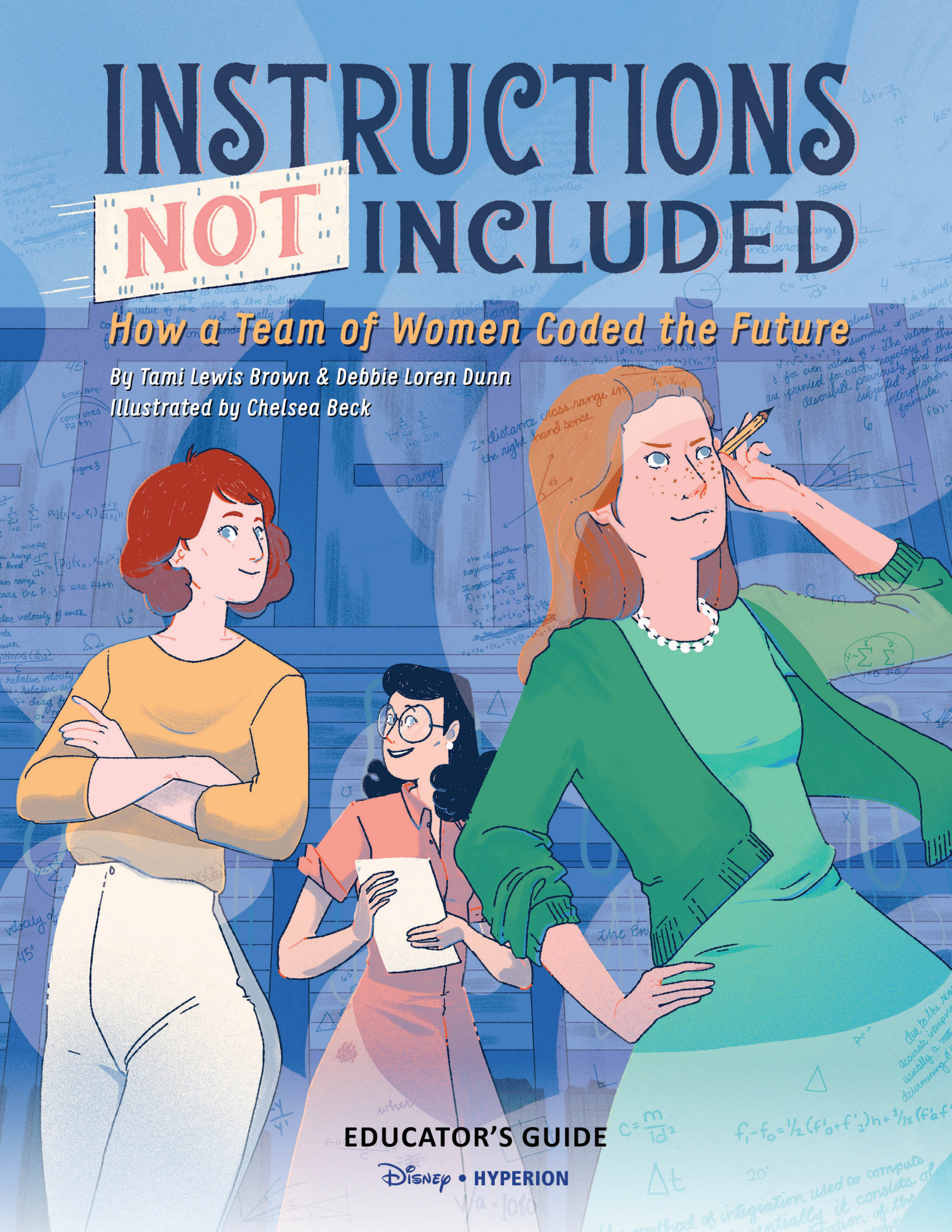
INSTRUCTIONS NOT INCLUDED

How a Team of Women Coded the Future

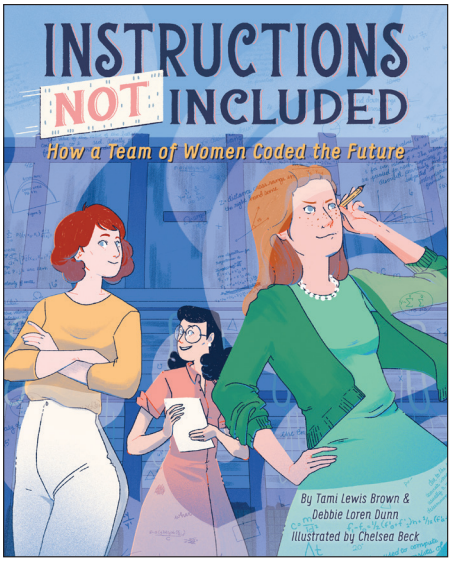
By Tami Lewis Brown & Debbie Loren Dunn
Illustrated by Chelsea Beck



EDUCATOR'S GUIDE

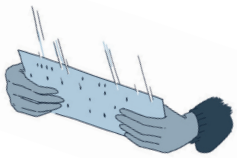
Disney • HYPERION

ABOUT THE BOOK



This informational picture book offers an introduction to three remarkable women who made long-lasting and groundbreaking contributions to the development of computers and technology. During World War II, Betty Snyder, Jean Jennings, and Kay McNulty used mathematics, electrical engineering, logic, and common sense to command ENIAC (Electronic Numerical Integrator and Computer), a computer as large as a room, and create the modern world. The machine was like Betty, requiring outside-the-box thinking; like Jean, persistent and consistent; and like Kay, no mistakes, every answer perfect. Today computers are all around us, performing every conceivable task, thanks, in large part, to Betty, Jean, and Kay's pioneering work.

KEY WORDS



In this book students will encounter mathematical references and technical terms. Explore this vocabulary and discuss and define these words with your students:

circuit boards
A circuit board is where electronic components are supported and connected.

command
An instruction for the computer. Many commands put together make up algorithms and computer programs.

computer
A computer is a device that processes and stores information given to it. It can also be a person who makes calculations, especially with a calculating machine.

ENIAC
ENIAC stands for Electronic Numerical Integrator and Computer, one of the first large-scale general-purpose electronic computers. It was built out of about eighteen thousand vacuum tubes and was programmed by physically plugging its different functional units (adders, multipliers, and accumulators) together with hundreds of wires and switches.

equation
An equation is a statement that says two things are equal and will have an equals sign: 2+2=4.

program
A program includes a set of coded instructions that can be run by a machine to carry out actions.

punch card
