GUIDED READING LEVEL: W
LEXILE: 920L
GENRE: Informational
TEXT FEATURES: table of contents, illustrations, diagrams, labels, photographs, captions, sidebars, glossary, index

NGSS PERFORMANCE EXPECTATION
Engineering & Technology
3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

NGSS THREE DIMENSIONS OF SCIENCE LEARNING
SEP Asking Questions and Defining Problems
DCI ETS1.A: Defining and Delimiting Engineering Problems
CCC Influence of Science, Engineering, and Technology on Society and the Natural World

ELA STANDARDS
W.5.7, W.5.8, W.5.9

VOCABULARY
automated (p. 11)
automatons (p. 10)
casualties (p. 13)
constraints (p. 15)
criteria (p. 15)
efficiency (p. 13)
laser (p. 18)
manipulators (p. 8)
mimic (p. 5)
mobility (p. 22)
potential (p. 16)
prototypes (p. 20)
terrain (p. 15)

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Robotics Engineering and Our Automated World

by: Rebecca Sjonger

Build Background

Point out the word *automated* in the book's title. Explain that the prefix *auto-* is derived from the Greek *autos* meaning "self." Students may already know words such as *automobile, autobiography,* or *autograph*. Ask volunteers to explain how these words, and others they know, reflect the idea of self. Explain that *automatic* means "working by itself with little or no human control." When a mechanical process is *automated*, it is operated largely by automatic equipment.

Help students begin a list of words that use *auto-,* such as *autocracy* and *autonomous*. Challenge them to find other words to add to the list, such as *autobus, autoimmune,* or *autopilot*. Suggest that this concept is key to understanding the information in this text.

Read the Text

Read pages 4 and 5 together to reinforce the key concepts: *technology, engineering, roboticists, program,* and *design*. Use the example of Dr. Cynthia Breazeal and Jibo to clarify the concepts. Discuss the pros and cons of robotic companions for humans in the caption on page 5. Then have students read the rest of the text independently, writing down any questions and taking notes about new concepts.

After Reading

Connect and Respond

1. *In general, what kinds of jobs do robots do for humans?* (Robots do dull, dirty, or dangerous jobs or go where humans are unable to go.)

2. *How are robots with artificial intelligence different from programmed robots?* (Robots with artificial intelligence are able to "think" in ways that are similar to humans; based on experience, they learn and reprogram themselves.)

3. *Summarize the steps in the design process for robots.* (Answers will vary but should include: defining the problem; identifying criteria and constraints; brainstorming possible solutions; selecting one possible solution; building, testing, and improving the prototype; and finally, sharing the solution with others.)

Write It Down

Have pairs of students create a chart that describes the various robots described in the text. Comparing and contrasting the examples will help them understand the scope of what roboticists have accomplished since the mid-1900s. Tell students that organizing the examples by date will provide a chronology of the progress of robotic design. A sample chart is shown below.

Page #	Robot	Year	Inventor	Purpose/activity
5	Jibo	1997	Dr. Cynthia Breazeal	helper and companion in home settings
10	Machina Speculatrix	1948	William Grey Walter	early battery-powered robot built mostly to entertain people
11	The Ultimate	1961	George Devol and Joseph Engelberger	welded car parts, working on an assembly line
17	Watson	2011	IBM	provided customer service at a hotel

Extension Activities

Examine a System

Direct students to page 9 of the text and read aloud the text box labeled "Examine a System." Divide students into small groups and have them follow the directions for this activity. Each group will play a simple game, observing and noting the systems and subsystems within the game. Have students list the inputs of the game: game pieces, cards, players' movements, etc. Have students list the output of the game, which is the task that the game performs. Then have students change one part of the game "system" such as how pieces move, how many cards are drawn, or how a player wins. Play the game again. As a class, have students share their observations and discuss the results of changing one part of the system.

Engineering and Building Robots to Solve Problems

(NOTE: This activity may require multiple days for completion.) Have students work in pairs to consider one simple problem they could use a robot to solve. Ask students to think about what materials need to be used, how much time they could spend building the robot, and overall cost. Students should make a poster that aims to convince their classmates to agree their design is best. Posters should include a picture of the robot; a summary of the materials, time, and cost required; and a description of the problem and how the robot will solve it.

Materials/Resources Needed

board and/or card games
poster board
markers or colored pencils

Research Connection

Encourage students to research robotics on the International Space Station, drone technology, or automated prosthetic legs, and share their findings with the class.