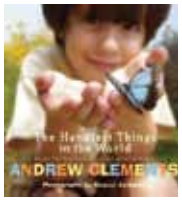
The Stealth Profession

By Emily Morgan and Karen Ansberry

Engineering is sometimes referred to as the "stealth" profession because, although we use thousands of designed objects each day, we seldom think about the engineering practices involved in the creation and production of these objects. This month's lessons give students not only an awareness of the work of engineers but also the opportunity to think like engineers.

This Month's Trade Books



The Handiest Things in the World
By Andrew Clements
Photographs by Raquel Jaramillo
Candlewick. 2010.
ISBN 9781416961666
Grades K–2

Synopsis

Simple rhyme and vivid photographs portray some of the everyday things we use to make life easier, including a dog leash, calculator, watering can, and umbrella. Each photograph on the left-hand page shows a child using their hands to do a task, while on the right-hand page is a photo of a "handy" invention completing the same task more efficiently.

Timeless Thomas: How Thomas Edison Changed Our Lives
By Gene Barretta
Henry Holt & Company. 2012.
ISBN 9780805091083
Grades 3–5

Synopsis

This clever book shows modern-day devices that had their beginnings in Edison's lab. Colorful and at times humorous illustrations depict Edison and his team of employees working in the lab, while the opposite side of each page shows present-day versions of his inventions. End matter includes a timeline of Edison's most famous inventions as well as short bios of some of his employees.

Curricular Connections

A Framework for K–12 Science Education identifies "Science and Engineering Practices" as one of three dimensions, and "Engineering, Technology, and Applications of Science" is included as a Disciplinary Core Idea (NRC 2012). Students are expected to have opportunities to use engineering practices in kindergarten through grade 12. This is a substantial shift, especially in the elementary classroom. By the end of grade 2, the *Framework* recommends that students understand that "Every human-made product is designed by applying some knowledge of the natural world and is built by using materials derived from the natural world" (NRC 2012, p. 213). This month's lesson for grades K–2 uses a simple picture book to open students' eyes to the "designed world."

In grades 3–5, the understandings about engineering and technology expand to include the development of technological designs in response to changing human needs and wants. Specifically, by the end of grade 5, students should understand that "Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), to decrease known risks (e.g., seat belts in cars), and to meet societal demands (e.g., cell phones). When new technologies become available, they can bring about changes in the way people live and interact with one another"(p. 213). This month's lesson for grades 3–5 focuses on how the inventions of Thomas Edison changed the world and that many of these inventions are still around today, but have been engineered to meet our changing needs as a society.

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Reference

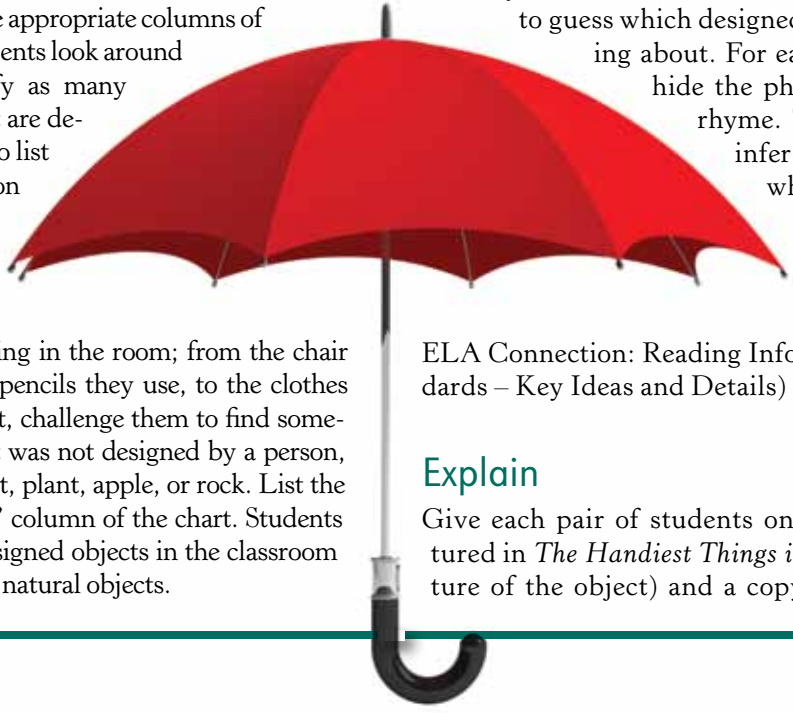
National Research Council (NRC). 2012. *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas.* Washington, DC: National Academies Press.

