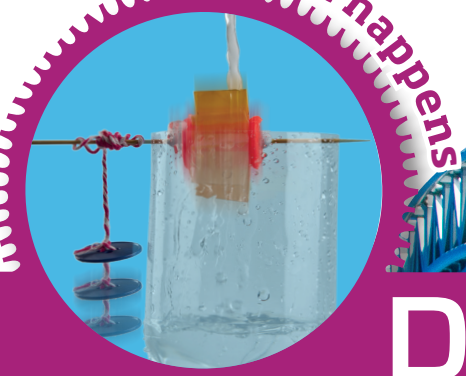
HOW TO BE AN Engineer



DISCOVER
amazing facts

DO
fun activities

ASK
the questions

Teacher's Guide

Prepared by
Tricia Leysath for RIF Reading Is Fundamental
RIF.org

HOW TO BE AN Engineer

Teacher's Guide

Note to Educators

How to Be an Engineer encourages students to think critically and act like engineers by completing engaging projects using materials commonly found in the home or classroom. Instructions are provided for more than 30 experiments that guide students through testing their ideas and using their imaginations to solve problems. Introducing students to the wonders of science and engineering through this eye-catching book may inspire them to pursue a career in engineering, just like the groundbreaking engineers the book highlights.

The introduction includes an explanation of "How the Book Works," a text box on safety, and a "Getting Ready" section to read before starting the experiments. The "Did You Know?" section on pages 136–137 defines the types of engineering and power, and includes other interesting facts. The book concludes with an extensive glossary and an index.

Projects are grouped into five categories: Amazing Materials (seven projects), Strong Structures (six projects), Mighty Machines (seven projects), Getting Around (eight projects), and Incredible Energy (five projects). Each project includes an introduction to the topic and instructions for completing the project. Each project also includes either a brief discussion of a real-world application or a simple explanation of the engineering concept behind the activity, which may include friction, physical and chemical changes, or energy transfer. Stories of great engineers and their discoveries are mixed in with the projects, and the book also includes nine two-page spreads on topics such as robots, computers, and simple machines.

Large, colorful pages with plenty of blank space, clear headings, and numbered instructions will appeal to students accustomed to reading information on a screen. Instructions for each project include a brief introductory paragraph followed by images of required materials rather than a simple list. Each step is also clearly illustrated with pictures of the project at each stage.

As students read the book, have them keep a list of projects they are especially interested in completing, noting why they are interested in the project and what they hope to discover. You may then choose to follow your students' interests while aligning the projects you choose to complete as a class with grade-level standards.

This book is recommended for students in grades 2–4.

Lesson Plan

For additional resources go to RIF's Literacy Central (***www.rif.org/DK***). There you'll find word lists, puzzles, games, and other resources.

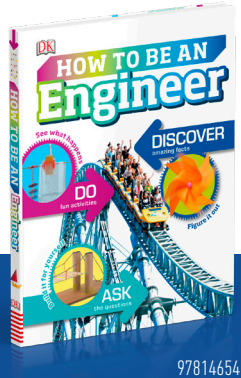
Discussion Questions

Pre-Reading Questions

What is an engineer? What types of problems might be solved by engineers? What are some different types of engineering?

Reading

Make the book available for students to read in the classroom. Once all students have had time to examine the book, discuss the post-reading questions below and give students the opportunity to look at the book again to answer them.



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Discussion Questions

Post-Reading Questions

1 How is a scientist different from an engineer? How are they the same? Find details from the book on pages 5–9 to support your answer. (CCSS.ELA-LITERACY.RI.2.1, CCSS.ELA-LITERACY.RI.3.1, CCSS.ELA-LITERACY.RI.4.1, CCSS.ELA-LITERACY.RI.2.2, CCSS.ELA-LITERACY.RI.3.2, CCSS.ELA-LITERACY.RI.4.2)

2 It's important for engineers to have the proper tools, but being an engineer also requires you to think about things in different ways. How can you think like an engineer? Find details from the book on pages 8–9 to support your answer. (CCSS.ELA-LITERACY.RI.2.1, CCSS.ELA-LITERACY.RI.3.1, CCSS.ELA-LITERACY.RI.4.1)

3 What do we mean when we talk about the "properties" of material? Why is it important for engineers to understand the properties of different materials? Find examples from the book, beginning on page 10, to support your answer. (CCSS.ELA-LITERACY.RI.2.4, CCSS.ELA-LITERACY.RI.3.4, CCSS.ELA-LITERACY.RI.4.4)

