MARGARET HAMILTON LESSON PLAN

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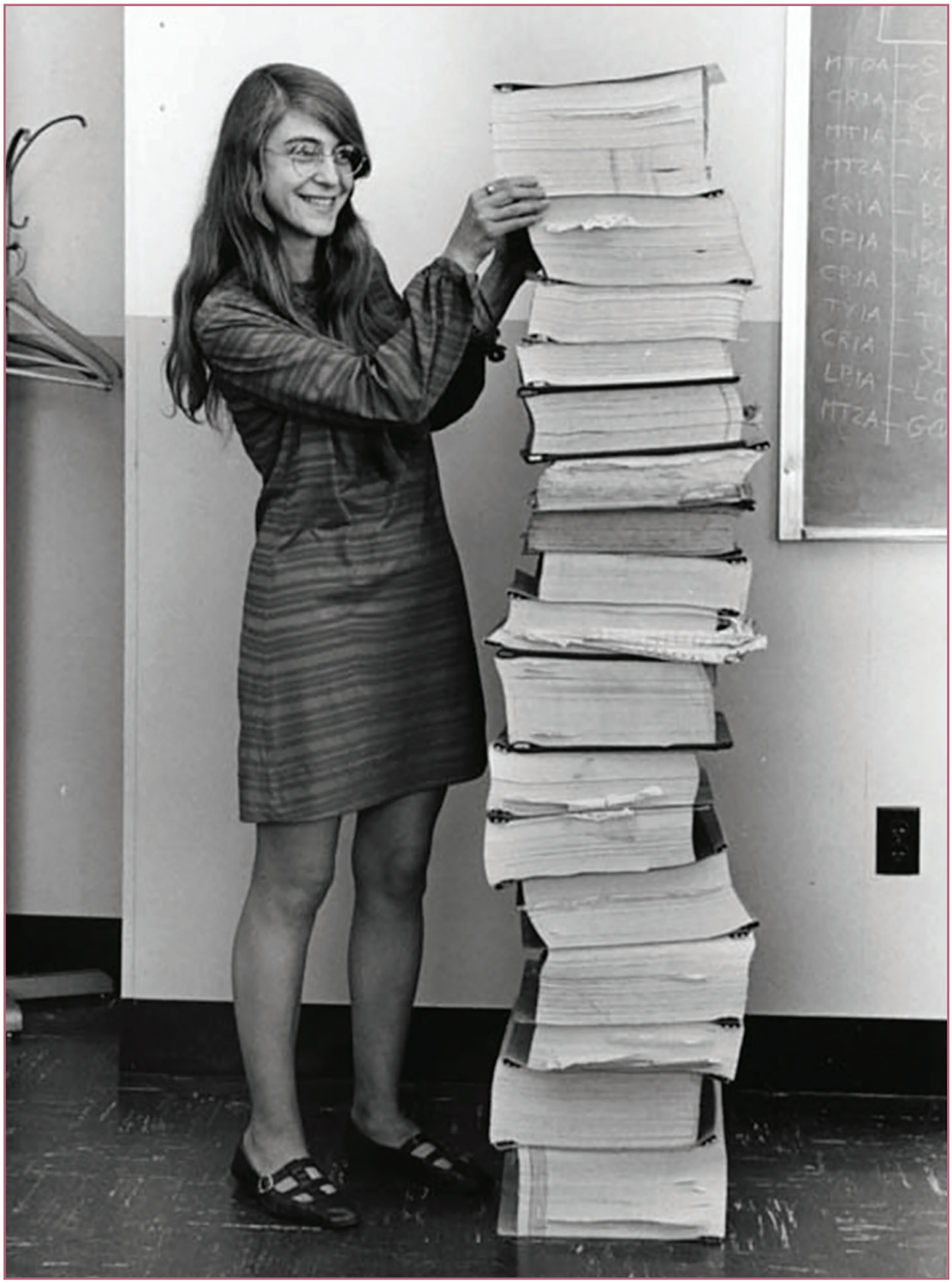

AMERICAN COMPUTER SCIENTIST AND SYSTEMS ENGINEER

BORN 1936

"I WAS ATTRACTED BY THE SHEER IDEA AND THE FACT IT HAD NEVER BEEN DONE BEFORE."

