SHE CAN STEM TOOLKIT

Middle school lesson plans and artwork for STEM (science, technology, engineering, and math).

THANK YOU

Thank you for bridging middle school classrooms and STEM (science, technology, engineering, and math) education to inspire youth, especially girls, around the country to get excited about — and stick with — STEM. The Education Amplifier program is committed to amplifying the voices of social change movements through art and community engagement by creating meaningful ways for educators and their students to join the national conversation. We achieve this by collaborating with artists and social change movements to create and distribute teaching tools such as artwork, lesson plans, art builds, and storytelling opportunities to registered Amplifier educators for their classrooms. We hope that you will adapt and improve upon these lesson plans to meet the needs and age range of your group.

The following lesson plans will walk you and your students through easy-to-digest computer science principles and their applications, with separate lesson plans for the following topics: algorithms, decomposition, design-test-build, pattern recognition, robotics, and user experience. These lesson plans can be used from math to science to history class — wherever they fit within the school day — to seamlessly introduce computer science to your students. Through these topics, students can explore the history of women in technology, discuss computer science's impact on the world, and uncover the ways they already think like a computer scientist. Everything in these lesson plans can be shared with students (regardless of their gender) directly.

These lesson plans are excerpts from the Women in Tech Lesson Plans created by the international nonprofit organization Girls Who Code, a partner of She Can STEM, and adapted for the Education Amplifier program. She Can STEM is a national public service advertising campaign created by the Ad Council in 2018 to inspire middle-school aged girls to stay interested in STEM.

Research shows that young girls like STEM subjects, but as they get older, they start to feel that STEM isn't for them based on outdated stereotypes. As girls look around for female role models, they often don't see anyone who looks like they do. The She Can STEM campaign targets tween girls (ages 11-15) and showcases the achievements of role models in STEM to reinforce the idea that STEM is cool, creative, and inspiring. We give girls the inspiration they need by showing them that if "She Can STEM. So Can You."

To learn more, visit @SheCanSTEM on Instagram.

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HOW ARE ROBOTS CHANGING THE WORLD?

Students define the term robot, discuss real-life examples of robots, and have a discussion weighing the positive and negative impacts of robots on the world. Students will also learn about Ayanna Howard, a roboticist who founded Zyrobotics, a company that builds educational learning tools for children with physical limitations to broaden their understanding of the history of women in technology.

The activities in this lesson plan include student-centered discussion, short videos, research, graphic organizers and movement.

PAGE 25 PATTERN RECOGNITION

HOW DO COMPUTER SCIENTISTS USE PATTERN RECOGNITION TO SOLVE PROBLEMS?

Students learn about pattern recognition, practice and create ciphers or a way to change information so someone else can't understand it, and discuss how a computer can use pattern recognition. Students will also learn about a computer scientist named Kathy Kleiman to broaden their understanding of the history of women in technology.

The activities in this lesson plan include student-centered discussion, short videos, collaborative work, and graphic organizers.

PAGE 38 DESIGN-TEST-BUILD

WHAT IS IT LIKE TO USE THE DESIGN-BUILD-TEST CYCLE LIKE A COMPUTER SCIENTIST?

Students read about the design-build-test cycle, then they use it to create a paper prototype for their own mobile app idea. The design-build-test cycle is a process for creating a product that involves designing what it should look like, building a draft, and then testing it to get feedback. This cycle can be repeated again and again to make a product better and better. Featured in this lesson plan is Miral Kotb, a computer scientist and dancer, who created iLuminate, a dance group that performs in special light-up suits to create visual illusions.

PAGE 45 ARTWORK

HOW CAN I USE ARTWORK TO GIVE GIRLS THE INSPIRATION THEY NEED TO GET EXCITED ABOUT — AND STICK WITH — STEM?

Not only can educators decorate their classrooms with these powerful artworks created by artists Sarai Llamas, Camila Rosa and Amanda Phingbodhipakkiya, but youth can also use these visuals to reflect critically about their experiences as learners in the fields of science, technology, engineering, and math.

- **What do you see represented in this artwork?**
- **What are the meanings behind the symbols?**
- **What has your experience with STEM been like?**
- **Do you agree or disagree with the message? Why?**
- **Why is it important for all students, especially girls, to learn about STEM?**
- **Do you feel that all students have equal access to STEM? Why or why not?**
- **If you could change the way STEM education is now, what would you change?**

You can download these high-resolution artworks and more at amplifier.org.

USER EXPERIENCE

LEARNING GOALS

Students will be able to...

1. **Define "user experience."**
2. **Explain how considering users' needs leads to better products.**

MATERIALS

1. **Worksheet**
2. **Photo: Nicole Dominguez**

STANDARDS

CSTA: 1B-AP-13
CCSS ELA: CCRA.W.4

VOCABULARY

USER EXPERIENCE

The feelings and attitudes a person has when they are using a product.

USER PERSONA

A made-up profile for a person who matches the characteristics of someone who might use a particular product.

HOOK (5 MIN)

1. **Ask students to think about a time when they had a really bad experience using a website, app, or other product.**
   - **Depending on your classroom content, you might choose to have students think about an experience with a book, paper, or other relevant product.**
2. **Set a timer for 2 minutes. Have students turn to a partner and share the following:**
   - **What was the product?**
   - **What were you trying to accomplish?**
   - **Why was it a frustrating experience?**
3. **Explain: As you may already know from personal experience, the best products are built when they take the user's experience into account. This means thinking about things like what the user wants from your product and how they might interact with it. User experience is something the best designers think about from the very beginning of a project.**

WOMAN IN TECH SPOTLIGHT (5 MIN)

1. **Set a timer for 3 minutes while students read the spotlight on Nicole Dominguez included on the worksheet.**
2. **Have students turn to a partner and discuss why Nicole might think about user experience.**
   - **Suggested Answer: By thinking about user experience, Nicole can build better products that fit what her clients want. That will make her clients happy, which means they might recommend her for other projects in the future.**

ACTIVITY (30 MIN)

1. **Set a timer for 5 minutes while students read the section of the worksheet titled "What is User Experience?"**
2. **Set a timer for 2 minutes. Have students turn to a partner and discuss the following questions:**
   - **What is a user persona?**
   - **How are user personas related to user experience?**
3. **Ask a few students to share out and summarize what they and their partner discussed.**
4. **Ask students to think about a project they are currently working on. This could be a program, an essay, a research project, or any other class assignment with an intended audience.**
5. **Explain to students that they will now have a chance to practice building their own user personas for that project.**
6. **Set a timer for 15 minutes while students fill out the user personas on the worksheet. Encourage them to be as detailed and creative as they'd like. The goal is for them to think about what different kinds of people might need from their project.**

DEBRIEF (5 MIN)

1. **Set a timer for 2 minutes. Have students turn to a new partner and share the user personas they created. Then have students discuss the following with their partner: How does thinking about your audience like a computer scientist help you create a better project?**
2. **Ask for a few students to share out their responses. The best student answers will emphasize that building user personas and thinking about what other people need from your project lets you build something more useful, which ultimately makes your project more successful.**
3. **As you close out the class, tell students that they will use the user personas they wrote as they continue to develop their project - just like computer scientists might as they build new products!**

USER EXPERIENCE WORKSHEET

WHAT IS USER EXPERIENCE?

User experience is the way a person feels when they are using a product. When a product has a good user experience, that usually means that a person finds it enjoyable and easy to use. But a good user experience isn't something that just gets built into a product automatically. The best designers think about how to build a great user experience from the very beginning of a project.

One way that designers make sure their product has a good user experience is by thinking like an actual user! Before they even start drawing designs, designers will often hold user interviews to ask real humans about their experiences. The designers might ask about the users' backgrounds or about what kinds of things they want out of a product. After talking to lots of different people, the designers look for trends and make categories of the different kinds of users who are interested in their product. Then, they use those categories to write user personas.

A user persona is like a profile page for a made-up person who matches some characteristics of someone who might use your product. The actual details in the persona vary based on what kinds of details are important to your particular project. It might include a short bio of that person's life, their age, their job, or their level of comfort with different technology. User personas help designers make sure they are designing a product that fits the needs of a specific type of user. For example, it can be hard to think about what kind of design might be fun for children ages 8-12, but it's easier to think about what might be fun for your 10-year-old cousin, Nina. Two different user personas for a mobile app to help students apply to colleges are pictured below:

NAME: Carla

AGE: 17

BIO: Carla is a junior in high school. When she's not at basketball practice, she can be found in the computer lab, building cool websites with her friends. She's interested in exploring colleges that offer computer science majors and scholarships for student athletes.

FAVORITE APPS: Snapschat, ESPN, Spotify

NAME: Faatimah

AGE: 18

BIO: Faatimah is a senior in high school and is currently applying to colleges. She wants to double major in physics and art history. Her biggest concern is keeping track of all her applications: deadlines, essays, and letters of recommendation.