4 Look at the opening pages of the five chapters of this book: Amazing Materials, Strong Structures, Mighty Machines, Getting Around, and Incredible Energy. What do you think are the topics that will be covered in each section? Are any of the words words unfamiliar to you? Hint: In addition to the introduction paragraph, look closely at the pictures and the design on the page. (CCSS.ELA-LITERACY.RI.2.4, CCSS.ELA-LITERACY.RI.3.4, CCSS.ELA-LITERACY.RI.4.4, CCSS.ELA-LITERACY.RI.2.3, CCSS.ELA-LITERACY.RI.3.3, CCSS.ELA-LITERACY.RI.4.3, CCSS.ELA-LITERACY.RI.2.5, CCSS.ELA-LITERACY.RI.3.6) (NGSS-3-ESS3-1)

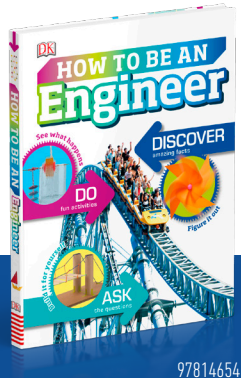
5 Find examples from the book about some of the challenges our world faced in the past. How can completing the related projects help you to understand how those problems were solved? What problem would you like to solve at home or at school using engineering? (CCSS.ELA-LITERACY.RI.2.3, CCSS.ELA-LITERACY.RI.3.3, CCSS.ELA-LITERACY.RI.4.3) (NGSS-K-2-ETS1-2, NGSS-4-ESS3-2)

6 Many projects include a subsection describing a real-world application of the activity. Why is it important to understand the scientific concepts and the real-world applications of each project? How does learning about the real-world applications help you to understand the goal of each project? (CCSS.ELA-LITERACY.RI.2.5, CCSS.ELA-LITERACY.RI.3.5, CCSS.ELA-LITERACY.RI.2.7, CCSS.ELA-LITERACY.RI.3.7, CCSS.ELA-LITERACY.RI.4.7)

7 The projects in this book contain detailed step-by-step instructions along with clear images of each step in the process. How do the written instructions help you? What do the images add to your understanding of the process? What would happen if you skipped a step? (CCSS.ELA-LITERACY.RI.2.7, CCSS.ELA-LITERACY.RI.3.7, CCSS.ELA-LITERACY.RI.4.7)

8 When you look at each project, where do your eyes go first for information? Discuss how the design of the book, including different fonts and text sizes, sidebars, headings, use of color, and images, affects how you read the book and what information you identify as important. (CCSS.ELA-LITERACY.RI.2.5, CCSS.ELA-LITERACY.RI.3.5, CCSS.ELA-LITERACY.RI.2.7, CCSS.ELA-LITERACY.RI.3.7, CCSS.ELA-LITERACY.RI.4.7)

9 Which of the projects in this book would you most like to complete? Make a plan for completing this project, including where you will access materials, where and when you will complete the project, whether you will need help, and how you will record and share your results. (CCSS.ELA-LITERACY.RI.2.3, CCSS.ELA-LITERACY.RI.3.3, CCSS.ELA-LITERACY.RI.4.3)



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Cross-Curricular Activities (Review and Assessment)

1. Writing Activity: Life Without Engineers

Divide students into small groups. Assign students one of the five categories (Amazing Materials, Strong Structures, Mighty Machines, Getting Around, or Incredible Energy). Ask them to choose an item from their chapter and use an age-appropriate combination of drawing and writing to describe what their life would be like if an engineer had never created that item.

(CCSS.ELA-LITERACY.W.2.3, CCSS.ELA-LITERACY.W.3.3, CCSS.ELA-LITERACY.W.4.3, CCSS.ELA-LITERACY.W.2.7, CCSS.ELA-LITERACY.W.3.7, CCSS.ELA-LITERACY.W.4.7, CCSS.ELA-LITERACY.W.2.8, CCSS.ELA-LITERACY.W.3.8, CCSS.ELA-LITERACY.W.4.8)

2. Data Gathering Activity: Staying Afloat

Divide the class into small groups. Conduct the experiment "Staying Afloat" on pages 94–95. Have the students create, or provide students with, a data collection chart. Have students record in their charts how many marbles each boat can hold before it begins to sink. Review the forces of gravity and buoyancy and discuss possible reasons why different boats were able to support different numbers of marbles.

