

## The All-Important Check Register

Fill in the circle by the correct answer. Then answer questions 3, 4, and 5.

1. If a checking account holder makes many big withdrawals and only a few small deposits, she can become \_\_\_\_\_.  
 A withdrawn  
 B overdrawn  
 C balanced  
 D hefty
2. In paragraph 2, what does the word “record” mean?  
 A to capture on video  
 B to make a note of or write  
 C an album that plays music  
 D a person’s greatest achievement
3. In the heading following paragraph 1, what does the word “faithfully” mean?  


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4. What is the relationship between a checking account and a debit card?  


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5. In your own words, explain what happens when a check “bounces.”  


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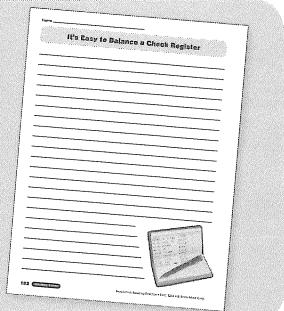
  


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### Write About the Topic

Use the Writing Form to write about what you read.

Explain how a checking account and a check register can help you manage your money. Provide examples.



# **Grace Murray Hopper**

**Level 1** ■

## Words to Know list, Reading Selection, and Reading Comprehension questions

**Level 2** ■ ■

## Words to Know list, Reading Selection, and Reading Comprehension questions

**Level 3** ■ ■ ■

## Words to Know list, Reading Selection, and Reading Comprehension questions

## **Assemble the Unit**

Reproduce and distribute one copy for each student:

- Visual Literacy page: Timeline of Grace Murray Hopper's Life, page 111
  - Level 1, 2, or 3 Reading Selection and Reading Comprehension page and the corresponding Words to Know list
  - Graphic Organizer of your choosing, provided on pages 180–186
  - Writing Form: Rear Admiral, Dr. Grace Murray Hopper, page 112

## Introduce the Topic

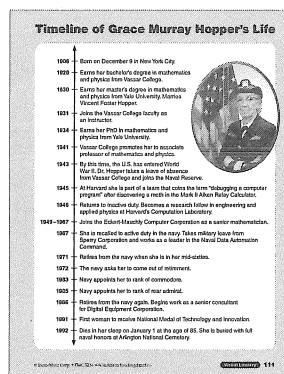
Read aloud and discuss the “Timeline of Grace Murray Hopper’s Life” text and portrait on the Visual Literacy page. Explain that no women of Hopper’s time affected computer technology as significantly as she did or achieved so many high honors.

## **Read and Respond**

Form leveled groups and review the Words to Know lists with each group of students. Instruct each group to read their selection individually, in pairs, or as a group. Have students complete the Reading Comprehension page for their selection.

## **Write About the Topic**

Read aloud the leveled writing prompt for each group. Tell students to use the Graphic Organizer to plan their writing. Direct students to use their Writing Form to respond to their prompt.