FAVORITE APPS: Instagram, Angry Bird, Twitter

NICOLE DOMINGUEZ

Nicole Dominguez learned to program when she was 13 by building her own blog about her life and the things she was creating. She started freelancing when she was 15, working with some friends to take on client projects. Now, she is a user interface (UI) designer and front-end developer. That means she builds the parts of websites that users interact with directly. She likes working at the intersection between design and code.

Nicole used to be a digital nomad, which means she worked remotely (doing all her work online from her computer, instead of in a normal office setting) and used the money she earned to travel the world. It gave her space to think about her own goals and what she wants out of life.

NAME ______________________________ DATE ____________

INSTRUCTIONS: **Think about a project you are currently working on. Who is your target audience? What kinds of people might they be? Use the table below to create two different user personas for two types of people who might interact with your project.**

PROJECT

Name: **Age:**	**Bio:** **What they need from your project:** **Additional details:**

Name: **Age:**	**Bio:** **What they need from your project:** **Additional details:**

How does thinking about your audience helps you create a better project?

DECOMPOSITION

LEARNING GOALS

Students will be able to...

1. **Break down a large project into smaller, bite-sized tasks.**

MATERIALS

1. **Worksheet**
2. **Photo: Ada Lovelace**
3. **Poster paper and sticky notes (if students are creating a physical Kanban board)**

STANDARDS

CSTA: 2-AP-13
CCSS ELA: CCRA.R.2
CCSS Math: MP1

VOCABULARY

DECOMPOSITION

The act of breaking something down into smaller pieces. Kanban board: A tool used for keeping track of progress on a project. The board has three columns labeled "To Do," "Doing," and "Done."

WOMAN IN TECH SPOTLIGHT (5 MIN)

1. **Ask students to close their eyes and imagine the very first computer programmer. What do they look like? What does their work look like? What era is it?**
2. **Distribute the worksheet to students. Set a timer for 3 minutes while students read the spotlight on Ada Lovelace.**
3. **Have students share out how the bio about Ada Lovelace compares to what they imagined about the first computer programmer.**

ACTIVITY (35 MIN)

1. **Explain: Today you're going to learn about decomposition. Decomposition is the process of breaking down something complex into smaller parts. This is the same process Ada used when she wrote an algorithm for how to compute a sequence of numbers. Computer scientists use decomposition to build algorithms, but they also use it to plan out projects. Today, we're going to focus on this second case.**
2. **Set a timer for 3 minutes while students read the "What is Decomposition?" section of the worksheet.**

3. Set a timer for 5 minutes while students fill out the table on the worksheet by improving the poorly written tasks. Have students share out the improved tasks they wrote. Some suggested answers are included:

Write report	Too large a task	Find 3 sources about global warming. Choose 1 quote from each source. Add quotes from sources into report outline. Write introduction paragraph. Write 1 supporting paragraph for each source. Write conclusion paragraph.
Email Keya	Hard to understand	Email Keya the links to the articles for the bibliography.
Poster	Not specific	Rewrite lab report content for poster. Print out content for poster. Assemble poster. Decorate poster.

4. Introduce the project you want students to start planning for. This could be any kind of large project (a presentation, a report, a diorama, etc.) that requires students to complete multiple steps.
5. Set a timer for 5 minutes while students break the assigned project down into a list of tasks. Students should record their work in the second table on the worksheet. Circulate while students work and redirect them if you notice their tasks are not specific, small, or understandable.
   - If students are working in groups, they may require more time.
6. Explain: Now that you have a list of what you need to get done for this project, the next step is to turn that list into a tool that can help you keep track of your progress.
7. Set a timer for 3 minutes while students read the "What is Kanban?" section of the worksheet.
8. Set a timer for 10 minutes while students build their own Kanban boards. If you have space, students can use poster paper to create their own physical boards. Alternatively, students can use an online tool like Trello to create a digital board.
   - If you choose to have students create Trello boards, be sure to have them invite you to the board so you can see their progress.

DEBRIEF (5 MIN)

1. Set a timer for 2 minutes. Have students partner up and share their task lists and Kanban boards. Then have students discuss the following with their partner:
   - What was easy about this activity? What was challenging?
   - When else might you use decomposition in your daily life?
2. Ask for a few students to share out their responses. The best student answers will emphasize that decomposition can be used any time a complex problem has to be broken down into smaller chunks. For example, decomposition can be used to solve a multi-step math problem or for planning a surprise party.
3. Explain to students that if decomposition was interesting to them, they might consider studying it further by learning more about computer science online or in classes!

DECOMPOSITION WORKSHEET

WHAT IS DECOMPOSITION?

Before you can get started on a new project, you first need to figure out everything that needs to get done! One way to do that is by breaking down the big project into smaller parts, like making a to-do list. This process is called decomposition. Once you have a list of all the tasks you need to complete for your project, you can figure out the best path forward.

There are different ways you might choose to break down your project. You might choose to separate tasks by project phase. For example, if you're writing an essay, you might have some tasks for a draft phase, a writing phase, and an editing phase. Or you might choose to split tasks by category. For example, if you're making a science fair project, you might have some tasks for your experiment, some for a lab report, and some for a poster. But no matter how you choose to group things, the most important thing is to make sure the tasks themselves are written well.

A good task will be:

- **Specific. It should be clear exactly what needs to be done. For example, "Find 3 articles about the positive and negative effects of social media" is better than "social media articles."**
- **Something you can finish in one sitting. If it seems like it will take you more than an hour to complete, try breaking it down into multiple steps.**
- **Easy to understand. Make sure you and your teammates will be able to remember what you meant! Using specific words will help with this.**

ADA LOVELACE

Ada Lovelace was born in 1815 in London. Although it was highly unusual for the time, Ada's mother insisted that Ada have tutors in math and science. When Ada was 17, she met mathematician Charles Babbage, a professor at the University of Cambridge. Charles was impressed by Ada's mathematical mind and called her an "enchantress of numbers." Ada and Charles remained lifelong friends.

In 1837, Charles had an idea for a new kind of machine called the "analytical engine." Although it was never built — it is considered to be the ancestor of the modern computers used today. Ada saw the potential of the idea, and in 1843 she translated a description of the engine from French to English. As she translated, she corrected mistakes that Charles had originally made and added her own notes to the translation — they were three times longer than the original! Her notes included the first published computer algorithm: it broke down how the machine could be used to compute a complex sequence of numbers. Because of this algorithm, Ada Lovelace is often called the world's first programmer.

NAME ______________________________ DATE ______________

INSTRUCTIONS: Use the table below to practice writing good tasks. For each task, figure out what's wrong with it, and then write an improved version of the same task. In some cases, you might need to make up some details or break the given task into multiple smaller tasks.

POORLY WRITTEN TASK	WHAT'S WRONG WITH IT?	BETTER TASK(S)
Write report		
Email Kiya		
Write report		

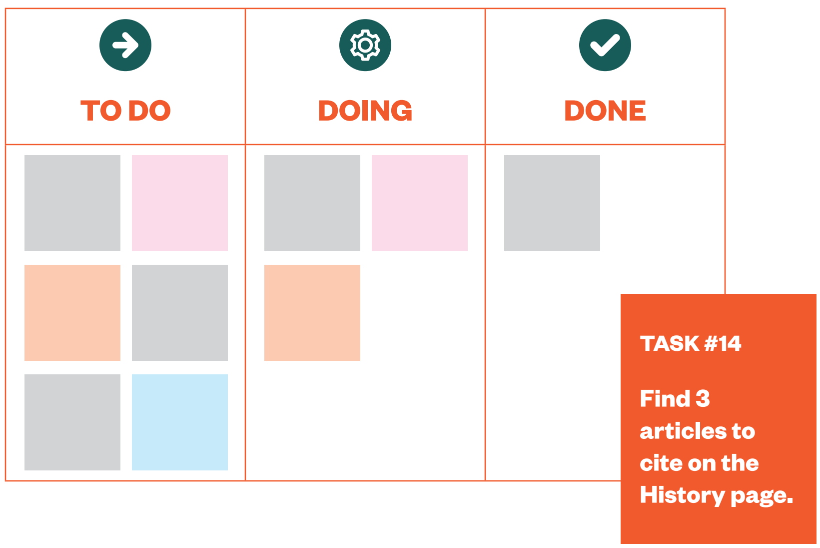
INSTRUCTIONS: Think of a project you are working on. Use the space below to break down your project into tasks.

PROJECT

NAME ______________________________ DATE ______________

WHAT IS A KANBAN BOARD?

Once a team has broken down their project into tasks, they can use the Kanban method — a strategy for keeping track of progress on a project. In the Kanban method, all of the tasks for a project are displayed on a large board so that everyone can see what needs to be done. Then, tasks are organized by placing the most urgent tasks at the top of the list. The board is divided into 3 or more columns, labeled by level of completion: "To Do," "Doing," and "Done." Kanban is useful because everyone on the team can see the work that is being done in one place.



TO USE KANBAN, DO THE FOLLOWING:

1. Write each task on its own card and place it in the "To Do" column.
2. Once a person takes responsibility for a task, write their name on it and move it to the "Doing" column.
3. When the task is complete, move it to the "Done" column.

