IES Institute of Education Sciences

FAMILY AND CAREGIVER ACTIVITY

October 2020

Encouraging Girls in Math and Science: Three Powerful Female Role Models

Regional Educational Laboratory West

From the National Center for Education Evaluation at IES

Families and caregivers, you play an important role in how girls see themselves as math and science learners. Unfortunately, negative gender stereotypes can hinder girls from fully succeeding in these subjects and from pursuing related careers. One research-based strategy to counteract these troubling stereotypes is to expose girls to female role models who have been successful in math and science. In this activity, you and your child will read biographical sketches of three important female role models and discuss why they are important. While the list of inspiring female role models is long, these three women all made important contributions to computer technologies that most of us take for granted today. This activity also includes links to additional resources about these three women for further discovery.

Tips and Suggestions:

- Do this activity when you and your child have at least 20 minutes together – about how long it takes to read about and discuss one of the three role models.
- Give your child plenty of time to respond to the discussion questions, but make sure to add your personal connections and reactions. The activity is meant to be interactive.
- Consider reading about the role models in the order presented in this guide and within a reasonable time-frame (e.g., a week or two). You'll be able to see how the first role model, who was born almost two centuries ago, influenced the work of the two other role models.
- Have fun learning about these amazing women and their accomplishments!

Learning Goal: Learn about three important female role models in math and computer science and make personal connections to their lives and accomplishments.

Grades: 3-8

Suggested Materials for Digging Deeper: Crayons or markers, pencil, paper

Activity Structure

This activity uses a simple **Think-Do-Discuss** process to maximize engagement. Before reading about one or more of the role models, first ask your child a few questions to get them thinking about this topic (Think). Then, you'll read about one or more of the role models (Do), and have a discussion about what your child learned and any reactions to the role model (Discuss). If your child wants to learn more about any of the role models, select from the resources under "To Learn More" that appear after each set of discussion questions. After you've discussed two or three of the role models, you can also try the "Digging Deeper" activity to summarize what you've learned and to make connections across these important women in math and science.

This activity helps families and caregivers carry out recommended practices described in the What Works Clearinghouse educator's practice guide, Encouraging Girls in Math and Science. You can view the full guide here: https://ies.ed.gov/ncee/wwc/PracticeGuide/5

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Think

Before you read about these three women, think about these questions and then discuss them:

1. Who are some famous (or not famous) women working in math and computer science careers?
2. Which math careers interest you? Why?
3. Do you think you might want a job someday that uses math? Why?

Ada Lovelace, Mathematician and Writer

Do: Who is Ada Lovelace?

Read aloud the following biographical sketch of Ada Lovelace. Decide who will be the reader, or, if you want to take turns reading, who will start.

> ***"Understand as well as I may, my comprehension can only be an infinitesimal fraction of all I want to understand."*** ~ADA LOVELACE

Did you know that mathematicians and scientists first began to imagine computer technology more than 150 years ago? One of the most important early mathematicians in computer programming was Ada Lovelace, often referred to as the first computer programmer. Lovelace was a top-notch mathematician, which was unusual in the 1800s as most mathematicians were male. Beginning at age 17, she worked closely with the engineer and inventor Charles Babbage as he designed some of the world's first mechanical computers. Because of funding problems, these computers were not fully built until after Babbage and Lovelace died. But when they were built years later, they actually worked! Early computers, such as Babbage's Analytical Engine, were designed to perform number calculations, similar to what a simple calculator does today. Lovelace worked closely with Babbage on the Analytical Engine and she wrote what is considered to be the first computer code for that early machine. She is also credited as being the first person to imagine computers as much more than calculators. Lovelace believed that computers could eventually be programmed to produce words and musical notes in digital form. That's right, when you type on your laptop or hear music from an electronic keyboard, Ada Lovelace saw that this was possible way back in the 1840s!

Lovelace was born in England in 1815 and was raised by a single mother. Her father was the famous poet, Lord Byron, but he left the family when Ada was only two months old and died when she was a young girl. Ada's mother encouraged her to study math and science, with the hopes that she wouldn't follow her father's interests. To support Ada's learning, her mother provided Ada with tutors throughout her childhood. Even though she became very ill for three years of her childhood, Ada continued to develop as a young mathematician and went on to study mathematics at the University of London. Sadly, Lovelace's significant contributions as a mathematician and to the field of computer science were not recognized until almost a century after her death in 1852. Her contributions became visible as early modern computer programmers in the late 1940s rediscovered her important work from a century earlier. In 1979, the U.S. Department of

Defense named a computer language, Ada, in her honor. Ada is still in use around the world today in many different industries. In 2009, a British technologist honored her legacy by creating Ada Lovelace Day, which occurs annually on the second Tuesday in October.

