. For example, babies and young children often put things in their mouths. If a toy is too small, or contains small parts, it could be a choking hazard. If a toy is too sharp it could poke someone.

Then ask

? Would you like to be a toy tester?

Tell students that they are going to have a chance to be toy testers for Waddatoy Toys! Pass out the Toy Testing student page. On the board, write the name of one of the toys and label it "Toy A." Write the name of the other toy on the board and label it "Toy B." Give each student or pair of students both toys to test. They will be testing how much fun and how safe each toy is. Allow them several minutes of guided discovery with the toys. Then have them fill out the Toy Testing student page as shown:

**1** Play with the toys! Then draw and label each toy below.

| Toy A Drawing | Toy B Drawing |
|---|---|
| | |

**2** Give each toy a fun rating:

| | Toy A | | | Toy B | | |
|---|---|---|---|---|---|---|
| Fun | not fun | sort of fun | very fun | not fun | sort of fun | very fun |

**3** Give each toy a safety rating:

| | Toy A | | | Toy B | | |
|---|---|---|---|---|---|---|
| Safety | not safe | sort of safe | very safe | not safe | sort of safe | very safe |

**4** Which toy would you prefer to buy? Why?

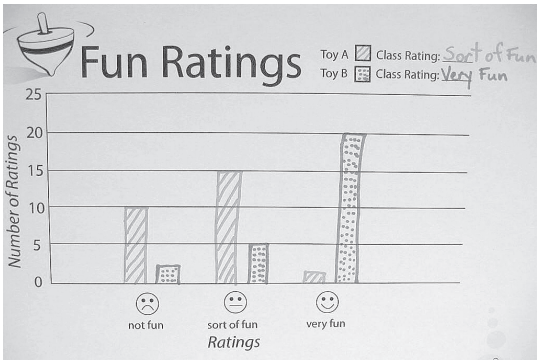
Briefly compare the ratings students gave the toys. Point out that not everyone gave the toys the same ratings. Then ask

**?** Do you think companies use only one toy tester? (No. It is good to have more than one opinion about a toy.)

## Overall Class Ratings

Discuss the idea that toy companies don't take just one person's opinion about a toy. They collect many people's opinions about a toy before making changes to the toy or before deciding to sell it in stores. Show students the Fun Ratings overhead. Point out the parts of the graph: the title, the x-axis label, the y-axis label, and the box with lines for summarizing the class ratings for Toy A and Toy B. Tell them that the graph will help them make a conclusion about the toy by showing everyone's ratings. Use a colored marker to color in the box for Toy A on the key. By a show of hands, count the number of "not fun" ratings and draw a bar using the color for Toy A. Then count the "sort of fun" and "very fun" ratings. Next, use a different-colored marker to color in the box for Toy B on the key. By a show of hands, count the number of "not fun" ratings and draw a bar using the color for Toy B. Repeat for the other two ratings.

Have students look carefully at all of the ratings on the graph. Have them come up with an overall class fun rating for Toy A by asking




*Sample fun ratings whole-class graph*

*Testing a Blow Ball Pipe*


*Warning label for a Blow Ball Pipe*

? Which fun rating did Toy A get most often?

Record that rating in the class rating box at the top of the graph. Then have students come up with an overall class fun rating for Toy B by asking

? Which fun rating did Toy B get most often?

Next, discuss what criteria students came up with to determine their safety ratings. See if students can locate a warning label on any of the toys or packaging, and discuss the possible risks of the toys. Then come up with an overall class safety rating for both toys using the Safety Rating overhead. Finally, ask students to compare the scores of both toys by comparing the class ratings. Ask

? Which toy scored higher for fun?

? Which toy scored higher for safety?

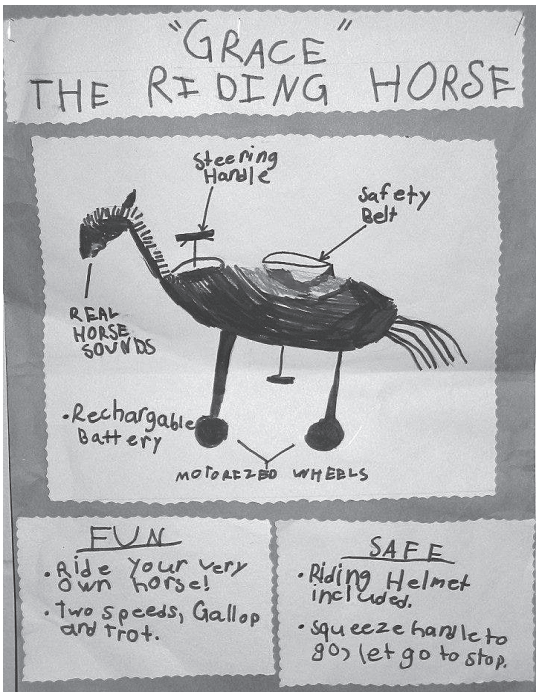
? Which toy would you prefer to buy? Why?