INSTRUCTIONS:

4. Write each task for your project on its own index card or sticky note.
5. Build a Kanban board for your team. Add all your tasks to your board.
6. Use your Kanban board to plan a timeline for your project. How might you spread out the different milestones or checkpoints for your project between now and when your project is due?
7. When else might you use decomposition in your daily life?

ALGORITHMS

LEARNING GOALS

Students will be able to...

1. **Define "algorithm."**
2. **Use flowcharts to design an algorithm to address a complex problem.**

MATERIALS

1. **Worksheet**
2. **Photo: Vanessa Tostado**
3. **Additional blank paper and drawing materials for flowcharts**

STANDARDS

CSTA: 2-AP-10
CCSS ELA: CCRA.R.2
CCSS Math: MP8

VOCABULARY

ALGORITHM

A list of step-by-step instructions for how to complete a task.

FLOWCHART

A diagram that uses different symbols and arrows to show the different steps in a process.

HOOK (10 MIN)

1. **Ask: What are some chores that you do on a regular basis? Have students call out some tasks. For example: "Do the dishes." "Walk my dog." "Take out the trash."**
2. **Ask students to imagine that they could program a robot to do those chores instead. Explain that, in order to build that robot, students would need to know how to design algorithms that tell the robot what to do. However, robots aren't very smart, so this will be a challenge in planning out your ideas and writing instructions with precision.**
3. **In the rest of this activity, students will practice designing their own algorithms using a tool called a flowchart.**
4. **Distribute worksheets to students, and set a timer for 5 minutes while students read the first two sections: "What is an Algorithm?" and "Designing an Algorithm: Flowcharts."**

5. As a group, have a few students summarize what an algorithm is, what a flowchart is, and what the different symbols in a flowchart represent.
6. Choose one of the chores that students called out at the beginning of the activity. The best examples will include one or more decision points, to make the algorithm slightly more complex.
7. As a group, have students help you draw a flowchart on the board for how to complete that chore.

WOMAN IN TECH SPOTLIGHT (5 MIN)

1. Set a timer for 2 minutes while students read the spotlight on Vanessa Tostado.
2. Set a timer for 2 minutes while students work with an elbow partner to sketch a flowchart for an algorithm of how Vanessa's Tag It! app might work.
3. Have students group up with another pair and share their flowcharts.

ACTIVITY (25 MIN)

1. Have students choose a more complex task to design an algorithm for.
2. You might choose to have students focus on a topic related to your specific class content (e.g., how to solve a system of equations, how to write a persuasive essay, how to find sources for a research project), or you may let students choose a task for themselves.
   - Ideally, this task should be something that can be completed in a few minutes, so that students can have a chance to practice following each other's algorithms.
3. Set a timer for 5 minutes while students work with a partner to fill out the top three rows of the table on the worksheet, which cover basic information for their algorithm, like inputs, outputs, steps, and decision points.
4. Set a timer for 10 minutes while students design and sketch their flowcharts.
   - Encourage students to test out their algorithms using a variety of inputs. For example, if students are writing algorithms on how to proofread a paper, they should try applying their algorithm to a variety of different examples of student writing.
5. Have students trade flowcharts with another group and take turns trying to follow each other's algorithms.
   - Tell students to do exactly what the instructions say, not what they think the instructions meant to say. That might mean that the algorithm ends up not working, but that's okay! This is how we learn! All good computer scientists have to go through many rounds of testing before they have a finished product.
   - Students should give each other feedback on what parts of the algorithm are clear and what parts need more revision.

DEBRIEF (5 MIN)

1. **Facilitate a group discussion using the following questions:**
   - **What was interesting or challenging about trying to build your algorithm? What strategies did you use to build your flowchart?**
   - **What did you learn from having someone else try to act out your algorithm? Is there anything about your flowchart that you'd revise, after seeing someone try to use it?**
   - **How is designing instructions for a computer different from giving instructions to another human being?**
     - **Suggested Answer: Instructions for a computer have to be very specific. A human can make inferences and understand what you were trying to say, but a computer will only do exactly what you tell it to do, even if that means it does the wrong thing.**

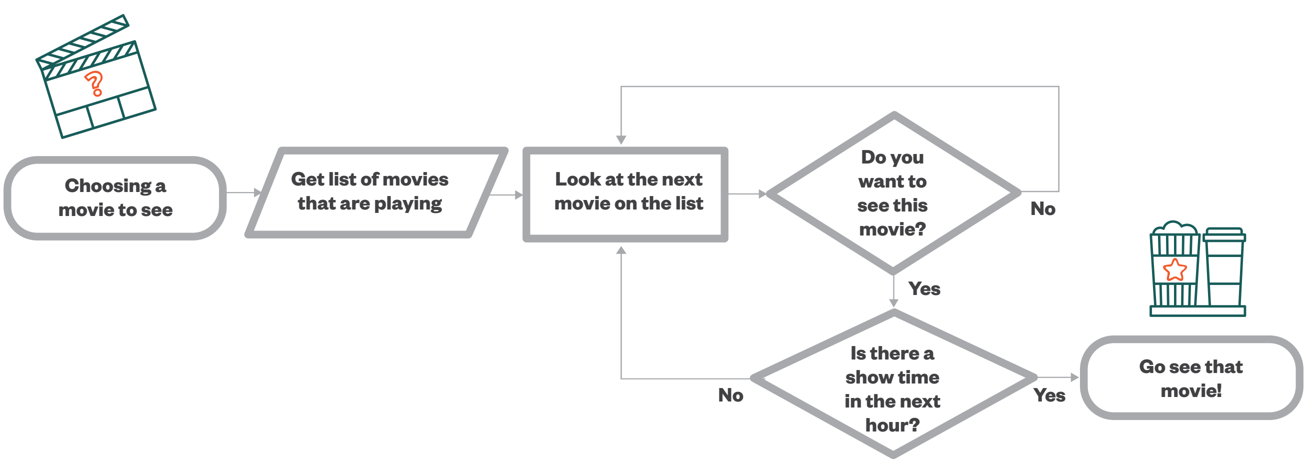
ALGORITHMS WORKSHEET

WHAT IS AN ALGORITHM?

Computers aren't smart on their own. They require humans called programmers to write the instructions (also called code) that tell them how to do things. But how do programmers know what instructions to write? First, they start by designing an algorithm. An algorithm is a set of step-by-step instructions on how to complete a particular task. You can think of an algorithm like a recipe; it has some inputs (the ingredients) which, if you follow the instructions correctly, get turned into an output (the finished dish).

DESIGNING AN ALGORITHM: FLOWCHARTS

One strategy that computer scientists use to design algorithms is drawing flowcharts. A flowchart is a diagram that uses different kinds of symbols and arrows to show the different steps in a process. For example, the flowchart below shows one possible algorithm for how to decide what movie to go see.



Each symbol has a specific meaning and use:

- **Ovals show the start and end of a process.**
- **Parallelograms show inputs or outputs for the process.**
- **Rectangles show steps or smaller processes that make up the larger task.**
- **Diamonds show decision points, also called branches.**
- **Arrows show connections and relationships between the other parts of the process.**

VANESSA TOSTADO

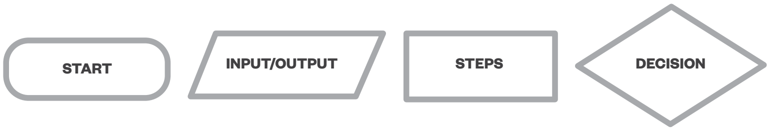
When Vanessa Tostado was growing up in East Palo Alto, California, she and her friends noticed that there was a lot of trash and graffiti around their neighborhood. The team of girls worked together to build Tag It!, a mobile app that lets people from the community mark locations that need to be cleaned up on a map. Other people in the community can then see the map and go remove the graffitti or pick up the trash. They entered their project in the Technovation Challenge, and they came in 5th place in the Bay Area and 20th place worldwide!

Vanessa is currently a student at Wesleyan University in Connecticut, where she is majoring in computer science. She has spent summers interning at companies like LinkedIn, Stanford Children's Health, and the Environmental Defense Fund.

NAME ______________________________ DATE ______________

INSTRUCTIONS: Choose a task or process that you do on a regular basis. Use the table below to create a flowchart that shows an algorithm for how someone might complete that task.

TASK:	
INPUTS:	**OUTPUTS:**
STEPS:	**DECISION POINTS:**
FLOW CHART	



ROBOTICS

LEARNING GOALS

Students will be able to...

1. **Define "robot".**
2. **Name 3 ways robots are used today.**
3. **Name 1 positive and 1 negative way robots are affecting the world.**

MATERIALS

1. **Worksheet**
2. **Video: What is a Robot? — WIRED**
3. **Photo: Ayanna Howard**
4. **Video: Ayanna Howard — MAKERS**

STANDARDS

CSTA: 2-IC20
CCSS ELA: CCRA.R.2
CCSS Math: MP3

VOCABULARY

ROBOT

A machine that follows the sense-think-act pattern to carry out some physical action.