Discuss the Ada Lovelace biographical sketch:

Talk about what you learned. Use these questions and take turns sharing your answers.

1. What is one thing you learned about this role model?
2. Was anything surprising or interesting to you? What was it?
3. What obstacles did she face? How did she deal with them?
4. If you could ask her one question, what would it be?
5. What do you think the opening quote from this role model means?

To Learn More about Ada Lovelace:

- This TED Talk with Zoe Philpott describes Ada Lovelace's importance in the history of women in science, technology, engineering, and mathematics (STEM).
  - TEDx Talks. (2017, May 26). *Ada Lovelace: The Original Woman in Tech|ZoePhillips|TedxBucharest* [Video]. YouTube. https://www.youtube.com/watch?v=1QQ3gWmd20s
- This short video by The Institution of Engineering and Technology that describes Lovelace's life and includes photos of Lovelace's work.
  - IET. (2019, October 10). *Ada Lovelace: The Story of Ada Lovelace* [Video]. YouTube. https://www.youtube.com/watch?v=J7ITqnEmf-g
- A short video cartoon for younger learners.
  - History Who's Who. (2019, May 18). *Ada Lovelace–History's Who's Who* [Video]. YouTube. https://www.youtube.com/watch?v=2vg-0mlSnSE
- Here are three children's books about Lovelace's life:
  - Purtill, C., & Muun, M. (2019). *Ada Lovelace Cracks the Code* (Good Night Stories for Rebel Girls Chapter Book). Timbuktu Labs, Inc.
  - Stanley, D., & Hartland, J. (2016). *Ada Lovelace, Poet of Science: The First Computer Programmer.* Simon & Schuster/Paula Wiseman Books.
  - Vegara, M. S., & Yamamoto, Z. (2018). *Ada Lovelace (Little People, Big Dreams).* Lincoln Children's Books.

Dr. Grace Hopper, Mathematician and Computer Scientist

Do: Who is Grace Hopper?

Read aloud the following biographical sketch of Grace Hopper. Decide who will be the reader, or, if you want to take turns reading, who will start.

> ***"A ship in port is safe, but that's not what ships are built for. Sail out to sea and do new things."***
> ~GRACE HOPPER

Dr. Grace Hopper was an important computer scientist in the late 1940s. You may have read about Ada Lovelace, the first role model in this guide, Dr. Hopper helped turn Lovelace's ideas from a century before into a reality. As a mathematician serving in the U.S. Navy, Hopper worked on two of the earliest functioning computers, the Harvard MARK I and the UNIVAC I. Early computers were programmed using a series of numbers that were difficult to understand. Hopper believed computer programming would be improved if the programs looked more like English statements. Despite doubt from others in the field, she helped create Common Business-Oriented Language (COBOL), an English-like computer programming language that is still in wide use today. Hopper continued to be at the leading edge of computer programming throughout her 42-year career in the Navy, leading innovations in computer networking and the establishment of technical standards for computing. Hopper was also a dynamic and prolific speaker. In the 1970s and 80s, she gave hundreds of engaging talks throughout the U.S. about how computers worked and how they could shape the future.

Dr. Hopper was born in New York City in 1906. She was an excellent student, graduating from Vassar College with degrees in mathematics and physics before receiving her Ph.D. in mathematics from Yale in 1934. She returned to Vassar to teach mathematics until World War II. Hopper tried to join the Navy early in the war, but the Navy determined she was too old and too small to serve. She didn't give up, though, joining the U.S. Naval Reserve in 1943 and continuing with the Navy until her retirement in 1986. She received many prestigious awards, including the Distinguished Service Medal, the highest decoration given to someone who did not fight in battle. President Obama awarded Hopper with the Presidential Medal of Freedom in 2016, almost 25 years after her death in 1992 at the age of 85.

Discuss the Grace Hopper biographical sketch:

Talk about what you learned. Use these questions and take turns sharing your answers.

1. What is one thing you learned about this role model?
2. Was anything surprising or interesting to you? What was it?
3. If you could ask her one question, what would it be?
4. What do you think the opening quote from this role model means?