Punch cards are paper cards with punched-out holes that represent information. Punch cards were one of the earliest forms of data storage and programming of computers.

solder
The process of soldering joins metal pieces together with a melted metal alloy.

toggle
Toggle describes the process of switching back and forth between settings.

tubes
A vacuum tube is a glass tube surrounding a vacuum (space from which all gases have been removed). When electrical contacts are put on the ends of the tube, current flows through the vacuum.

variable
A variable is a symbol used to represent a number in an equation.

BEFORE READING

Introduce the book to students with one or more of these activities:

- To activate prior knowledge and establish a purpose for reading, ask students:
  Do you ever use computers? What is a computer? What do you know about computers? Who invented computers and when? What do you know about how computers are made and how they operate?

- To engage students with this historical look at one of the earliest computers and the women involved in programming it, show and explain images of objects that will prepare students for reading, such as:

  Punch card: www.computerhope.com/jargon/p/punccard.htm

  Vacuum tube: www.computerhope.com/jargon/v/vacuumtu.htm
  www.ibm.com/ibm/history/exhibits/vintage/vintage_4506VV2111.html

  ENIAC cables and switches: https://ids.si.edu/ids/deliveryService?id=SIA-SIA2010-2899
  https://ids.si.edu/ids/deliveryService?id=SIA-SIA2010-2900

- Prepare students for learning and build background knowledge by showing this short video:
  What Makes a Computer a Computer?
  www.khanacademy.org/computing/computer-science/how-computers-work2/v/khan-academy-and-codeorg-what-makes-a-computer-a-computer

DISCUSSION QUESTIONS

1. Talk about the title, *Instructions Not Included*. How do you feel when you don't have instructions for something like a new game or a LEGO® building set? What would you do if you had to make something important work perfectly, but you didn't have any directions?

2. Talk about the subtitle, *How a Team of Women Coded the Future*. What is coding? How does the subtitle relate to the title *Instructions Not Included*?