HOOK (10 MIN)

1. **Set the stage by sharing the goals of the lesson.**
2. **Ask students to picture a robot. What does it look like? What does it do? Set a timer for 2 minutes while students write or draw their ideas.**
3. **Instruct students to turn to an elbow partner and share their ideas. As students share, circulate to see if there are any themes or misconceptions you'd like to discuss as a class.**
4. **As a class, have students share out the similarities and differences between what they and their partner thought. Summarize the discussion by sharing the fact that a robot can be challenging to define, partially because the field is changing so quickly!**
5. **Play the What is a Robot? Video.**
   - **Unplugged Alternative: Have students read the "What is a Robot?" section of the worksheet.**
6. **Highlight the definition for "robot" introduced in the video. Before moving on, take a poll of students by asking them to raise their hand if their original robot fit this definition.**
7. **Tell students that during the rest of the lesson, they're going to dig into real-life robots that living people have created! Challenge them to ask themselves: how are these robots impacting their world?**

WOMAN IN TECH SPOTLIGHT (5 MIN)

1. Play the Ayanna Howard — MAKERS video.
   - Unplugged Alternative: Have students read the biography of Ayanna Howard included on the worksheet.
2. Explain: This video talked about two different kinds of robots that Ayanna worked on. One type was a robot that could navigate on Mars. The other type was for helping children with physical disabilities learn.
3. Ask: How are Ayanna's robots changing the world?
4. Suggested Answers: Ayanna's rovers are exploring space, which expands our understanding of the universe and how it works. Ayanna's educational tools are helping students of all ability levels have access to quality learning products.

ACTIVITY (25 MIN)

1. Split students into groups. Assign each group one of the following robots to research:
   - Self-driving cars: How Self-Driving Cars Work (Medium article)
   - Kuri: Mayfield Robotics' Kuri is an adorable home robot (video)
   - Chef bot: These robotic arms put a five-star chef in your kitchen (CNET video)
   - FarmBot: Meet FarmBot (video)
2. Set a timer for 20 minutes. Within their groups, students should fill out the worksheet based on their assigned robot. Then, groups should discuss:
   - How is your assigned robot changing the world?
   - In what ways are those changes positive or negative?
3. As a group: Share out the robot you discussed and its impact. The best student answers will also address the ways their robot senses, thinks, and acts.

DEBRIEF (5 MIN)

1. **Explain to students that they're going to take a final vote on the impact of robots.**
2. **Designate one side of the room to be "helping" and one side to be "hurting."**
3. **Give students a moment to consider whether robots are helping or hurting the world.**
4. **Have students move themselves based on their opinions. Students might place themselves somewhere in the middle.**
5. **Have students turn to someone standing nearby, with a similar opinion. Set a timer for 1 minute while they discuss why they agree with each other.**
6. **Have students find a different partner who has a different opinion from them. Set a timer for 2 minutes while they discuss their different perspectives.**
7. **As a group, ask a few students to summarize their discussions with their partners. Student answers may vary, but some sample responses are included below:**
   - **Robots are helping the world because they can automate tasks that are hard or time-consuming for humans to complete manually. That frees up humans to do more creative work, which they might enjoy more.**
   - **Robots are potentially harmful because automating tasks means that people who used to do that work lose their jobs.**
   - **Robots are neither wholly good or wholly bad on their own. They can be either helpful or harmful, depending on who is building them and what they are being programmed to do.**
8. **Close out by sharing that robotics is a growing field that they can continue to study.**

ROBOT WORKSHEET

WHAT IS A ROBOT?

A robot is a machine that follows a sense-think-act pattern to carry out some physical action. This means that the robot is programmed to follow three different kinds of steps:

SENSE. First, the robot uses small electronic parts called sensors to take in information about the world around it. Some of these sensors are similar to your own senses of sight (like a camera) or hearing (like a microphone). But there are also other kinds of sensors that measure things like temperature, speed, or even fingerprints!

THINK. Next, the robot processes the information it sensed, so that it can decide what to do next. For example, imagine an assistant robot. First, it might sense through its microphone that you said something. Then it would run some code to break down what you said into specific commands. Then it would decide what action to perform, based on the command you gave.

ACT. Finally, the robot has to do some physical action. The physical movement is what separates robots from other "thinking" machines like laptops or cell phones. This action could be something as simple as moving forward or backward, or it could be something more complex, like moving a ball into a bucket. In addition to the physical action, the robot might use other types of output, like displaying some information displaying on a screen or playing an audio message through a speaker.

There are tons and tons of different kinds of robots in the world today. While some robots look like the metal human-like figures you might have seen in movies (think WALL-E), you have probably encountered different kinds of robots without even realizing it!

AYANNA HOWARD

Ayanna Howard is a roboticist and professor at the Georgia Institute of Technology. She first became interested in robotics after watching a TV show called The Bionic Woman, which is a sci-fi show about a woman with cybernetic implants that give her superhuman powers. Ayanna liked that the show told a story about how technology can be used for social good.

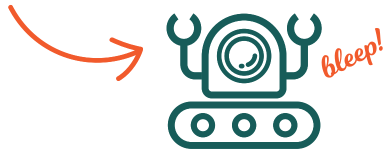
Ayanna earned a bachelor's degree in engineering, a master's degree in electrical engineering, a business degree, and a PhD in electrical engineering, robotics, and computer science! While she was in school, Ayanna started working at NASA's Jet Propulsion Laboratory, where she built rovers to navigate on Mars by themselves.

When Ayanna was working as a professor at Georgia Tech, she wanted to shift her focus from using robots in space to using robots for health care. It was a new area that not many other people had worked in before, which Ayanna thought was a little scary but also exciting! Ayanna founded Zyrobotics, a company that builds educational learning tools for children with physical limitations. One product they created was an electronic turtle stuffed animal named Zumo. Children could press on different parts of Zumo's shell, which would then map to different on-screen gestures (like swiping or tapping) for a mobile app.

How are Ayannas' robots changing the world?

NAME ____________________ DATE __________

ROBOT ____________________



THINK	**What decisions does your robot make?**
SENSE	**How does your robot take in information?**
ACT	**What physical action does your robot do?**

Discuss the following questions with your group. Record notes from your discussion here:

How is your assigned robot changing the world?

In what ways are those changes positive or negative?

PATTERN RECOGNITION

LEARNING GOALS

Students will be able to...

1. **Define "pattern recognition".**
2. **Use pattern recognition on a cipher.**
3. **Name one way a computer can use pattern recognition.**

MATERIALS

1. **Pattern Recognition Brief**
2. **Pig Latin Worksheet**
3. **Answer Key**
4. **Code Breaking Worksheet**
5. **Scissors**
6. **Fastener**
7. **Cardboards**
8. **Video: ENIAC Programmers Project**
9. **Article: ENIAC Programmers**

STANDARDS

CSTA: 2-NI-06
CCSS ELA: CCRA.R.1
CCSS Math: MP1

VOCABULARY

PATTERN RECOGNITION

Finding a pattern in a set of data.

CIPHER

A code; a way to change information so someone else can't understand it.

CODE/ENCODE

Convert information into a cipher.

DECODE

Convert a cipher back into information.

HOOK (10 MIN)

1. Share today's learning goals with the students and ask them to read sample text that has been encoded using Pig Latin.
2. Ask students to count off by threes.
3. Set a timer for 2 minutes. Ask students try to decode their assigned sentence on the Pig Latin Worksheet back into English.
   - Extension: If students finish early, encourage them to decode the remaining sentences back into English.
4. Ask students to share the answers they came up with.
5. Set a timer for 3 minutes. Ask students to turn to their elbow-partner and come up with 2 to 3 rules for Pig Latin together.
6. As a class, have students share out rules. How does Pig Latin work? What patterns emerged as they translated each sentence?
   - Focus on Why/How they came up with the rules and what patterns they identified in the sample. Use the Answer Key ONLY as a guide because answers will vary.
7. Highlight that students used pattern recognition. They used a sample sentence to figure out the rules and decode new messages using them.
8. Set a timer for 3 minutes. Have students read out loud the brief description of pattern recognition and its uses using the popcorn method. One person starts and picks the next person to read after each sentence.
9. Tell students that they will spend the rest of the activity building their pattern recognition muscle by using historic methods of encoding and decoding messages, as they already began doing with Pig Latin.

WOMAN IN TECH SPOTLIGHT (5 MINUTES)

1. Play the ENIAC Programmers Project trailer [1:10 - 3:35] video.
   - Unplugged Alternative: Have students read an article about the ENIAC Programmers.
2. Explain: This video talked about the women who were the first programmers of the ENIAC computer. Everything they did was new — can you imagine being handed all the parts for a computer and given the instruction, "Now put it together and make it work?"
3. Ask: What are some differences you noticed between the ENIAC and computers today?
   - Suggested Answers: There are no screens on the ENIAC. There are a lot of cables everywhere. The women appear to be plugging in wires from different places. It's huge!