Visual Literacy

Name \_\_\_\_\_

## Rear Admiral, Dr. Grace Murray Hopper

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112 **History Boxes**

Nonfiction Reading Passages © 2012 by Linda Ward Beech

## Writing Form

# Timeline of Grace Murray Hopper's Life

- 1906 Born on December 9 in New York City.
- 1928 Earns her bachelor's degree in mathematics and physics from Vassar College.
- 1930 Earns her master's degree in mathematics and physics from Yale University. Marries Vincent Foster Hopper.
- 1931 Joins the Vassar College faculty as an instructor.
- 1934 Earns her PhD in mathematics and physics from Yale University.
- 1941 Vassar College promotes her to associate professor of mathematics and physics.
- 1943 By this time, the U.S. has entered World War II. Dr. Hopper takes a leave of absence from Vassar College and joins the Naval Reserve.
- 1945 At Harvard she is part of a team that coins the term "debugging a computer program" after discovering a moth in the Mark II Aiken Relay Calculator.
- 1946 Returns to inactive duty. Becomes a research fellow in engineering and applied physics at Harvard's Computation Laboratory.
- 1949–1967 Joins the Eckert-Mauchly Computer Corporation as a senior mathematician.
- 1967 She is recalled to active duty in the navy. Takes military leave from Sperry Corporation and works as a leader in the Naval Data Automation Command.
- 1971 Retires from the navy when she is in her mid-sixties.
- 1972 The navy asks her to come out of retirement.
- 1983 Navy appoints her to rank of commodore.
- 1985 Navy appoints her to rank of rear admiral.
- 1986 Retires from the navy again. Begins work as a senior consultant for Digital Equipment Corporation.
- 1991 First woman to receive National Medal of Technology and Innovation.
- 1992 Dies in her sleep on January 1 at the age of 85. She is buried with full naval honors at Arlington National Cemetery.



# **Rear Admiral, Dr. Grace Murray Hopper**

A black and white photograph showing four individuals in what looks like a church interior. In the foreground, a man wearing a white shirt and a dark tie is leaning over a large, ornate wooden organ. Behind him, two men and one woman stand, all looking towards the organ. The woman is on the right, and the two men are to her left. The background is dark, suggesting a wooden paneled wall or choir loft.



Unknown (Smithsonian Institution)

## **Words to Know**

### **A Very Full Life**

dismantled  
surveyor  
high achievers  
doctorate, PhD  
admiral  
Naval Reserve  
enlist  
leave of absence  
coding  
programming  
fundamental  
debugged

## **Words to Know**

### **A Computer-Programming Pioneer**

programming  
B.A.  
doctorate, doctoral  
professorship  
ordnance  
colleagues  
debug  
research fellow  
trailblazing  
digital  
civilian  
commodore  
lofty  
rear admiral  
academia

## **Words to Know**

### **A Computer Scientist in the Navy**

infancy  
calculations  
ordnance  
jumpstart  
rear admiral  
yearned  
disapproved  
enlisted  
petite  
leave of absence  
Lieutenant  
coding  
programming  
fundamental  
COBOL

Grace Murray Hopper ■

Grace Murray Hopper ■ ■

Grace Murray Hopper ■ ■ ■



# A Very Full Life

Grace Brewster Murray was born on December 9, 1906, in New York City. Machines fascinated little Grace; before her mother could stop her, she dismantled several alarm clocks to figure out how they worked. She spent hours building odd vehicles with her "Struktiron" construction kit. Grace's grandfather was a New York City surveyor, and she loved to help him hold his surveyor's pole as he mapped out new streets. She learned about angles, curves, and intersections.

Grace was an excellent student who came from a family of high achievers—before she was 30 she had earned a bachelor's degree, a master's, and a doctorate in math and physics. She also became an assistant professor at Vassar College. She earned her PhD from Yale University in 1934. Between 1930 and 1934, only 396 people in the U.S. obtained math doctorates. That is an average of about 79 people per year. Of those 396, 334 were men and 62 were women. In other words, Grace was one of 12 U.S. women to earn a math PhD in 1934. Grace had married an English professor in 1930, so her name was now Dr. Grace Murray Hopper.

In 1941, the U.S. entered World War II. Hopper came from a patriotic family. Her great-grandfather had been an admiral in the U.S. Navy. He had commanded sailors in the Union Navy during the Civil War. Dr. Hopper entered the Naval Reserve in 1943. She had to struggle to enlist. The navy told her she was too old, too thin (105 pounds), and too valuable as a math professor. Determined to serve, no matter what, Hopper obtained a leave of absence from Vassar.

How could a petite female math PhD help the navy win World War II? They sent her to Harvard University to work on the Mark I, an early form of electronic computer. Computer science was brand new at the time. Hopper learned coding (an early term for programming). She wrote a 500-page manual for the "Automatic Sequence-Controlled Calculator." Her work explained the fundamental operating principles of "computing machines."