Margaret Heafield Hamilton is an American computer scientist and systems engineer. She was director of the Software Engineering Division of the MIT Instrumentation Laboratory, which developed on-board flight software for NASA's Apollo program. She later founded two software companies—Higher Order Software in 1976 and Hamilton Technologies in 1986, both in Cambridge, Massachusetts.

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AWARDS

NASA Exceptional Space Act Award (2003) and the Presidential Medal of Freedom awarded by Barack Obama (2016).

CURRICULUM VOCABULARY

Software - the programs and other operating information used by a computer.

Software Engineer - a person who applies the principles of software engineering to the design, development, maintenance, testing, and evaluation of computer software.

NASA - formed July 29, 1958, National Aeronautics and Space Administration. It's the federal agency that institutes and administers the civilian programs of the U.S. government that deal with aeronautical research and the development of launch vehicles and spacecraft.

MIT - Massachusetts Institute of Technology, a private research university in Cambridge, Massachusetts.

Astronaut - a person who is trained to travel in a spacecraft.

Apollo Missions - Apollo was the NASA program that resulted in American astronauts making a total of 11 spaceflights and walking on the moon. Learn more here: https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-was-apollo-program-58.html

THEATRE/STORY VOCABULARY

Monologue - when one person is speaking.
Context - the circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood and assessed.

MATERIALS

Written Monologue
Video Monologue

TO UNDERSTAND A STORY, YOU MUST HAVE CONTEXT.

Context is - the circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood and assessed. In acting, we call this the When/Where/Who. When I am speaking? Where am I speaking? And Who am I speaking to?

UNDERSTANDING THE STORY

WHEN/WHERE/WHO?

When is Margaret Hamilton talking in the monologue?

a. Before the Apollo missions
b. During the Apollo missions
c. After the Apollo missions

How did you get your answer?

_____

_____

_____

_____

_____

_____

Who is she speaking with?

a. A room full of students
b. Her family
c. A doctor

How did you get your answer?

_____

_____

_____

_____

_____

_____

Where is she when she is talking?

a. In her home
b. In a classroom at a university
c. On a spacecraft

How did you get your answer?

Why do you think Margaret is telling this story?

EXAMINING THE MONOLOGUE

Examining and understanding the details and the emotions of a story helps a person to get the picture and the perspective of the speaker.

DETAILS, DETAILS, DETAILS

What were the Apollo missions? Why were they so important?

Why is the Apollo 11 mission so important to Margaret Hamilton?

Why are the numbers 1201 and 1202 so important?

How many more *successful* missions followed the Apollo 11 mission?

DID YOU KNOW?

When the story/play ends, it's up to the audience to decide what happens next. When working with Historical Characters, the audience has the privilege of learning what actually happened to the characters through research.

THE MOMENT AFTER

How does Margaret Hamilton feel about problems and plans? Give a specific example.

Who was the United States racing in the space race? Not sure? Follow this link to help you find your answer: https://www.khanacademy.org/humanities/us-history/postwarera/1950s-america/a/the-start-of-the-space-race

Follow this link, https://www.smithsonianmag.com/smithsonian-institution/margaret-hamilton-led-nasa-software-team-landed-astronauts-moon-180971575/, and share two things Hamilton did after she left NASA.

Follow this link, https://www.nytimes.com/2019/07/23/science/moon-landing-women-apollo-11.html, and list two other women who helped the Apollo Space Missions, along with a brief summary.

Having learned about Margaret Hamilton, what do you admire most about her? What is a quality that she has that you might want to emulate?

Emulate definition: matching or surpassing a person's achievement.

MONOLOGUE

MARGARET IS ADDRESSING A CLASS OF FRESHMAN IN COLLEGE. She is older, mid-sixties.

Costume: White button up, black vest or jacket or sweater.

Good morning. Welcome. I am Margaret Hamilton.

ALL HANDS IN THE ROOM GO UP WITH QUESTIONS.

[chuckles] I see you've heard of me. Yes, I am the Computer Scientist who was, let's see how did the NY Times describe me, "instrumental to NASA's efforts to put man on the moon in the 1960s and 70s."