3. What were Betty, Jean, and Kay like when they were kids? How were they similar to one another? How were they different? Do you know anyone who has interests or qualities similar to those of Betty, Jean, and Kay? Share what you know about this person.

4. Betty, Jean, and Kay loved math! How and when do you use math? Give some examples of when math is used in daily life. How does the math you are studying connect to math in daily life?

5. How was math used at the University of Pennsylvania secret lab? Why was math going to win World War II?

6. Is using a machine a better way to solve routine problems? Why or why not? Give some examples to support your answer.

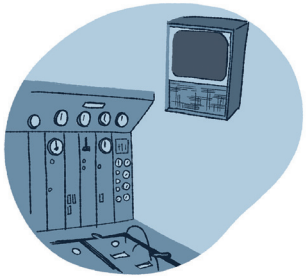
7. What is a "computer"? How is the word used in the book? How has use of that word changed?

8. How and when do you use computers? Give some examples of when computers are used in daily life. Describe and discuss some of the differences between ENIAC and the computers you use today.

9. Discuss the work and contributions of Betty, Jean, and Kay to the development of ENIAC. How do you think their work is different from modern computer programming?

10. Why do you think that Betty, Jean, and Kay were not invited to celebrate the success of ENIAC?

11. Discuss the idea of the "forgotten" women who are profiled in the Authors' Note. How has the experience of women working in science, technology, engineering, and math changed since the 1940s?



12. What would you like to know about the other women and men who worked with ENIAC? What questions do you have about how this computer was built and programmed?

EXTENSION ACTIVITIES

"The world is at war. *All hands on deck,* America calls."

Nothing in America went unchanged by World War II. More than 16 million men and women served in the armed forces. Those who remained at home found themselves taking on new responsibilities, like the jobs Betty, Jean, and Kay had as computers. Students who are unfamiliar with World War II might have questions about the causes and magnitude of the war, as well as about the process of calculating the targets for aiming guns and launching bombs. You might explain that World War II was fought between Germany, Japan, and Italy (the Axis) and Great Britain, the Soviet Union [Russia], and the United States among others (the Allies), and that the United States entered a global war that had been raging for nearly two years after Japan attacked the U.S. at Pearl Harbor on December 7, 1941.

Gently investigate World War II with younger students by reading historical picture books to them that describe different aspects of the war:

Across the Blue Pacific: A World War II Story by Louise Borden; illustrated by Robert Andrew Parker

Nim and the War Effort by Milly Lee; illustrated by Yangsook Choi

Always Remember Me: How One Family Survived World War II by Marisabina Russo

Tucky Jo and Little Heart by Patricia Polacco

Baseball Saved Us by Ken Mochizuki; illustrated by Dom Lee

Benno and the Night of Broken Glass by Meg Wiviott; illustrated by Josée Bisaillon