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To Learn More about Grace Hopper:

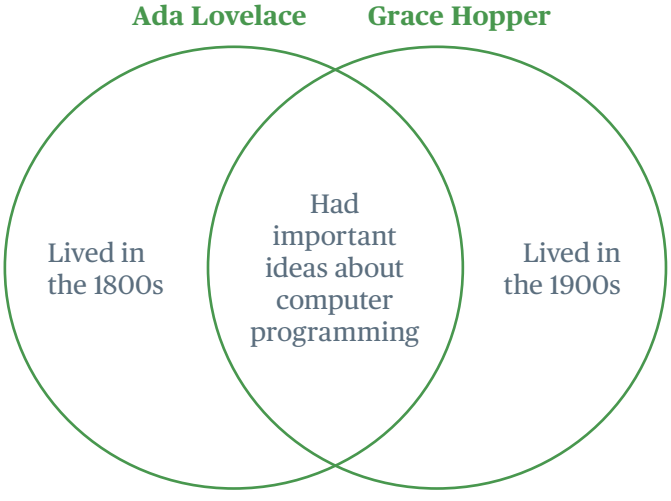
- Here is a television interview with Grace Hopper.
  - 60 Minutes. (2018, March 15). *March 6, 1983: Grace Hopper–She taught computers to talk* [Video]. YouTube. https://www.youtube.com/watch?v=1LR6NPpFxw4
- Listen to someone read aloud a book about Grace Hopper.
  - Readalotamus Books Read Aloud. (2019, November 16). *Read Aloud: Grace Hopper, Queen of Computer Code, Written by Laurie Wallmark and Illustrated by Katy Wu* [Video]. YouTube. https://www.youtube.com/watch?v=j2hv1Dm4t0A
- Here are three children's books about Grace Hopper:
  - Lowen, N. (2020). *Grace Hopper: The Woman Behind Computer Programming* (Little Explorer series). Pebble.
  - Pelleschi, A. (2016). *Mathematician and Computer Scientist Grace Hopper* (STEM Trailblazer Bios). Learner Publishing Group Inc.
  - Wallmark, L., & Wu, K. (2017). *Grace Hopper: Queen of Computer Code* (Volume 1: People Who Shaped Our World). Sterling.
- This book is for students in grades 5-8:
  - Williams, K. B. (2004). *Grace Hopper: Admiral of the Cyber Sea*. Naval Institute Press.

Digging Deeper:

If you have read about the first two amazing women, try making a Venn Diagram to see how they are similar and different. Or, pick one or both role models and consider how they are similar or different to you!

1. Draw two large overlapping circles. The circles do not have to be perfectly round.
2. Label one circle with Ada Lovelace and the other with Grace Hopper.
3. Where the circles overlap, enter the similarities between the two role models. You can use words or pictures.
4. In the non-overlapping sections of each circle, enter differences between the two role models.

Here is an example:



Dr. Gladys West, Mathematician

Do: Who is Gladys West?

Read aloud the following biographical sketch of Gladys West. Decide who will be the reader, or, if you want to take turns reading, who will start.

> ***"I was always motivated by doing something new and completing something…having a goal."***
> ~GLADYS WEST

The next time someone uses their phone to get directions, think of Gladys West. She is one of the mathematicians whose work led to the development of global positioning system (GPS) technology, which allows our phones to take us where we want to go (and allows lots of other technologies to work). Because the earth is not a perfect sphere, mathematicians must model its actual shape for GPS navigation calculations to work. Dr. West was a pioneer in modeling the shape of the earth, paving the way for GPS technology. She had a 42-year career as a mathematician for the U.S. Navy. Like role model Grace Hopper, she began her career working on some of the first computers. One of her jobs was to check the mathematics of these new machines, which was often incorrect! Her impressive career led to her being inducted into the U.S. Air Force Hall of Fame in 2018, a very distinguished honor.

In many respects, Dr. West's successful career as a mathematician was surprising. An African American, she was born in 1930 in Dinwiddie County, Virginia, from very modest beginnings. She worked on a small family farm and most of the people around her also worked on farms, picking crops like corn and tobacco. Others in her community worked in a nearby factory, beating tobacco leaves into pieces small enough for cigarettes and pipes. Although farming and factory work were honorable, she was a hard-working student and realized that continuing her education could expand her career opportunities. At the time, the top two students from each high school in Virginia earned a college scholarship. This motivated her to work even harder, and she became the valedictorian of her high school, earning a full scholarship. She made the most of it, excelling in college and then earning two master's degrees during her working career and adding a Ph.D. after she retired in 1998. If there is an example of a life-long learner, it is Gladys West! When asked about education and career opportunities for women, West said that the world is opening up but that "they still gotta fight."