ACTIVITY (25 MINUTES)

PART 1: THE CAESAR CIPHER (10 MINUTES)

1. **Pass out the Code Breaking Worksheet. Have students cut out their Caesar Cipher encoder/ decoders.**
2. **Ask a student to read out the rules for the Caesar Cipher.**
3. **Write "ENIAC" on the board.**
4. **Ask a student come up to the board while the class follows along and helps them encode the word: ENIAC using 1 rotation.**
5. **Split students into groups of 2 - 3 people.**
6. **Set a timer for 3 minutes. Each group should create their own Caesar Cipher using a number between 1 and 26. Tell them to translate the word ENIAC and two other 5-letter words of their choosing.**
   - **Example: ENIAC, HELLO, WORLD with 2 rotations is "GPKCE JGNNQ YQTNF"**
7. **Set a timer for 5 minutes. Students should pass only the three encoded words in a random order to the another group. Groups should try to figure out what the encoded words are using the knowledge that at least one translates to ENIAC.**

PART 2: THE CAESAR CIPHER WITH TOO MUCH DATA (10 MINUTES)

1. **Explain: In your groups, instead of creating a cipher with just three words, you will encode three to five long sentences with the Caesar Cipher.**
   - **Note: The sentences don't have to make sense together or make a paragraph. Any 3 - 5 sentences will do.**
2. **Set a timer for 5 minutes. Groups should create their ciphered sentences.**
3. **Explain: Before you give your cipher to another group, brainstorm some strategies for how you'll solve this next one. Strategies will help you break the ciphers faster!**
4. **Set a timer for 2 minutes. Students should strategize in their groups.**
   - **Guiding Questions:**
     - **Are there words that are easier to break than others?**
     - **How might you decipher a one-letter or two-letter word?**
5. **Set a timer for 3 minutes. Groups should trade ciphers and try to break the new cipher.**
   - **Note: Students are not expected to be able to break this cipher.**

CLOSE OUT (5 MINUTES)

1. Close out the activity with the following Think-Pair-Share:
2. Think: Ask them to silently reflect on the questions at the end of the activity for a minute.
   - What strategies did you use to try to decode the cipher? How did you use these to decide if something was right or wrong?
   - Suggested Answers:
     - We converted one word at a time to see if it was a real word or a word in English.
     - We converted the smaller words first because those were the fastest to look at.
     - Could you have broken the second cipher with enough time? What if it was the length of a book? Why or why not?
3. Pair: Ask them to turn to an elbow partner and share their thoughts on the questions.
4. Share: Have a few students share out their thoughts on the questions with the class.

DEBRIEF (5 MIN)

1. Explain: Imagine you now had a computer to break the cipher. This computer processes information so quickly that the length of the message doesn't matter.
2. Ask: Let's brainstorm; what are some useful things a computer could do to help decode the cipher?
   - Guiding Question:
     - If the computer decodes one word using a specific rotation, how do you know if it's right?
   - Suggested Answers:
     - The computer should be able to tell if a word is in English or the word is in the English dictionary.
     - The computer should be able to tell if all the words are in English.
     - The computer should be able to tell how long a word is so it can look at the shortest words first.
     - The computer should be able to change the text by whatever rotation we're using.
     - The computer should be able to go through all the rotations in the Cipher Disc that you created.
3. Close Out: Congratulations! You all learned how to recognize a pattern and created strategies for how a computer could break codes. In Computer Science, a list of strategies that solve a problem is called an algorithm. Algorithms are one way computer scientists use pattern recognition to solve problems.
   - Extension: Close out by talking about how pattern recognition applies to the subject matter of your class by using the standards guide.

PATTERN RECOGNITION WORKSHEET

WHAT IS PATTERN RECOGNITION?

Pattern recognition is a way to find trends and make predictions. We use patterns in data to determine key features and predict outcomes.

HOW IS IT USED?

A computer software may track the things you buy. It can use this data to recognize patterns and predict your preferences. Mathematicians look for patterns in groups of shapes to predict what they have in common. They predicted and proved that inside angles in a triangle add to 180 degrees. Pattern recognition allows readers to understand how writers use grammar. For example, an active voice puts focus on a character. Passive voice puts the focus on an action. Knowing that readers recognize this can be used to change the mood in a passage. Scientists use pattern recognition to analyze nature. For example, they study patterns in animals to group them by Kingdom, Phylum, and so on. Historians classify governments by studying patterns in societies. Examples include democracies, monarchies, and so on.

ENIAC PROGRAMMERS

During World War II, advances in military technology had created a need for individuals called "computers" who could solve the lengthy and complicated equations needed to aim and target large ballistic weapons. As with most wartime positions, there were few qualified men who were available for the job. So in the 1940s, the U.S. Army recruited over 100 women to work as computers at the Army's Ballistic Research Labs in Philadelphia, Pennsylvania.

Yet even with dozens of America's most intelligent women working on the problems, doing the calculations by hand took far too long. In 1943, engineers John Mauchly and John Presper Eckert were given permission to pursue an experimental project — an electrical machine that could handle the computations in a matter of seconds. This machine, the Electrical Numerical Integrator and Computer (ENIAC), was completed in 1945 and is considered the world's first electronic computer. But unlike modern computers, it had no memory or ability to store the equations and processes needed to actually complete the calculations. A team of human computers who could complete the equations by hand were needed to hard-program these sequences into the ENIAC.

Six young women were chosen for the task: Frances "Betty" Holberton, Kathleen "Kay" McNulty, Marlyn Wescoff, Ruth Lichterman, Frances Spence, and Jean Jennings. The women had no precedent or manuals to follow and had to teach themselves the functions of the 30-ton machine, which was comprised of approximately 70,000 resistors, 10,000 capacitors, and 6,000 manual switches. In order for the ENIAC to work through the differential equations, the programmers had to break the bulky sequences into smaller, simplified steps, and literally handprogram the 1,800 square foot machine.

The result was groundbreaking. The six ENIAC women had successfully managed to cut the time-table on the ballistic equations from over 30 hours to mere seconds. In February of 1946, just months after the end of the war, the world's first electronic computer was revealed to the public.

But none of its programmers were present or named. Instead, male engineers Presper Eckert and Mauchly were elevated to fame and credited with the full creation and function of the ENIAC. Despite going on to make names for themselves in the industry, the female programmers and their contributions were over-looked for almost 70 years — at the 50thanniversary celebration of the ENIAC project, the majority of the team wasn't even invited.

In the 1980s, a young computer science major named Kathy Kleiman grew frustrated by the small number of women in her classes. While looking into the role of women in computer science, she came across the photos of the ENIAC project, which featured uncaptioned photos of the ENIAC programmers. According to Kleiman, when she asked a professor about the women, she was told they were likely "refrigerator ladies," models who were posed with the machine to make it more alluring. This search for the pioneers of programming spawned a 20- year project called the ENIAC Programmers Project, as a way to promote the six women and their contributions.

What Kleiman and her collaborators found was heartening. While history was quickly working to forget them, the ENIAC women had continued to press forward with technological advances. Each woman went on to make her own mark in the field: Lichterman stayed with the ENIAC program for two years to train new programmers, while Holbertson and Jennings helped convert the ENIAC into a "stored-program" machine. Holbertson created the first program that allowed for sorting and storing large data files, and members of the team would later work to develop guidelines and standards for a universal programming language. Jennings spent the remainder of her career working to make computers more accessible and easier to use.

The ENIAC Programmers project paid off — not just as a way to memorialize the original programmers, but to promote the important work that women have done, and continue to do, for the field. This year marks 70 years since the first electronic computer was unveiled to the world, and although the programmers' names were temporarily lost to history, they have now taken their rightful places in the hall of fame, inspiring the next generations of pioneers.

NAME ______________________ DATE ____________

PIG LATIN WORKSHEET

INSTRUCTIONS: **Decode the encoded phrases below.**

SAMPLE:

Encoded: Idday youway avehay away eatgray ayday?

Decoded: Did you have a great day?

Sentence 1: **Erethay ereway onay reensscay onway ethay ENIACway, osay ethay omenway usedway aperpay otay eepkay acktray ofway everythingway.**

____

____

Sentence 2: **Ethay irstfway “omputerscay” ereway omenway howay idday athmay alculationscay ybay andhay orfay ASANay.**

____

____

Sentence 3: **Ethay ENIACway adhay onay instructionsway, osay ethay omenwat adhay otay ogay roughthay ethay ardwarehay otay earnlay owhay otay usewat itway.**

____

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Rules Brainstorm:

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NAME ____ DATE ______________

CODE BREAKING WORKSHEET

PART ONE: **The Caesar Cipher**

A Caesar Cipher works by rotating the alphabet by a number of rotations. The example below shows one rotation. The bottom row is the original word and the top row is the cipher. So, A becomes B, B becomes C, C becomes D, and so on.

EXAMPLE USING ROT1:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

Use the example cipher to decode the following word: IJ! ____!