Add-on activities: Disassemble the boats and allow students to design their own boats to conduct the experiment. Alternatively, using the same materials, create one or two large boats as a class. How can you transport the most marbles, with many small boats or with one large boat?

(CCSS.ELA-LITERACY.W.2.3, CCSS.ELA-LITERACY.W.3.3, CCSS.ELA-LITERACY.W.4.3)
(NGSS.2-PS1-2, NGSS.2-PS1-3, NGSS-2-ETS1-1, NGSS-2-ETS1-2, NGSS-2ETS1-3, NGSS-PS2-1)

3. Research Activity: Types of Engineers

Create a "Type of Engineer" fold-up book using page 136 as a guide. Use available digital resources and other books brought into the classroom to discuss the different types of engineering. Discuss where different engineers work and what they design. Look at the different experiments in the book and determine what type of engineering is being used in the activity. Look around the room at different objects and determine what type of engineer may have created the object. Make sure each student has a chance to contribute at least one item. Choose an age-appropriate follow-up question for students to answer about all or a selection of engineers. Sample follow-up questions: What would you like and not like about being this type of engineer? How have the inventions/designs on this page changed or been improved over time? If you were this type of engineer, what would you invent? Has this invention changed since you were born? How might it be different in the future?

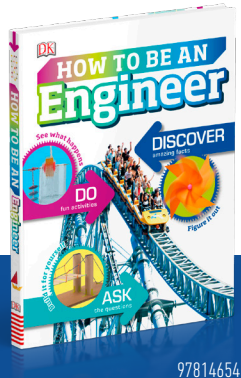
Each page of the book should include the following types of information.

1) Type of Engineer

2) Inventions/problems solved

3) Follow-up question

(CCSS.ELA-LITERACY.RI.2.3, CCSS.ELA-LITERACY.RI.3.3, CCSS.ELA-LITERACY.RI.4.3, CCSS.ELA-LITERACY.SL.2.1, CCSS.ELA-LITERACY.SL.3.1, CCSS.ELA-LITERACY.SL.4.1)



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Cross-Curricular Activities (Review and Assessment)

4. Multimedia Presentation: Famous Engineers

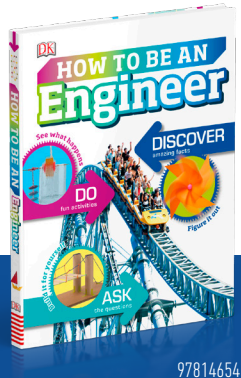
Individually or in small groups, using the digital resources available to you and other books brought into the classroom, have students research a famous engineer. Have students create a multimedia presentation that includes text, images, charts and graphs, video and audio clips, and/or other multimedia elements as appropriate, making sure all students have a chance to practice using digital tools. The presentation should include details about the chosen engineer as well as their important engineering accomplishment. Have each individual or group present their findings to the other students, making sure each student has a chance to practice speaking and listening and asking and answering questions.

(CCSS.ELA.LITERACY.W.2.2, CCSS.ELA.LITERACY.W.3.2, CCSS.ELA.LITERACY.W.4.2, CCSS.ELA.LITERACY.W.2.6, CCSS.ELA.LITERACY.W.3.6, CCSS.ELA.LITERACY.W.4.6, CCSS.ELA.LITERACY.W.2.7, CCSS.ELA.LITERACY.W.3.7, CCSS.ELA.LITERACY.W.4.7,CCSS.ELA.LITERACY.SL.2.4, CCSS.ELA.LITERACY.SL.3.4, CCSS.ELA.LITERACY.SL.4.4, CCSS.ELA.LITERACY.SL.2.5, CCSS.ELA.LITERACY.SL.3.5, CCSS.ELA.LITERACY.SL.4.5, CCSS.ELA.LITERACY.SL.2.6, CCSS.ELA.LITERACY.SL.3.6, CCSS.ELA.LITERACY.SL.4.6)

5. Problem-Solving Scenario

Have students brainstorm to identify a problem around or in the classroom or school. Encourage students to build off one another's responses. After listing all ideas, eliminate ones that have limiting factors such as safety or high costs. For younger students, limit your list to problems with relatively simple solutions. Have the students vote on what problem to solve. Review the numbered list on page 9 to encourage students to think like an engineer. Brainstorm ways to solve the problem, and encourage students to draw a design. Choose a solution as a class and test it. Here are some possible problems: the classroom is too cold, the sun comes in at an angle and makes it hard to see, a bookshelf is messy, the lunch line is too long. Answer these post-activity questions: Did the solution solve the problem? Do you think this was the best solution? Do you think the experiment or invention can be improved? If so, how?