Grades K–2: The Handiest Things

Purpose: Students will recognize the difference between designed and natural objects, identify the problems that various objects were designed to solve, and come up with ways to improve upon these designs to make the objects more useful or more fun.

Engage

Show students an example of a natural object (plant or piece of fruit) and a designed object (marker or paper clip). Ask students what the differences are between the two objects. Ask guiding questions such as: *Where did it come from?* and *What is it made of?* Tell students that there are two types of objects in the world, those that are natural (like the plant or fruit) and those that are designed (like the marker or paper clip). Explain that most designed objects come from the work of engineers. Engineers are people who design new or improved objects and ways of doing things in order to make life better for people. They use science, math, and creativity to come up with their ideas. They spend a lot of time researching, talking to others about their work, sketching out plans, and then testing and improving their designs. Tell students that they can thank an engineer for many of the things that make their lives easier, safer, or even more fun. Then, make a T-chart on the board labeled "Designed" on one side and "Natural" on the other. List these two objects in the appropriate columns of the T-chart. Have students look around the room and identify as many things as they can that are designed objects. Begin to list some of these items on the "Designed" side of the T-chart. Students will quickly realize that this includes almost everything in the room; from the chair they are sitting in, to pencils they use, to the clothes they are wearing. Next, challenge them to find something in the room that was not designed by a person, such as a classroom pet, plant, apple, or rock. List the items in the "Natural" column of the chart. Students will notice that the designed objects in the classroom greatly outnumber the natural objects.



Materials

Per class:
Actual examples or pictures of some of the inventions featured in *The Handiest Things in the World*:

- chopsticks
- dog leash
- calculator
- butterfly net
- watering can
- umbrella
- broom
- baseball cap
- small gardening shovel
- comb
- paper fan
- drum or drum set
- meterstick
- hand mixer
- crayons
- earmuffs

Explore

Show students real examples of some of the designed objects featured in *The Handiest Things in the World* (see materials list). If you do not have all of the items, you could use a picture of the object to substitute. Explain that each of these items was designed by people to solve a problem. Tell students that as you read the book aloud, you would like them to guess which designed object you are reading about. For each two-page spread, hide the photos as you read the rhyme. Then, have students infer from the rhyme which of the objects the book is describing. After students have guessed, reveal the illustrations. (CC ELA Connection: Reading Informational Text Standards – Key Ideas and Details)

Explain

Give each pair of students one of the objects featured in *The Handiest Things in the World* (or a picture of the object) and a copy of the One Handy