In 1945, still at Harvard, Hopper and her team discovered an actual bug—a moth—trapped in the "Mark II Aiken Relay Calculator." The operators glued or taped the dead moth to their computer log. They labeled it "First actual case of bug being found." They explained that they had "debugged" the Mark II. This is why, whenever computer experts discover a problem, they call it "a bug."



Grace Murray Hopper at work in a computer lab, circa 1960.

Unknown (Smithsonian Institution)

Grace Murray Hopper never left the computing field. She codeveloped one of the earliest computer languages. She also remained in the navy for most of her life. When she retired in 1986, she was an admiral like her great-grandpa.

## A Very Full Life

Fill in the circle by the correct answer. Then answer questions 3, 4, and 5.

1. Which two words are synonyms?
  - (A) dismantled, constructed
  - (B) enlist, retire
  - (C) coding, programming
  - (D) fundamental, inessential
  
2. Hopper's interest in machines began \_\_\_\_\_.  
  - (A) when she entered Yale University
  - (B) when she was four and lasted almost one hundred years
  - (C) in the early nineteen hundreds and lasted almost eighty years
  - (D) when she went to Harvard to work on the Mark I
  
3. What examples can you find of "high achievers" in Grace Murray Hopper's family?  
 \_\_\_\_\_  
 \_\_\_\_\_

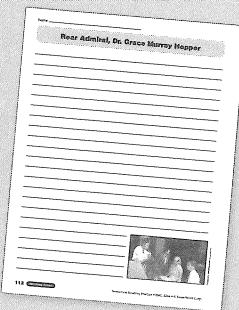
4. What facts suggest that the navy was probably glad they didn't turn Dr. Hopper down?  
 \_\_\_\_\_  
 \_\_\_\_\_

5. Why do you think so few U.S. women earned math PhDs in the 1930s?  
 \_\_\_\_\_  
 \_\_\_\_\_

### Write About the Topic

Use the Writing Form to write about what you read.

Summarize the article by explaining in detail how Grace Murray Hopper was unusual for a woman of her time.



# A Computer-Programming Pioneer

“The most dangerous phrase in the language is, ‘We’ve always done it this way.’” —Grace Murray Hopper

## An Excellent Student and Teacher of Mathematics

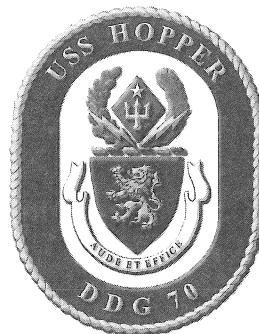
Grace Murray was born in New York City in 1906. In 1928 she graduated from Vassar College with a B.A. in mathematics and physics. Next she earned a master’s degree (1930) and a doctorate (1934) in math and physics from Yale University. In 1930 she married English professor Vincent Foster Hopper. Grace Murray Hopper then taught mathematics at Vassar, from 1931 until 1943.

## An Excellent Naval Officer and Computer Scientist

The United States entered World War II in 1941. In 1943, Hopper left her professorship at Vassar to join the Naval Reserve. The navy assigned her to the “Bureau of Ordnance Computation Project” at Harvard University. She and her colleagues worked on the Mark series, which were early forms of the electronic computer. While working on the Mark II, Hopper’s team coined the terms “bug” and “debug” to describe computer problems and solutions.

When World War II ended, Hopper joined the Harvard faculty as a computer research fellow. In 1949 the Eckert-Mauchly Corporation hired Hopper to continue her trailblazing work in computer science. Hopper helped to create UNIVAC, the first all-electronic digital computer. She invented the first “computer compiler,” a program that converts written instructions into computer command codes. Next she codeveloped COBOL, one of the first computer languages. COBOL allowed computers to “understand” and respond to words as well as numbers. To share information with other professionals, Hopper gave up to 300 lectures per year. She predicted that someday computers (which were huge in size back then) would be small enough to fit on people’s desks.