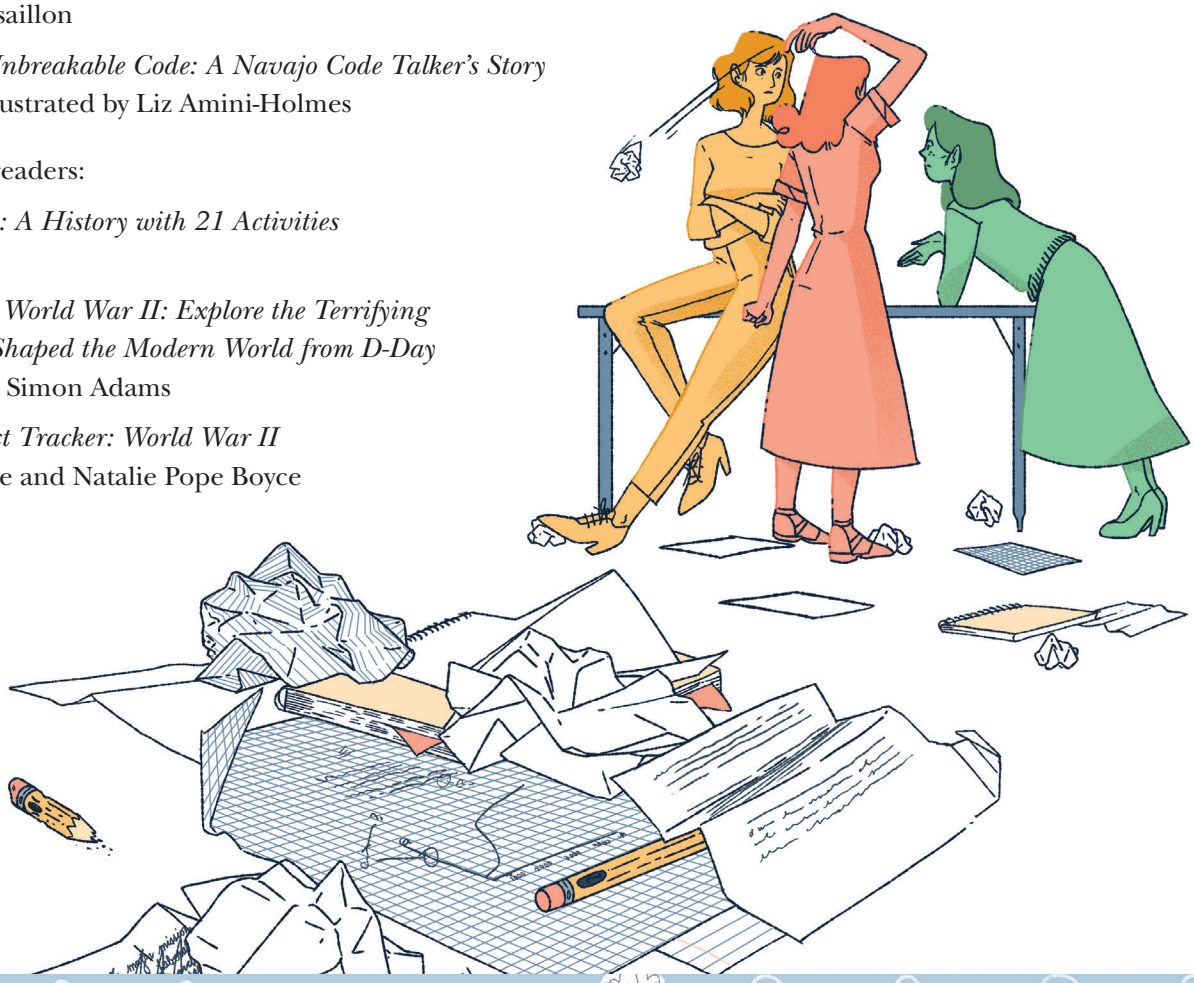
Chester Nez and the Unbreakable Code: A Navajo Code Talker's Story by Joseph Bruchac; illustrated by Liz Amini-Holmes

Nonfiction for older readers:

World War II for Kids: A History with 21 Activities by Richard Panchyk

DK Eyewitness Books: World War II: Explore the Terrifying Global Conflict That Shaped the Modern World from D-Day to the Atomic Bomb by Simon Adams

Magic Tree House Fact Tracker: World War II by Mary Pope Osborne and Natalie Pope Boyce



"All that work took lots of steps, and lots of people, and lots of time."

One of the greatest achievements of ENIAC was revealing the potential of what could be done with computers. Learning about the massive ENIAC in *Instructions Not Included* will get students thinking about the origins of technologies they regularly use. Have students share what they know and what questions they have about technologies they rely on—cell phones, tablets, game consoles, etc. Following this discussion, divide students into small groups to research and create a timeline focused on how the computer has evolved since the development of ENIAC. Beginning with the 1940s, have each group concentrate on a different time period, covering developments in computer technology in that era, what the technology was used for, and how that usage compares to similar technological uses today. Have each group present their findings in chronological order to create one large timeline.

RESOURCES:

Timeline of Computer History
www.computerhistory.org/timeline/

When Was the First Computer Invented?
www.computerhope.com/issues/ch000984.htm

"They sing and dance and calculate around the clock, until they fall asleep."

Computers follow very specific instructions. These instructions are programs and can have a few or more than a thousand steps. Planning one move after another is part of both programming and choreography. Have students work in small groups to create their own short dance routine that involves specific steps, step sequences, and some repeated moves. Remind them to think through how all their steps work together and write their dance down. See how well they did with their notations when groups trade routines and perform them from the written instructions.