Click for Caesar Cipher Template

INSTRUCTIONS:

1. **As a class, encode the word ENIAC.**
2. **In your group, encode three 5-letter words using the worksheet.**
   - **One of the words must decode to ENIAC.**
3. **You must use the same rotation for all three words.**
4. **Give your three ciphers to another group in a random order.**
5. **In your group, decode the three ciphers from another group.**

NAME ______________________________ DATE ______________

CODE BREAKING WORKSHEET

PART TWO: The Extended Caesar Cipher

INSTRUCTIONS:

1. **In your group, encode 3-5 long sentences using the worksheet. Consider avoiding words that might make your message easy to decode.**
   - **You must use the same rotation for all words.**
2. **Brainstorm strategies for how you'll decode another group's message. Consider how you might decode your own message.**
3. **Give your cipher to another group.**
4. **In your group, decode the cipher from another group.**

FUN FACT!!

The Caesar Cipher is named after Julius Caesar because he used it for his private messages. It was in use for hundreds of years. A method to break it was first documented in the 9th Century called: Frequency Analysis. Al-Kindi, a mathematician, found that certain letters appeared more often in Arabic by counting the letters in the Qur'an. He realized that by knowing which letters appear most often, he could guess the rotation used in a cipher and decode any message.

How does it work? Each language has its own order for which letters appear most often. This is known as that language's fingerprint. In English, E appears most often. If we're given a cipher, we start by finding the letter that appears most often. Let's pretend that F appears most often. Next, we rotate our wheel until E becomes F, which is the above ROT1. Now, we can decode the rest of the message using this rotation!

NAME ______________________________ DATE ______________

CODE BREAKING WORKSHEET

PART ONE: **The Caesar Cipher**

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

ROTATION USED: ________ (between 1 and 25)			
ORIGINAL	E N A I C	_ _ _ _ _	_ _ _ _ _

PART TWO: **The Extended Caesar Cipher**

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

ROTATION USED: ________ (between 1 and 25)
ORIGINAL

NAME ____ DATE ______________

CODE BREAKING WORKSHEET

STRATEGIES BRAINSTORM

NAME ______________________________ DATE ______________

CODE BREAKING WORKSHEET

PART ONE: **The Caesar Cipher**

_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _

PART TWO: **The Extended Caesar Cipher**

PIG LATIN WORKSHEET ANSWER KEY

TRANSLATIONS:

Sentence 1: There were no screens on the ENIAC, so the women used paper to keep track of everything.

Sentence 2: The first "computers" were women who did math calculations by hand for NASA.

Sentence 3: The ENIAC had no instructions, so the women had to go through the hardware to learn how to use it.

RULES:

If a word starts with:

- **One letter consonant sound:**
  - Move the consonant letter to the end of the word.
  - Add "ay" to the end.
- **A two letter consonant sound:**
  - Move both consonant letters to the end of the word.
  - Add "ay" to the end.
- **Vowel sound:**
  - Add "way" or "yay" (or just "ay") to the end of the word.

CODE BREAKING WORKSHEET ANSWER KEY

ROTATION USED: 1 (between 1 and 25)			
ORIGINAL	E N A I C	CODED	F O J B D

ROT 2 EXAMPLE:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X

ROTATION USED: 2 (between 1 and 25)			
ORIGINAL	E N A I C	H E L L O	W O R L D
CODED	G P K C E	J G N N Q	Y Q T N F

DESIGN-TEST-BUILD

LEARNING GOALS

Students will be able to...

1. **Explain what happens in each stage of the design-build- test cycle.**
2. **Use the design-build-test cycle to create a paper prototype.**

MATERIALS

1. **Worksheet**
2. **Photo: Miral Kotb**
3. **Video: Miral Kotb — Made with Code**
4. **Additional blank paper and drawing materials for prototypes**

STANDARDS

CSTA: 2A-AP-15
CCSS ELA: CCRA.SL.
CCSS Math: MP3

VOCABULARY

DESIGN-BUILD-TEST CYCLE

A process for creating a product that involves designing what it should look like, building a draft, and then testing it to get feedback. This cycle can be repeated again and again to make a product better and better.

PROTOTYPE

An early version of a product that computer scientists use for testing and getting feedback, like a draft.

HOOK (5 MIN)

1. **Ask: What is a problem or challenge that you face that could be fixed with a mobile app?**
2. **Set a timer for 1 minute while students write down as many ideas as they can think of.**
3. **Have students share out some of their ideas by filling in the sentence stem: "I'd build an app that helps with ________ by ________."**
4. **Explain: Many great products are invented because they help someone solve a problem or they fill a need. Today, you'll get a chance to see what it's like to dream up a product and start innovating.**
5. **Distribute the worksheet and set a timer for 2 minutes while students read the sections "What is the Design-Build-Test Cycle?" and "What is a Prototype?"**
6. **Call on a few students to summarize what the design-build-test cycle is and why it's useful.**
   - **Suggested Answer: The design-build-test cycle helps computer scientists get feedback on their products and make them better.**

WOMAN IN TECH SPOTLIGHT (5 MIN)

1. **Play the Miral Kotb — Made with Code video.**
   - **Unplugged Alternative: Have students read the biography of Miral Kotb included on the worksheet.**
2. **Ask: When might Miral have used the design-build-test cycle when she was creating iLuminate?**
   - **Suggested Answers: Miral probably used the design-build-test cycle when she was creating the special costumes that her performers wear. She probably also used it when she was creating different kinds of visual effects for her shows, to test out which ones were the most exciting.**

ACTIVITY (25 MIN)

1. **Give students a moment to choose one of the app ideas they came up with earlier to turn into a prototype.**
2. **Set a timer for 5 minutes while students fill out the Design section of the worksheet. During this time, students should make rough sketches for how they might design their apps. Encourage students to try out lots of different designs to see which they like best. They'll flesh out a single idea in more detail in the next section.**
   - **Students might feel nervous and claim they can't draw. Let them know that this activity isn't about creating a work of art; it's about getting their ideas across as easily as possible.**
3. **Explain: Now that you've had some time to try out some different designs, it's time to choose your best sketches and use them to build a paper prototype.**
4. **Set a timer for 15 minutes while students use the Build section of the worksheet to draw out a paper prototype for their app.**
   - **Have extra paper handy in case students need more than the three screens provided.**
   - **If you have more time, consider having students build a more interactive paper prototype, like the one shown in this video. This will let students get more accurate feedback in the Test phase.**
5. **Have students find a partner for the Test phase. Explain to them that providing feedback to teammates is an important skill for computer scientists, and something they're going to now practice!**
6. **Set a timer for 5 minutes. In this time, the first partner should demo their prototype and answer any questions the second partner has about how it works. Then the second partner should give feedback on the prototype, using the format of Glows and Grows. The first partner should take notes using the Test section of the worksheet.**
   - **Glows: Things that are working well.**
   - **Grows: Ways the product could be improved.**
7. **Set a timer for 5 minutes. Have the students switch roles so that the second partner has a chance to demo their prototype and get feedback.**

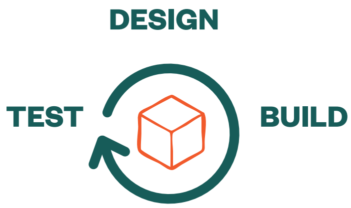
DEBRIEF (5 MIN)

1. Set a timer for 1 minute. Have students write down what changes they might make to their prototypes if they were to do another round of design-build-test.
2. Ask for volunteers to share out their thoughts on the design-build-test cycle. How did it feel to use it? What did they like? What did they dislike?
3. Set a timer for 1 minute. Have students turn to a new partner and discuss the following: How might you apply the design-build-test cycle to other parts of your life? Why might it be useful to use in that situation?
4. Have a few students share out what they talked about with their partners. The best student answers will emphasize that the design-build-test cycle is helpful because it lets you work in smaller chunks and get feedback early, which lets you make adjustments quickly without wasting a lot of effort.
5. Tell students that they can use this strategy in any of their classes, and dive even deeper into it by taking a computer science class when it's available!

DESIGN-BUILD-TEST CYCLE WORKSHEET

WHAT IS THE DESIGN-BUILD-TEST CYCLE?

Just like how a good author will go through multiple drafts when writing a book, a good computer scientist will build multiple versions of a product before it's finished. One process that computer scientists can use to build a product is the design-build-test cycle. In this cycle, computer scientists create a product by moving through three different stages:



DESIGN: Deciding what the product should look like.

BUILD: Creating a version of the product.

TEST: Getting feedback on the product from other people.

Once you finish the test phase, take what you've learned and use it in your next design phase. For example, in your tests you might learn that your users have a hard time finding a particular feature. So you might start a new design stage where you tweak your product's layout to improve the user's experience. This cycle can be repeated again and again to make a product better and better.

WHAT IS A PROTOTYPE?