? How could you improve upon either of the toys?

## elaborate

### Toy Invention Journal and Advertising Poster

Tell students that they are going to have the opportunity to be toy inventors. Pass out the My Toy Invention Journal to each student. Tell them that they will be working with an adult helper at home to invent a new toy or improve a toy that they already have or know about. The journal will help them brainstorm ideas and keep track




*Sample toy advertisement*

of their invention process. You may want to have students actually build a prototype of the new or improved toy with an adult's help. The assignment concludes with a 3-2-1 poster advertising the new or improved toy. The poster should include:

- 3 points: A labeled drawing of the new or improved toy, including a creative name for the toy.
- 2 Points: Two reasons why people should buy the toy.
- 1 Point: Directions for using the toy safely or a warning label.
- Extra Credit: A catchy slogan, a jingle, or a drawing of the toy's packaging.

You can use the rubric in the Toy Invention Journal to score completed posters and provide comments.

## Inquiry Place

Have students brainstorm testable questions about toys, such as

- Which brand of toy car rolls the straightest? fastest?
- Does the size of a Frisbee affect how far it goes?
- Which brand of bubble solution makes the longest-lasting bubbles?

Then have students select a question to investigate as a class, or have groups of students vote on the question they want to investigate as a team. After they make their predictions, have them design an experiment to test their predictions. Students can present their findings at a poster session or gallery walk.

## More Books to Read

Dodds, D.A. 2004. *Henry's amazing machine*. New York: Farrar, Straus, and Giroux.

Summary: From the time Henry is a baby he loves to put things together—wheels with rods, switches with levers, cranks with gears. By the age of 6, he's built an Amazing Machine that fills his entire room. By the time he's 10, the machine has taken over the entire house—and the yard. His parents are proud of Henry, but they're getting a little worried. They can't help wondering: What does it do?

Lionni, L. 1974. *Alexander and the wind-up mouse*. New York: Dragonfly Books.

Summary: Alexander the mouse finds a friend to end his loneliness—Willy the wind-up mouse. When Willy is about to be thrown away, Alexander makes a selfless decision and with the help of a magic lizard saves his friend.

McGough, R. 1997. *Until I met Dudley: How everyday things really work*. New York: Walker.

Summary: A young girl used to have fantastic ideas about how things work, but Dudley, a pencil-wielding, bespectacled dog, tells her how it really is. This lively picture book explains the inner workings of mechanical objects such as vacuum cleaners, refrigerators, dishwashers, toasters, and garbage trucks.

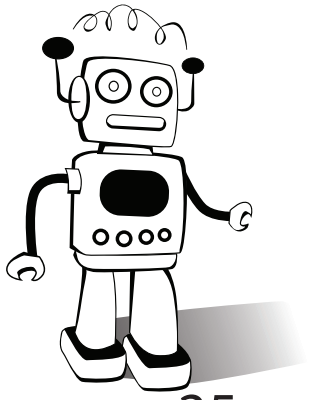
Taylor, B. 2003. *I wonder why zippers have teeth: And other questions about inventions*. New York: Kingfisher.

Summary: "What did people use before they had refrigerators?" and "Where do inventors get their ideas?" are some of the questions answered in this intriguing question-and-answer book about common household inventions.

## Websites

Houghton Mifflin Education Place Invention Convention
*www.eduplace.com/science/invention/overview.html*