RESOURCES:

If You Can Dance, You Can Code: Workshop Guide
https://geekdad.com/2017/10/if-you-can-dance-you-can-code-workshop-guide/

Dance Party: Unplugged
https://curriculum.code.org/hoc/unplugged/4/

"Dozens of 'forgotten' women, whose efforts were key to the development of computers and technology, deserve to be celebrated."

Women who made history in math, science, and engineering are often not as well-known as men in those fields. Have students research and then share the stories of women's achievements in a class talk show. Students should work in pairs to select a significant female scientist, mathematician, or engineer and research information about her childhood and family, her key accomplishments, and the important events or people who influenced her. For younger students, provide a few specific research questions. To share what they've learned, student pairs should prepare for an interview with their subject to present on the talk show. After student pairs write interview questions and answers together, one student can serve as the interviewer to ask questions while the other portrays the woman from history and reads scripted answers. Interviews on the talk show can be live in front of a classroom audience or recorded and shared as a podcast.

RESOURCES:

March 6, 1983: Grace Hopper—She taught computers to talk—https://www.youtube.com/watch?v=1LR6NPpFxw4

Student Grace Hopper Interview (Dramatization)—www.youtube.com/watch?v=JAQg_Aym31g

WRITING ACTIVITIES

CODING THE FUTURE. Have students write their own ideas for improving computers to meet a current problem or need and their thoughts about what computers will do in the future.

LUNCH PROGRAM. Making a (peanut-free) nut butter and jelly sandwich may seem simple until students have to write every step of the process. As in programming, these instructions, when followed, always need to produce the correct outcome. Let students know they are writing the instructions for you and that you will bring in ingredients and follow their directions *exactly* and quite literally.

WRITING HOME. Ask students to imagine they are either Betty, Jean, or Kay and have them write a letter to a family member describing their work on ENIAC.

UNCOVERED STORY. After reading *Instructions Not Included*, have students watch this clip from *Great Unsung Women of Computing* (www.youtube.com/watch?v=WJzyn0MGxB0), which covers much of what is presented in the book. After they have finished watching, ask students to write a paragraph that compares and contrasts the information presented in the book and the video.

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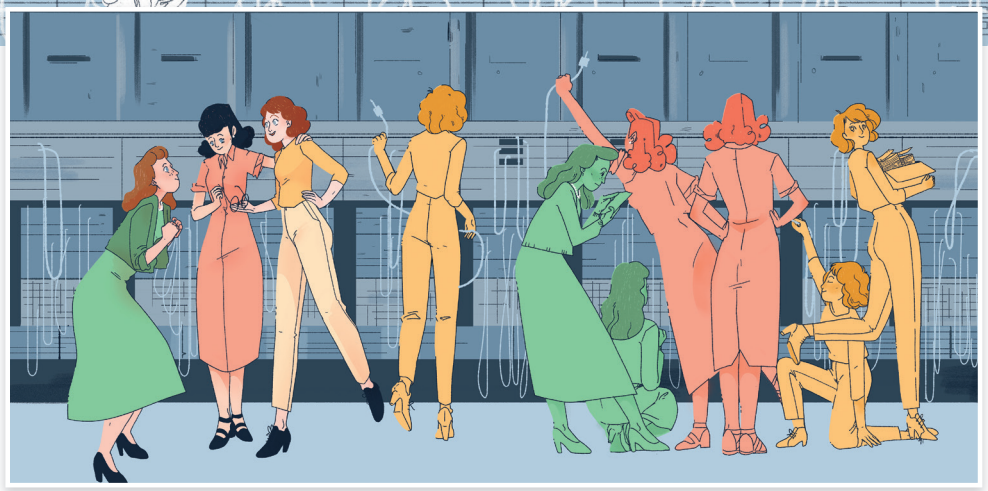

RESOURCES

RESOURCES FOR BRINGING PROGRAMMING TO THE CLASSROOM

Code.org is a national nonprofit organization that promotes access to coding education for everyone. The organization offers free in-person workshops for K–12 educators, as well as online training and tutorials.
https://code.org/