Yes, I developed the term Software Engineering.

Yes, I am a woman.

There were actually a lot of us working for NASA during that time. Though you don't often hear too much about us.

It's also true that I began at MIT as a temp. All I was looking for was a temp job. I was teaching high school math, and then we moved to Boston. I was planning to go to Brandeis University, in the fall.

Plans. Plans are funny things. We make them all the time don't we? Today you have a plan for your day. You woke up, you had breakfast, you came to class, after this class you will move on to your next class, and so forth.

Plans. Plans are what we have before they're interrupted by problems, aren't they? How many of you have had a plan interrupted by a problem?

ALL HANDS GO UP

I thought so. So, what happens when the plan goes wrong? Today, if your lunch break doesn't go as planned, you just move on, and think well, that didn't go as planned. But what if you're headed towards the moon? What if you're headed towards a lifeless rock away 238,000 miles

from Earth, your home, and things didn't go as planned?

What then?

Better yet, how do you fix it? Because in space, in lunar missions, I know of only two constants 1) there will always be a problem because 2) nothing will go as planned. *[smiles]* We all know the words: "Houston, we have a problem."

So what do you do when it all goes wrong?

And, that became my job. My job was to create computer systems for the Guidance and Control Systems for the in-flight command and lunar modules for the Apollo missions. The focus was to detect system errors and recover info in the computer crash.

BEAT

I was attracted by the sheer idea and the fact it had never been done before. ***[actual quote]***

So I got to work.

We wanted to create "man in the loop concepts", so we needed the software to interrupt astronauts and replace their normal displays with priority displays to warn them in an emergency.

SOME BLANK FACES

We wanted the computer to tell the astronauts if there was a problem, if something wasn't going as planned, so the astronauts could solve that problem in real time.

And we were working with computers that were, hmmmm, how is the best way to put this? Computers that were as fast as rocks at computing when comparing them to the phone in your pocket right now.

LAUGHS TO HERSELF

It was the 60s computers were very new, very, very big, and very, very slow. And yet, we were using them to put people on the moon. We dreamed big.

I hope all of you do as well. *[Stern and sincere]*

I could get into all the technical things, but since this is the first day of class, I will spare you.

What I will tell you is this, in order to be excellent at computer programming or any job is to learn when things don't go right. To learn how to move forward when everything is falling a part.

When we were creating the software, you couldn't hide from your mistakes.

When the computer crashed during the execution of your program, there was no hiding. Lights would be flashing, bells would be ringing and everyone would come running to find out whose program was doing something bad to the system. And we all came running to learn. ***[actual quote]***

And learn we all did.

Especially on that fateful Apollo 11 mission. You know the one where Neil and Buzz landed on the moon. What a fantastic moment for all of us! But right before they touched down, well the flashing, the ringing bells all started to go off and we all rushed to see what program was doing bad things to the system. *[BEAT]* The space modular holding the lives of three men.

Everything was going according to plan until something totally unexpected happened. Just as the astronauts were in the process of landing, the computer alarms 1201 and 1202 started going off. Land or not to land? Malfunction. Land or not to land? The astronauts had to decide.

In one way, the software was doing its job. It was reporting the problem in real time, but it couldn't figure out what the problem was. That's where the astronauts had to decide.

In the end, they decided to land. And we know the famous words of Astronaut Armstrong: That's one small step for man, one giant leap for mankind.

And it was. It was also one giant step for computer engineering. Software Engineering. *[Smiles, maybe more to herself, she likes that phrase Software Engineer]*

We discovered that the software was informing not only that there was a hardware related problem, but also the software was compensating for it.

Because of that, we were able to launch 5 more successful missions to the moon. Apollo 13 as you know, was not successful in terms of completing its mission, but it was successful in discovering and solving lots of new problems.

Those problems. Those moments where things didn't go as planned allowed the next 4 Apollo missions to be even more successful.

Problems lead to new discoveries. New advancements.

So, in this new school year, don't be afraid of the problems. Don't run when the alarms start ringing and lights start flashing. Run towards them. See what's going wrong with the system, and fix it. Learn from it. Grow from it.

And with that, I am happy to answer any questions.

ALL HANDS GO UP.