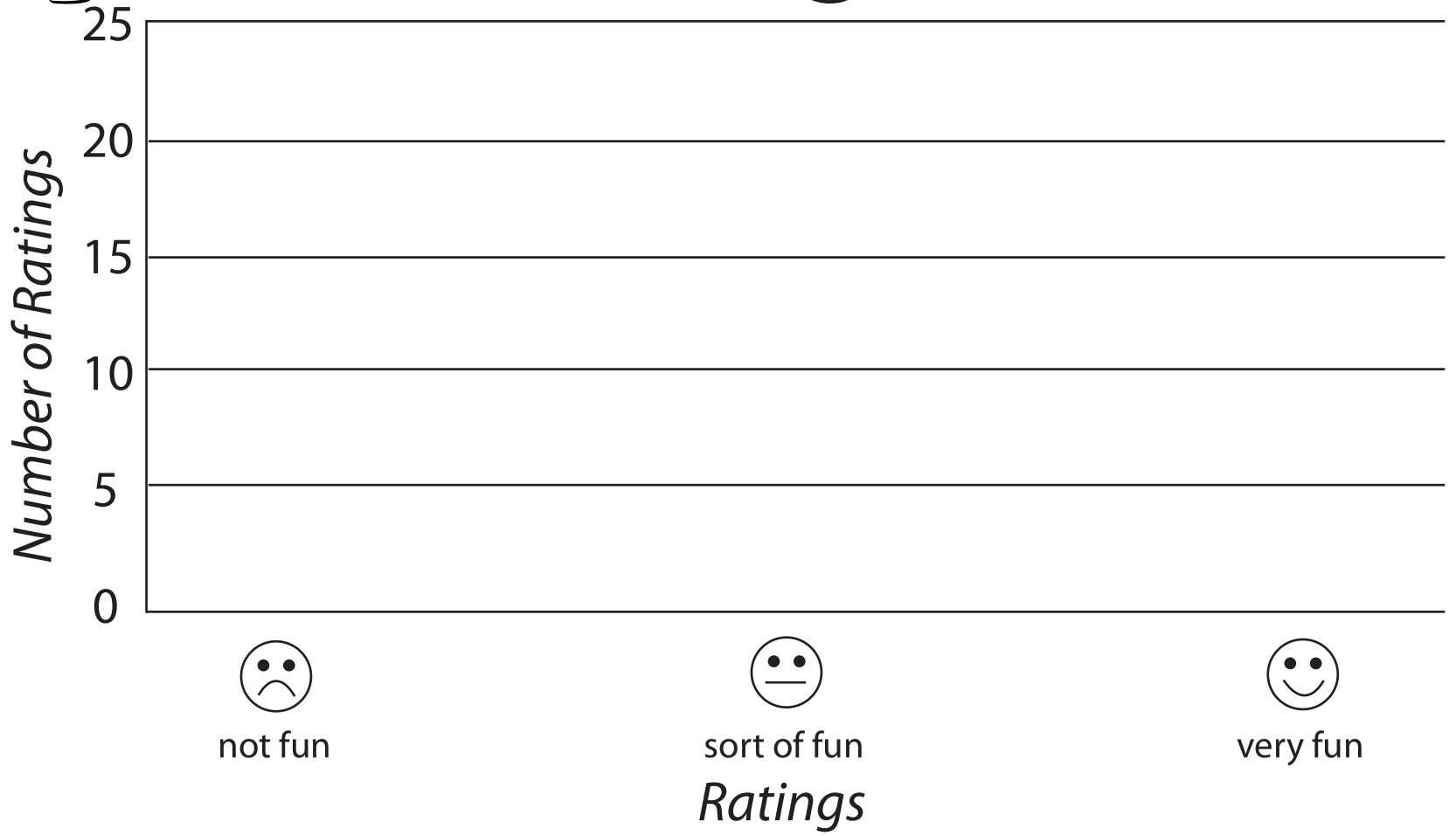
The History Channel History of Toys and Games
*www.historychannel.com/exhibits/toys*