During Dr. Hopper’s civilian career, she continued to be a member of the Naval Reserve, though she was “inactive.” In 1967 Commander Hopper (she had risen through the ranks) returned to active duty. Hopper took over as “Director, Navy Programming Languages Group.” In 1973 she gained the rank of captain; ten years later she became Commodore Hopper; and in 1985 she achieved the lofty rank of rear admiral. After retiring from the navy, Hopper continued to work in industry and academia until she died in 1992. She was buried with full naval honors at Arlington National Cemetery. In 1996 the navy ship *USS Hopper* (DDG-70) was named in honor of Rear Admiral Grace Murray Hopper. The destroyer’s nickname is “Amazing Grace.”



**USS Hopper badge**

## A Computer-Programming Pioneer

Fill in the circle by the correct answer. Then answer questions 3, 4, and 5.

1. Which two words are antonyms?  
 (A) doctorate, PhD  
 (B) ordnance, weapons  
 (C) civilian, military  
 (D) academia, university
  2. The quotation under the title implies that Hopper preferred \_\_\_\_\_.  
 (A) orderly work habits  
 (B) creative thinking  
 (C) respectful students  
 (D) obedient workers
  3. What was surprising about the fact that Hopper joined the navy?
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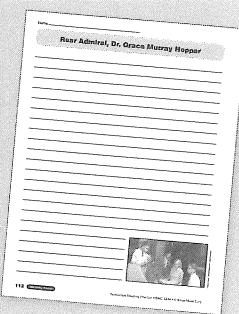
4. How did Hopper's wartime job in the navy help her career after World War II ended?
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5. Infer some of Hopper's reasons for joining the navy.
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### Write About the Topic

Use the Writing Form to write about what you read.

In your opinion, should students aspire to be like Grace Murray Hopper? Why or why not?



# A Computer Scientist in the Navy

"I was ordered to the first computer in the United States by the United States Navy, and I reported to the Mark I computer." —Grace Murray Hopper

When the United States entered World War II in 1941, computer science was in its infancy. Yet the armed forces, including the navy, badly needed machines that could perform math calculations far more quickly than people could. One reason the navy needed "computing machines" was to create "ordnance firing tables." This kind of chart provides data that is needed to accurately fire weapons under ordinary conditions. Math experts can also use such tables to make corrections for variations in wind velocity and temperature. The U.S. military needed to jumpstart computer development in order to learn this technology.



Rear Admiral Grace M. Hopper, 1983

Enter Dr. Grace Murray Hopper. She was a 30-something, 105-pound math professor at Vassar College. It was lucky for the navy that Dr. Hopper had a strong desire to join. Hopper's great-grandpa had been a rear admiral in the U.S. Navy, commanding Union sailors during the Civil War. His great-granddaughter yearned to follow in his footsteps, even though she knew her great-grandpa would have disapproved. (He believed that neither women nor cats belonged in the navy.) Dr. Hopper enlisted in the Naval Reserve in 1943, but the process was a struggle for her. The navy told her that she was too old, too petite, and too valuable in her current position as a math professor. Determined to serve no matter what, Hopper obtained a leave of absence from Vassar. After two months of training ("30 days to learn how to take orders, and 30 days to learn how to give orders"), the new Lieutenant Hopper reported for duty at Harvard University. There she worked under computer pioneer Howard Aiken on his Mark series of computing machines.

Hopper learned coding (an early term for programming), and wrote a 500-page manual for the "Automatic Sequence-Controlled Calculator." Her work explained early computers' fundamental operating principles. Though she lived almost 50 more years, Hopper never left the exciting new world of computer science. She invented the first "computer compiler," a program that converts written instructions into computer command codes. She also codeveloped COBOL, one of the first computer languages.

Hopper remained in the navy for most of her life, too. She served for many "active" years. Even during the years when she worked as a civilian computer programmer, she was an "inactive" member of the Naval Reserve. By the time she retired from her beloved U.S. Navy, she was a rear admiral like her great-grandpa.