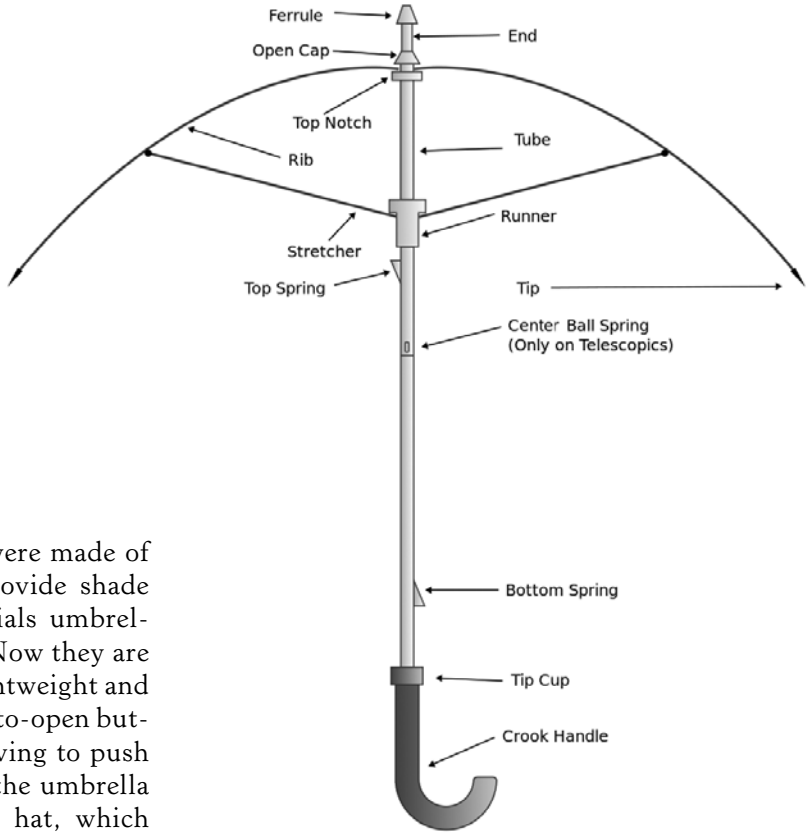
Thing student page (see NSTA Connection). Have them draw a picture of the designed object, identify the problem it solves, and write about what life would be like without it. Have students share their papers with at least two other pairs of students. After this discussion, ask students how long they think their designed object has been around. Is it something fairly new or something that has been around for a long time? As a class, research the history of some of the objects from the book. How long have they been around? How have they changed over the years? (See Internet Resources for some suggested websites.) (CC ELA Connection: Writing Standards – Research to Build and Present Knowledge)

Elaborate

Explain that instead of coming up with completely new inventions, engineers often think of ways to make an old one better. A good example of this involves improvements made over time to one of the objects featured in the book, the umbrella. Show students an umbrella and ask them to identify the problem that an umbrella solves. (It keeps you from getting wet in the rain.) Tell students that the first umbrellas were invented thousands of years ago and over time they have been improved. The first umbrellas were made of leaves or paper and were used to provide shade from the Sun. Over time, the materials umbrellas are made of have been improved. Now they are made of stronger materials that are lightweight and waterproof. Another example is the auto-open button on some umbrellas. Instead of having to push it open, you just touch a button and the umbrella pops open. Another is the umbrella hat, which frees up your hands while keeping you dry. (See Internet Resources for more information and photos regarding the history of the umbrella.) Have a discussion with the group about other ways the umbrella might be improved. How could it be more useful or fun?

Evaluate

Invite pairs of students to choose one of the featured objects from the book, other than the umbrella, to improve upon. Tell them that they are going to have the opportunity to think like engineers and brainstorm ways the object could be more useful or fun than the original. Once students have decided on a way to improve it, have them create a diagram of their improved invention and come up with a name for it. They should label the diagram and explain verbally or in writing why it is better than the original. (CC ELA Connections: Writing Standards – Text Types and Purposes)



NSTA Connection

Download the One Handy Thing and New Invention student pages and the Edison quotes at *www.nsta.org/SC1301.*

Grades 4–6: Timeless Thomas

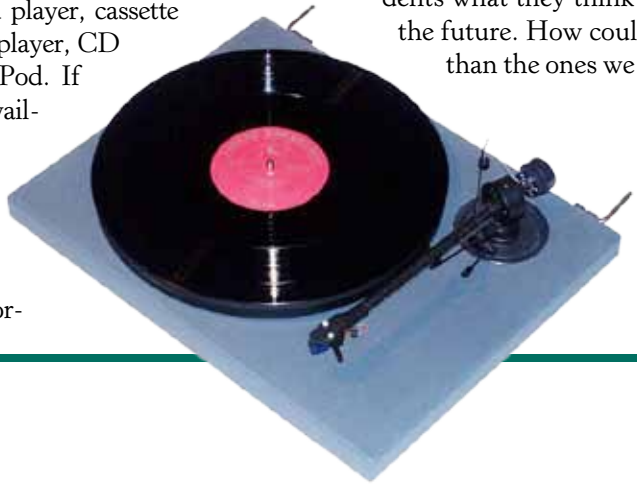
Purpose: Students will follow the evolution of sound recording devices beginning with Edison's phonograph and ending with present-day devices. Then, through a read-aloud, they will learn about many other inventions of Thomas Edison and how they have changed to meet the needs of the present day. Finally, they will research some of the top inventions of 2012 and share their research with others.