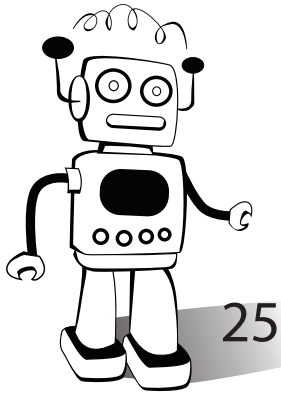


# Fun Ratings

Toy A ☐ Class Rating: _____

Toy B ☐ Class Rating: _____

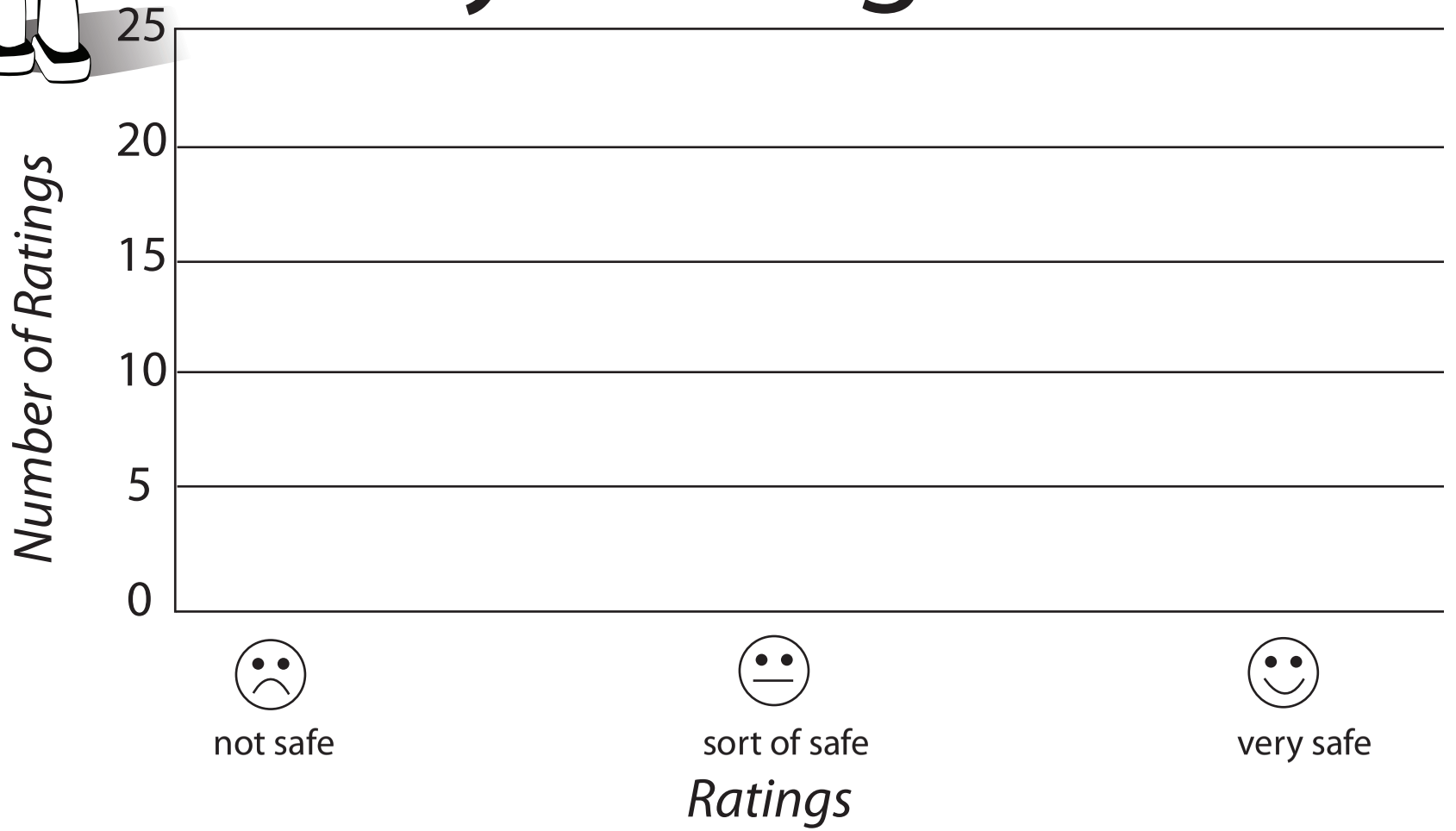




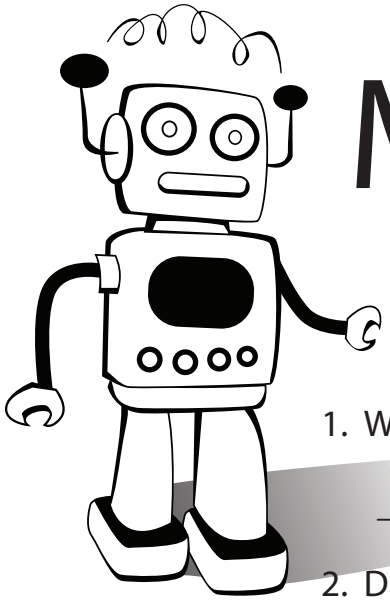
# Safety Ratings

Toy A ☐ Class Rating: _____

Toy B ☐ Class Rating: _____



*Name:* _____



# My Improved Invention

1. Which invention would you like to improve? _____

   _____

2. Draw and label your improved invention in the box below and give it a new name.

Name of My Improved Invention: _____

3. How is your improved invention more fun or useful than the original?

   _____

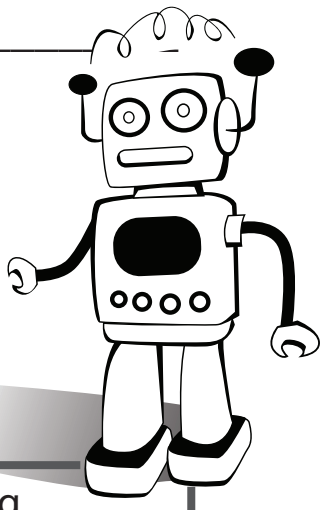
4. What are the benefits of your improved invention?