The **ScratchEd** program, developed by Harvard education researchers, is a free, downloadable guide for K–12 teachers to instruct students in creative computing. The seven-unit curriculum is designed to guide students through the development of interactive media projects.
http://scratched.gse.harvard.edu/resources/scratch-curriculum-guide.html

<code_by_math/> is a place for people to write simple computer programs in the context of exploring mathematics.
https://www.codebymath.com/index.php/welcome

Tynker Games offers age-appropriate games to teach your elementary students coding concepts.
https://www.tynker.com/free-classroom-school/coding-curriculum

Computer Science-in-a-Box: Unplug Your Curriculum introduces fundamental building blocks of computer science—without using computers.
https://www.ncwit.org/resources/computer-science-box-unplug-your-curriculum-2018-update

RESOURCES FOR LEARNING MORE ABOUT ENIAC AND ITS PROGRAMMERS

Programming the ENIAC
https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8467000

ENIAC Simulator and Related Material
www.cs.drexel.edu/~bls96/eniac/

1946 ENIAC Computer History
https://www.youtube.com/watch?v=bGk9W65vXNA&feature=youtu.be

Women Pioneers of Computer Programming Field Trip
www.womenshistory.org/resources/video/women-pioneers-computer-programming

ABOUT THE AUTHORS

TAMI LEWIS BROWN is a former lawyer and elementary school librarian. She holds an MFA in writing for children and young adults from Vermont College of Fine Arts, where she has served on the Board of Trustees for over ten years. Her books include two other picture-book biographies, *Art Is Life* and *Soar, Elinor!*, which was a 2011 Amelia Bloomer Project Top Ten selection and Junior Library Guild Selection. She lives with her family in Washington, DC.

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PHOTOGRAPHY CREDIT: DAVID SEAVER

You can visit Tami and Debbie online at their website: www.brownanddunn.com.

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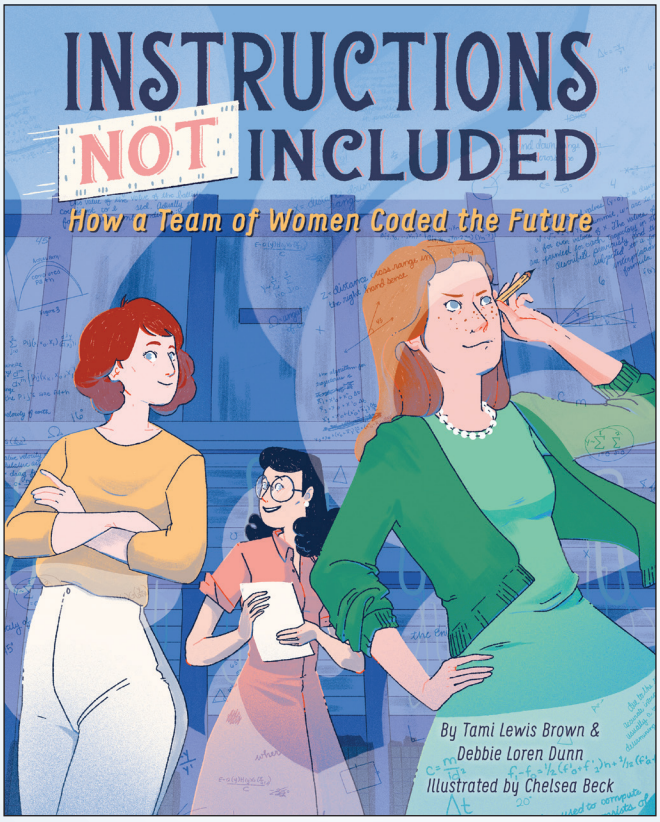
CHELSEA BECK (chelseadrewthis.com) is an illustrator based in New York. She currently works for Gizmodo Media Group and has created illustrations for clients including the *New York Times*, the *Washington Post*, NPR, the *Atlantic*, and some of the coolest musical acts all over the USA. *Instructions Not Included* is the first book she has illustrated.

Rachael Walker (belleofthebook.com) created this guide.
She consults on a wide variety of educational programs and multimedia projects, and develops educational materials and reading resources for children, parents, and teachers.

Many more guides can be found on the Disney • Hyperion website at www.disneybooks.com.



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