Engage

Start a conversation about music with your students by asking questions such as: What is your favorite song? Who is your favorite singer/band? How often do you listen to music? What do you use to play your music most of the time—iPod, phone, CDs? Then, show students a record or a cassette tape and ask them if they know what it is. (Some may know and others may have never seen one.) Tell students that before iPods, mp3 players, and CDs, this is how people (maybe even you?) listened to music.

Explore

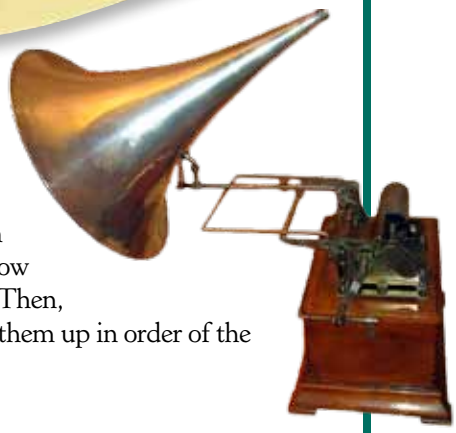
Tell students that the first sound recording device, the phonograph, was invented by the American inventor, Thomas Edison. Explain that before the phonograph, if people wanted to hear music, they had to go hear a live band or orchestra. Play Edison's first recording made by his phonograph in 1877 (see Internet Resources). Ask students what they think about the quality of the recording compared to the quality of recordings they hear nowadays. (They will realize that the recording has a lot of background noise and is not as clear as the recordings they are used to hearing.) Bring in some examples of audio players from over the years for students to explore, such as a record player, cassette tape player, 8-track tape player, CD player, mp3 player, or iPod. If actual examples are unavailable, print photos from an internet search. Demonstrate how each device works, including how to start and stop the music, go forward and backward, and so on. If possible, give students a chance to listen to the sound quality produced by each device and tell them how many songs each holds. Then, have students try to line them up in order of the year they were invented.



Materials

Actual recording devices and players from over the years (or photos of them), such as:

- record album
- record player
- cassette tape
- cassette tape player
- 8-track tape
- 8-track player
- mp3 player
- CD
- CD player
- iPod, and so on



- Record – 1895
- Compact Cassette Tape – 1963
- 8-Track – 1965
- Compact Disc – 1982
- mp3 – 1993
- iPod – 2003

Ask students to think about how each one is better than the one that preceded it. For example, a compact cassette tape is better than a record player because it is easier to transport and holds more music. The CD is better than the cassette tape because it has better sound quality, holds more songs, and you don't have to rewind it to listen to a song again. For fun, ask students what they think music players might be like in the future. How could they be designed to be better than the ones we use today?

Explain

Tell students they are going to learn more about the person who invented that first sound recording device, the phonograph. Show them the

cover of the book, *Timeless Thomas: How Thomas Edison Changed Our Lives.* Tell them that as you read, you would like them to listen for the other inventions that Edison invented (most of them over 100 years ago) and how they are still part of our lives today. After reading, call on students to share one of Edison's inventions that they enjoy a version of today, and discuss how the invention has been improved over the years. (CC ELA Connection: Reading Standards: Informational Text – Key Ideas and Details)

Elaborate

Tell students that Thomas Edison is considered one of the greatest engineers of all time. An engineer is a person who designs solutions to problems. Ask students what qualities Edison had that made him so successful in his career. (Students will have learned from the book that Edison was intelligent, was always looking for problems to solve, would fail many times and not give up, and worked closely with a team of others.) Form student groups of four and give each one of them a strip of paper with a quote from Thomas Edison, such as:

- Genius is 1% inspiration and 99% perspiration.
- I have not failed. I have just found 10,000 ways that do not work.
- Our greatest weakness lies in giving up. The most certain way to succeed is to try just one more time.
- Just because something doesn't do what you planned it to do doesn't mean it's useless.
- I never did a day's work in my life. It was all fun.
- I have friends in overalls that I would not swap for the favor of the kings of the world.
- To invent, you need a good imagination and a pile of junk.
- If we did all the things we were capable of, we would literally astound ourselves.