A prototype is an early version of a product, like a first draft of an essay. Computer scientists will often start off by building a prototype, because it lets them quickly put something together so they can get feedback from actual users. It's better to use a prototype to test than a finished product, because if users don't like something, it's easier to make changes to a prototype. Think about a time when you wrote a paper for class. Wouldn't it be easier to make changes to your first outline than it would be to change your final draft?

MIRAL KOTB

Miral Kotb was born in Egypt, and she and her parents moved to the United States when she was 2. When Miral was 9, she built her first computer program. She went on to earn a degree in computer science at Columbia University while studying dance at Barnard College at the same time. After college, she started working as a software engineer, but she dreamed of combining her love of dance with her love of technology.

Then, in 2009, when Miral was working as an engineer on mobile apps, she had an idea. She imagined a performance where dancers wore costumes with lights that could be wirelessly turned on and off in time with the music. This idea led Miral to create iLuminate, a dance group that performs in special light-up suits to create visual illusions. As the company got started, Miral and her team built different prototypes of the costumes until they found one that worked just right. Miral likes that iLuminate brings together people from different backgrounds - programmers, dancers, costume designers — to create something magnificent!

When might Miral have used the design-build-test cycle when she was creating iLuminate?

NAME ______________________________ DATE ____________

INSTRUCTIONS: **Choose a challenge or problem you face that could be solved with a mobile app. Use the space below to sketch some ideas for the design of your app. Don't worry about being perfect - just get your ideas down quickly! You'll have a chance to refine your ideas in the next section. As you sketch, consider the following questions:**

- **What is the main thing your app needs to do? What's the simplest way to help the user do that?**
- **What information goes on each screen of your app? How does the user move from one screen to the next?**
- **What buttons does your app need? What happens when the user clicks them?**

CHALLENGE
SOLUTION
DESIGN

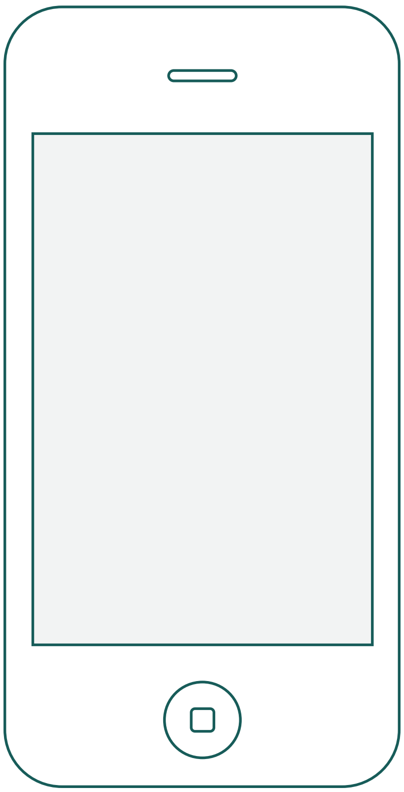
NAME ______________________ DATE ____________

INSTRUCTIONS: Use the space below to build a paper prototype of your app.

BUILD

SCREEN

____



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SCREEN

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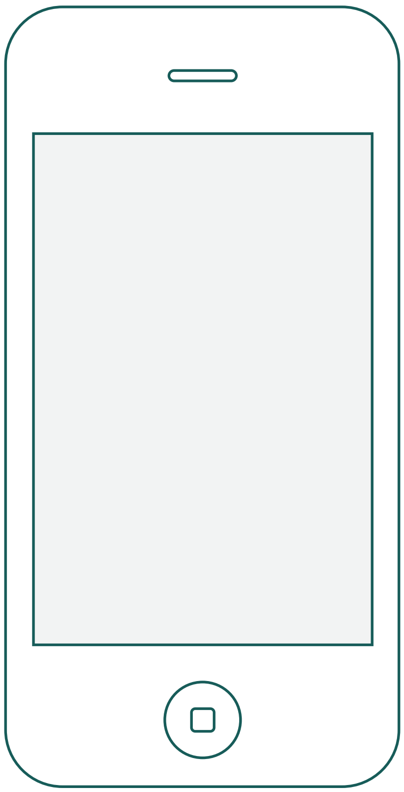

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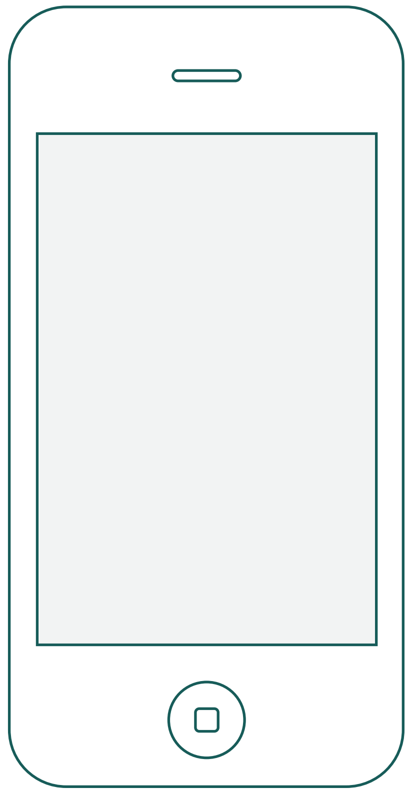

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NAME ______________________ DATE ____________

INSTRUCTIONS: Use the space below to keep track of the feedback you receive from your classmates.

GLOWS	**What is working well?**
GROWS	**What might make it work even better?**

Based on the feedback you received, what changes might you make to your product if you were to do another round of design-build-test?

How might you apply the design-build-test cycle to other parts of your life?


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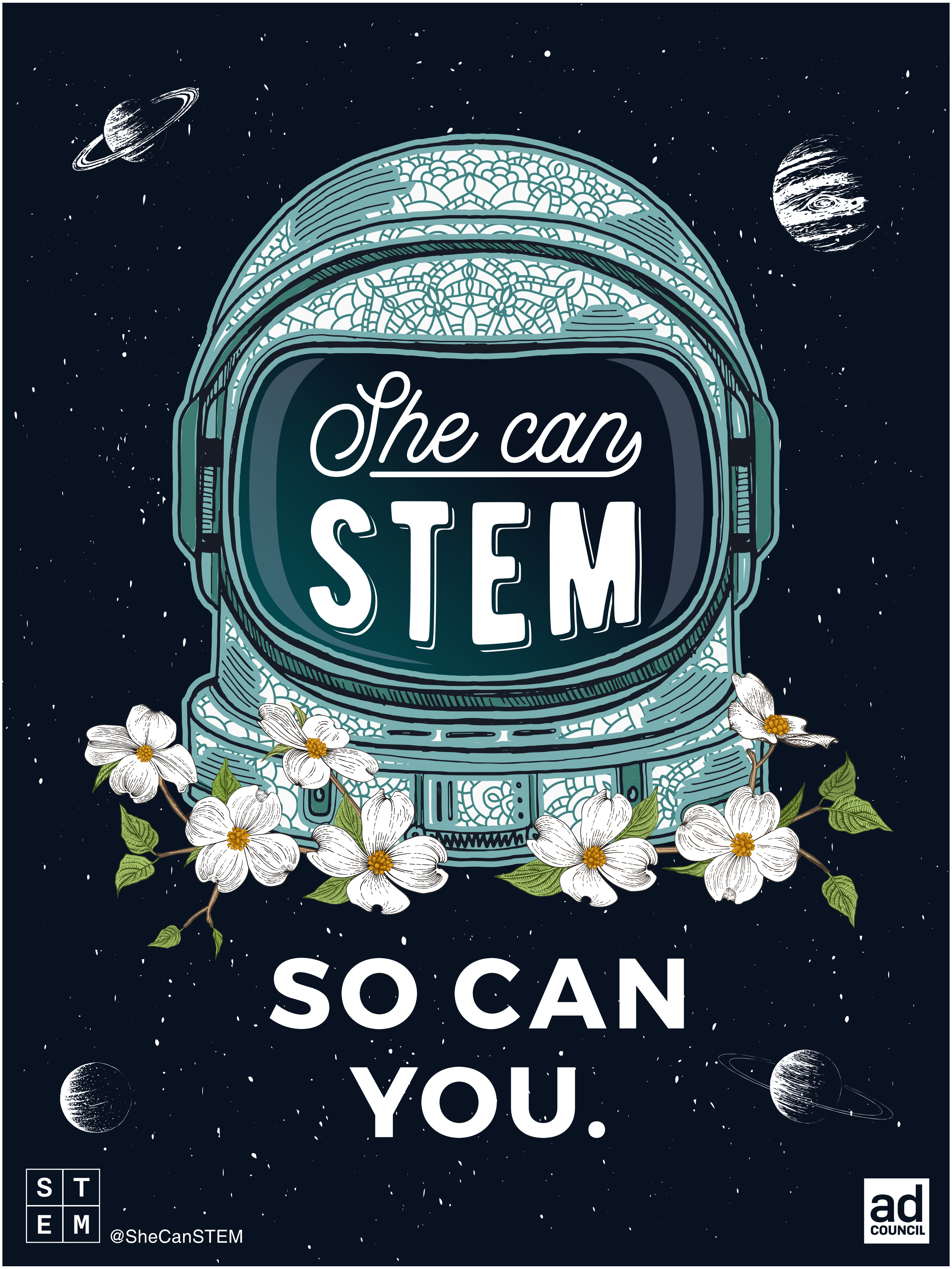