(CCSS.ELA-LITERACY.SL.2.1, CCSS.ELA-LITERACY.SL.3.1, CCSS.ELA-LITERACY.SL.4.1, CCSS.ELA-LITERACY.W.2.7, CCSS.ELA-LITERACY.W.3.7, CCSS.ELA-LITERACY.W.4.7, CCSS.ELA-LITERACY.W.2.8, CCSS.ELA-LITERACY.W.3.8, CCSS.ELA-LITERACY.W.4.8)
(NGSS.2-PS1-1, NGSS. 2-PS1-2, NGSS.K-2-ETS1-1, NGSS.K-2-ETS1-2)



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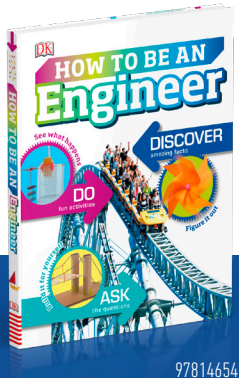

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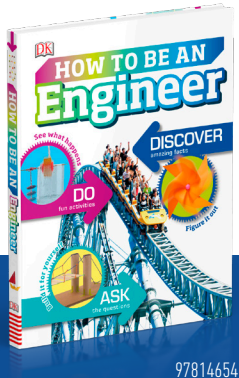

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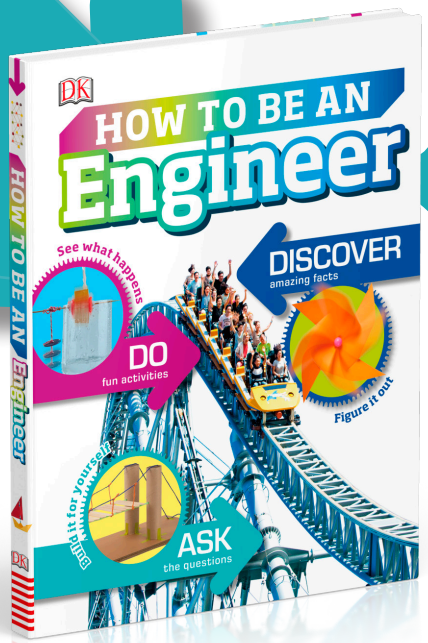
what do you Want to be?



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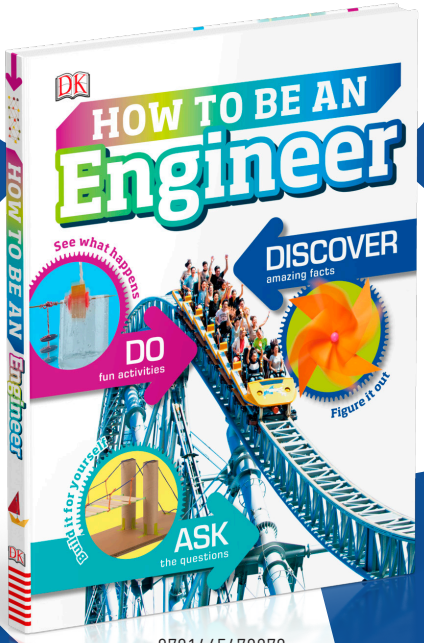

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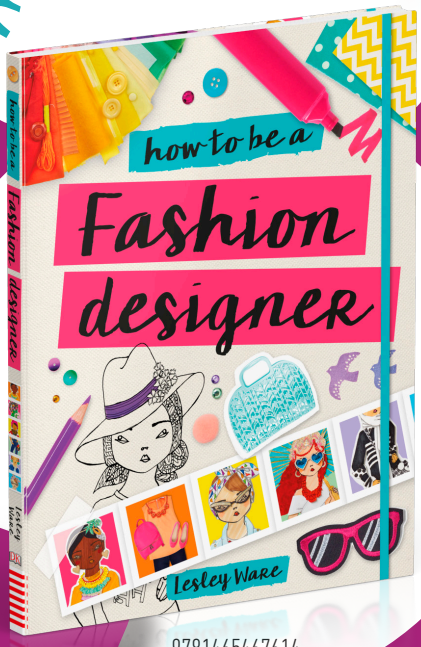

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