Discuss the Gladys West biographical sketch:

Talk about what you learned. Use these questions and take turns sharing your answers.

1. What is one thing you learned about this role model?
2. Was anything surprising or interesting to you? What was it?
3. If you could ask her one question, what would it be?
4. What do you think the opening quote from this role model means?

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To Learn More about Gladys West:

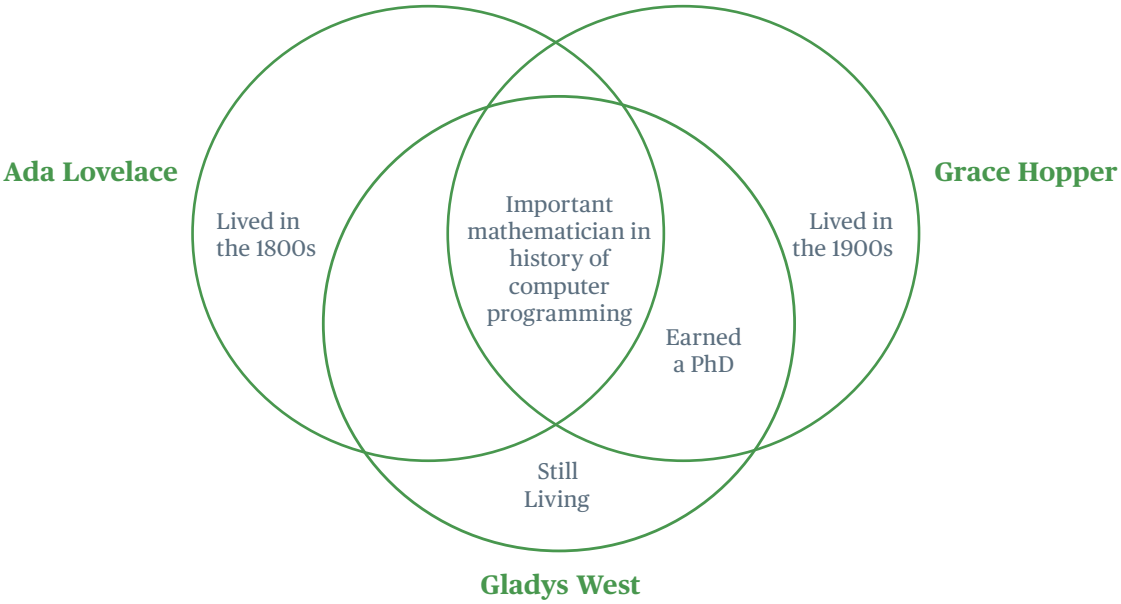
- In this short video, Gladys West describes her upbringing and career.
  - U.S. Department of Defense Videos. (n.d.). *Home*. U.S. Department of Defense. https://dod.defense.gov/News/Special-Reports/Videos/?videoid=673447#.X0KEGIXKr3Q.facebook
- Here's another short video from the Department of Defense where she describes her career in the U.S. Navy.
  - U.S. Navy. (2018, December 19). *Navy Hidden Hero: Gladys Mae West and GPS* [Video]. YouTube. https://www.youtube.com/watch?v=McIemoQWv64
- Gladys West published a book about her life.
  - West, G. B. (2020). *It Began With a Dream: Dr. Gladys B. West*. IGWEST Publishing.
- Dr. West is featured in this book.
  - Pellum, K. B. (2019). *Black Women in Science–A Black History Book for Kids*. Rockridge Press.

Digging Deeper:

If you have read about all three incredible women, try making a Venn Diagram using three circles to see how they are similar and different. Or, if you would rather, pick any of the three role models and compare her to you!

1. Draw three large overlapping circles. The circles do not have to be perfectly round. If you want a lot of space to work, you can use the inside of a paper grocery bag.
2. Label each of the three circles with Ada Lovelace, Grace Hopper, or Gladys West.
3. Where the circles overlap, enter the similarities between the three role models. You can use words or pictures.
4. In the non-overlapping sections of each circle, enter differences between the two role models.

Here is an example:



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