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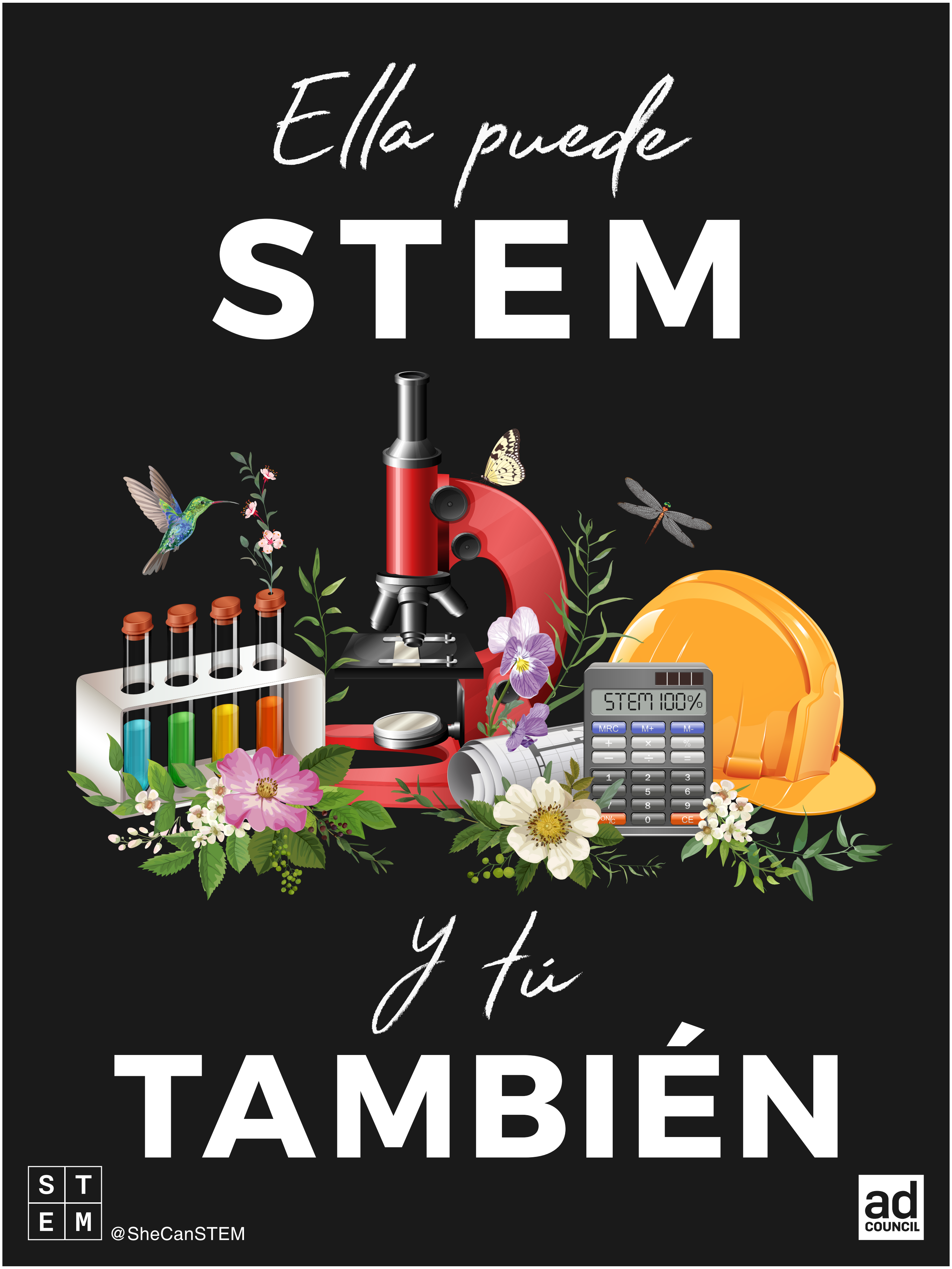
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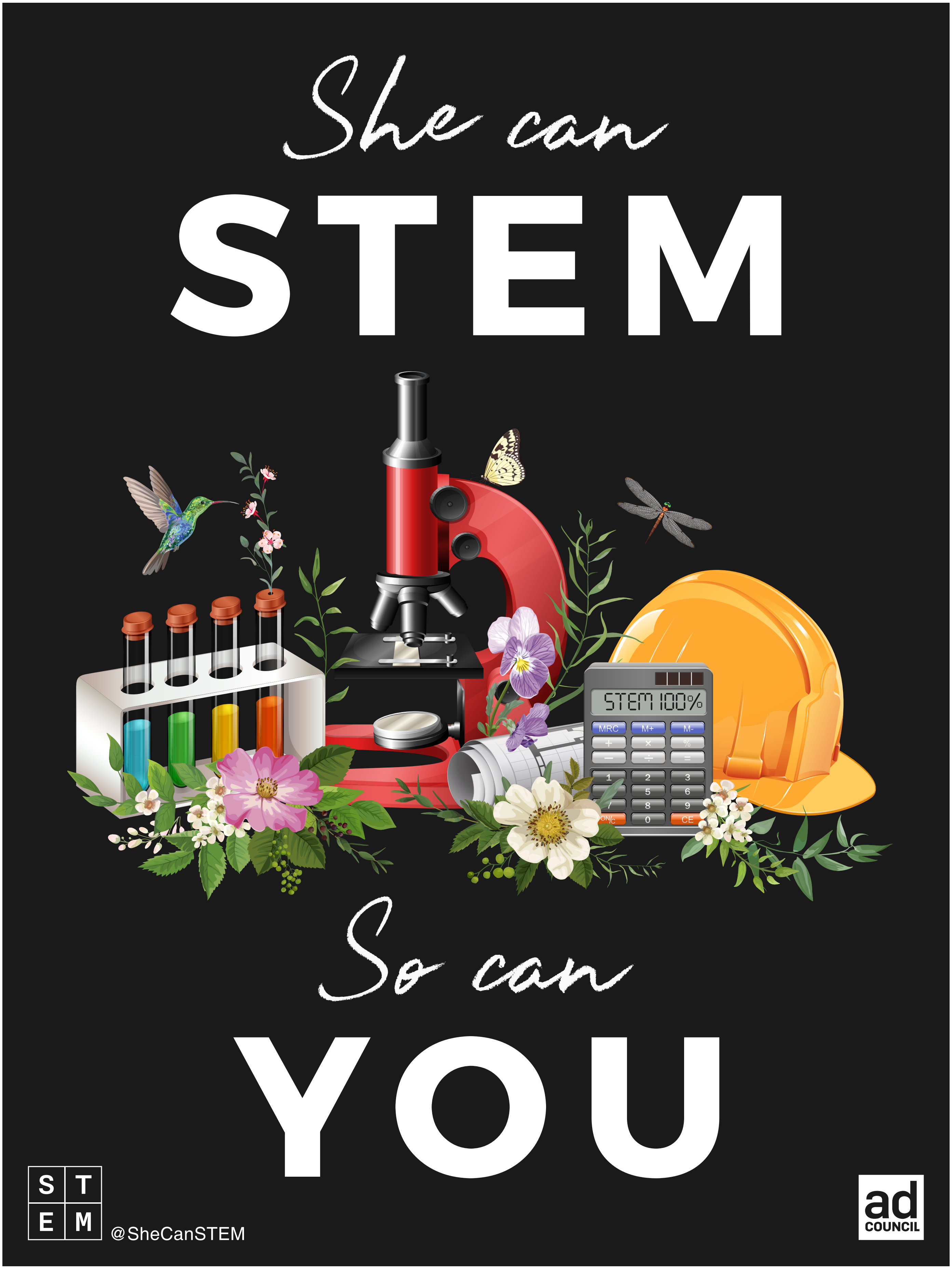
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FEEDBACK

We would love to share the story of your conversations around STEM integration with the rest of the Education Amplifier network, as well as other educators interested in bringing art and dialogue into their classrooms.

If you'd like to share, please email us at education@amplifier.org.

Some emails we like getting most:

FEEDBACK

Such as: How did the lesson plan go? What did you learn? What were your students most interested in? How did they respond? What would you change if you were going to facilitate this lesson plan again? Did you revise the lesson plan to fit your students better, and if so how?

PHOTOS OR VIDEO OF YOUR STUDENTS IN ACTION.

If you share this, please indicate if you have permissions for us to share these photos publicly with other educators, or if they are strictly for documentation purposes.

YOUR STORY!

Such as: Why did you decide to facilitate this conversation in your classroom? What has your experience been so far as an Education Amplifier? How are you using the artwork in your classroom? How have your students reacted to the artwork?

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