   _____

5. What are the risks of your improved invention?

   _____

*Name:* _____



# Toy Testing

You are a toy tester for Waddatoy Toys! Follow this procedure for each toy, and record your data below.

1. Play with the toys! Then draw and label each toy below.

| Toy A Drawing | Toy B Drawing |
|---|---|
| | |

2. Give each toy a fun rating:

| Toy A | | | Toy B | | |
|---|---|---|---|---|---|
| not fun | sort of fun | very fun | not fun | sort of fun | very fun |

3. Give each toy a safety rating:

| Toy A | | | Toy B | | |
|---|---|---|---|---|---|
| not safe | sort of safe | very safe | not safe | sort of safe | very safe |

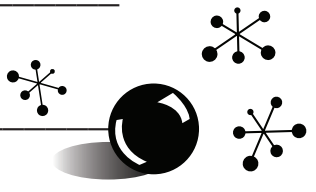
4. Which toy would you prefer to buy? Why? _____

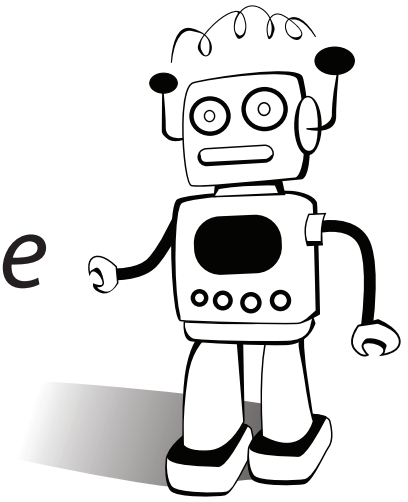
_____

# My Toy Invention Journal

Inventor: _____

Adult Helper: _____





# *Brainstorming Page*

Inventor

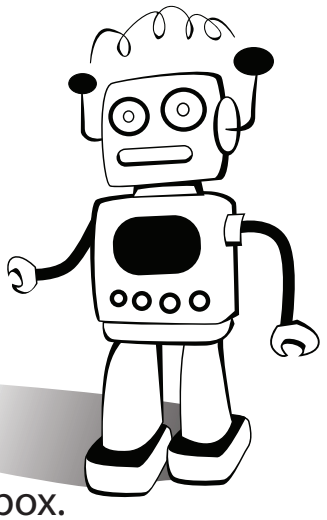
1 List some toys you like to play with:

Adult Helper

2 List some toys you liked to play with when you were a child:

Inventor and Adult Helper

3 List some toys you think could be more fun or more safe if they were improved:



# *Inventing Page*

Inventor and Adult Helper

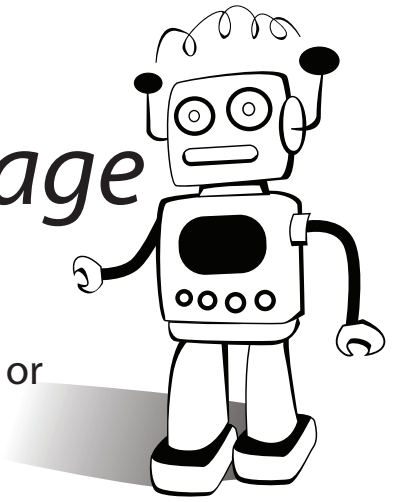
1 Invent a new toy, or choose one toy you are going to improve. Draw the new or improved toy in the box.

Name of Toy: _____

2 Fill out the T-chart to tell the benefits and risks of your new or improved toy.

| Benefits | Risks |
| --- | --- |
| | |

# *Advertising Poster Page*



Make a 3-2-1 poster to advertise your new or improved toy. Your poster should include:

3 Points: A labeled drawing of the new or improved toy, including a creative name for the toy.

3 2 1 0

2 Points: Two reasons why people should buy the toy.

2 1 0

1 Point: Directions for using the toy safely or a warning label.

1 0

Extra Credit: A catchy slogan, a jingle, or a drawing of the toy's packaging.

1 0

Total Points_____/6

Comments: _____

# Index

Note: Page numbers in *italics* refer to tables. Page numbers in **boldface** refer to student activity pages.