(See NSTA Connection for premade strips with these quotes.) Ask them to read the quote, look up any words they don't know, discuss the meaning with their group, and consider what the quote tells us about Thomas Edison. Then have each group share their Edison quote and interpretation with the rest of the class. After everyone is done sharing, ask what these quotes tell us about Thomas Edison as a person. (He didn't give up, he did not let failure make him quit, he loved the work he did, and so on.)

Evaluate

Convey to students that one thing that will never change is that people are always going to be inventing new things. Show them some of the top inventions of the past year from *Time* Magazine, *Popular Science*, or other sources that rate inventions (see Internet Resources). (You may want to screen these sites for advertisements or print out some of the photos and descriptions to avoid the ads altogether.) Have students select a new invention to research. They can use the New Invention student page (see NSTA Connection) to record information about the invention: its inventor, its purpose, whether it is something brand-new or an improvement upon an existing invention, as well as advantages and disadvantages of the invention. When they finish, give students an opportunity to share the invention they researched with others, whether whole-class or small-group. (CC ELA Connection: Writing Standards – Research to Build and Present Knowledge)

Internet Resources

Behind the Earmuff
www.kidzworld.com/article/880-behind-the-earmuff

Edison's First Sound Recording: Mary Had a Little Lamb
http://archive.org/details/EDIS-SCD-02

History of Umbrellas
www.oakthriftumbrellas.com/pages/umbrellas4.htm

Popular Science 2012 Invention Awards
www.popsci.com/category/category-badges/invention-awards-2012

Thomas Edison National Historic Park, New Jersey
www.nps.gov/edis/index.htm

Time Magazine Best Inventions of 2012
http://techland.time.com/2012/11/01/best-inventions-of-the-year-2012/slide/all/

Umbrella Hat
www.umbrellahat.net/

Who Invented the Crayon?
www2.crayola.com/canwehelp/contact/faq_view.cfm?id=246

Who Invented the Umbrella?
http://inventors.about.com/od/uvstartinventions/a/Umbrella.htm

Connecting to the Common Core

This section provides a link between *A Framework for K–12 Science Education* and the Common Core for English Language Arts and/or Mathematics to allow for cross-curricular planning and integration.

Standards state that students should be able to do the following at grade level.

English/Language Arts

Reading Standards for Informational Text K–5—Key Ideas and Details

- Kindergarten: "With prompting and support ask and answer questions about key details in a text."
- Grade 1: "Ask and answer questions about key details in a text."
- Grade 2: "Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text."
- Grade 3: "Describe the relationship between a series of historical events, scientific ideas or concepts, a historical, scientific, or technical text, including cause/effect."
- Grade 4: "Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text," and "Explain events, procedures, ideas, or concepts in or steps in technical procedures in a text, using what happened and why, based on specific language that pertains to time, sequence, and information in the text."
- Grade 5: "Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text," and "Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text."

Writing Standards—Research to Build and Present Knowledge

- Kindergarten and Grade 1: "With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question."
- Grade 2: "Recall information from experiences or gather information from provided sources to answer a question."
- Grade 3: "Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories."
- Grade 4: "Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources."
- Grade 5: "Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources."

Writing Standards—Text Types and Purposes

- Kindergarten: "Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic."
- Grade 1: "Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure."
- Grade 2: "Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section."

Connecting to the Standards

This article relates to the following National Science Education Standards (NRC 1996):

Content Standards

Grades K–8

Standard E: Science and Technology

- Abilities of technological design
- Understanding about science and technology

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.