Key Student Learnings:

Elementary Tour Objective

Students will be able to learn how computer science, engineering, and people work together to fulfill customer orders at Amazon. Students will also meet software, hardware, and system engineers and learn how their jobs helped make this technology possible.

Key Vocabulary:

The following vocabulary will be introduced in audio and visual format during the tour:

- **Hardware:** the physical parts of a computer or device (stuff you can touch).
- **Software:** also known as code or program, the instructions that tell the computer or robot how to work and what to do.
- **System:** a group of devices (hardware and software) that work together to accomplish a task.
- **Algorithm:** a set of step-by-step instructions or rules that a computer or robot follows to perform a task
- **Database:** a place where data is organized and stored.
- **Sensor:** a device that takes in information from its environment and responds.

Key Learnings by Tour Stop:

Below is an outline of the tour's key learnings by tour stop. Each tour stop has at least one interactive question. Some questions will be multiple-choice trivia questions while others will be open response opportunities for student reflection. Teachers may utilize the open response questions for typing in Kahoot!, partner discussion, or stop-and-jot time using **the student worksheet**.

Stop:	Interactive Questions:	CS Learnings and FC Context Summary:
Welcome 	**1) What do you already know about Amazon, robots or computer science?** Open response answers or turn and talk. **2) What was the fastest Amazon has ever delivered a customer order?** **a.** Under 3 minutes **b. Under 30 minutes** **c.** About 1 hour **d.** About 3 hours **3) The robots used to carry the pods are an example of _____.** **a. hardware** **b.** software **c.** algorithm **d.** system **4) The robots know where to go because ____ programs its path using code.** **a.** hardware **b. software** **c.** sensors **d.** system	The tour guide will give an overview of the tour and set expectations. **Hardware** is the physical parts of a computer or device - it's the stuff you can touch, like computers, scanners, robots, and machines. **Software** is the code or program - the instructions that tell a computer or robot how to work and what to do. When **hardware** and **software** work together to accomplish a task it is called a **system**. The hardware and software at the Pick, Pack, and Ship sites work together to deliver orders safely and correctly to Amazon customers. Watch this tour stop in Video 1, Video 2, and Video 3.

Key Student Learnings:

Stop:	Interactive Questions:	CS Learnings and FC Context Summary:
Pick 	**5) How does Amazon organize and store items in each fulfillment center?** **a.** Alphabetically by name **b.** By their purpose (cleaning supplies, art supplies, sports items, clothes, etc). **c.** By their color (orange items, green items, blue items). **d. Randomly — no organization method** **6) After the item is placed in a tote, the picker taps a sensor. The sensor is an example of _____.** **a.** software **b.** algorithm **c. hardware** **d.** system **7) Hardware, software, and people work together at a pick station to form a _____** **a.** sensor **b. system** **c.** database **d.** algorithm	**Algorithms** are sets of instructions or rules that a computer follows to perform a task. **Algorithms** decide what Fulfillment Center should process your order. The algorithm first looks at which Fulfillment Centers have your item(s) and then selects the one that is closest. Once an order goes to a Fulfillment Center with the items in stock, the computer needs to determine where the item is stored within the huge fulfillment center. Inside the FC, items are stored in tall, moveable shelves called pods. Each pod can be moved by a robot (called a drive unit) that is programmed by a software program and has **sensors** on it that can detect and respond to the robot's environment. The robotic drive unit uses **sensors** and unique QR codes on the floor to move around, avoid obstacles like other robots, fallen items, or people, and deliver the correct pods to the correct place. If there is ever a problem with the **hardware** (robots) or **software** (algorithm), there is a team that can go onto the FC floor and help troubleshoot, or solve, the problem. Items in a fulfillment center are stored randomly so items are spread out across a big area, and a robot can efficiently choose a path to the nearest object without running into or getting stuck around other robots. An algorithm calculates the closest pod with the correct item and then tells the robot to take it to the human picker. When the robot delivers the correct pod(s) to a picking station, an associate will pick the item from the pod and send it off for packing. Watch this stop in Video 3, Video 4, and Video 5.
Pack 	**8) How does a packer choose the right sized box?** **a.** Years of training with the experts at our Packing Dojo **b. Following on screen commands based on previously recorded item measurements** **c.** Using rulers and tape measures on each item and working out the math for each order **d.** Pick the box which simply looks big enough **9) ____ tells a packer exactly which box to use for the items they are packing.** **a.** hardware **b.** sensors **c.** robots **d. software** **10) The tape dispenser that spits out the right amount of tape is an example of _____.** **a. hardware** **b.** sensors **c.** robots **d.** software	When an item arrives at Amazon to be sold, we record many piece of **data**, or information, about it like its height, width, and weight. These facts are stored in a database. A **database** is a place where data is organized and stored, like on a computer or in the cloud. Amazon ships a lot of items. We try to be as **efficient** as possible and use as little time, electricity, cardboard, gasoline, etc. to deliver this item. **Efficiency** is the ability to accomplish something with the least waste of time, energy, effort, or material. Amazon's Sustainability team works to make sure Amazon's shipping and delivery process uses as little time, electricity, cardboard, gasoline, etc. to deliver items to customers. How do we practice efficiency when choosing a box to ship an item? We need to pick the smallest box possible while also protecting the items. When an item is ordered, a computer program finds the item's dimensions and weight from the database and automatically calculates (using an algorithm!) which box will be most efficient to use (even when combined with other items!). Watch this stop in Video 5, Video 6, and Video 7.

Key Student Learnings:

Stop:	Interactive Questions:	CS Learnings and FC Context Summary:
Ship 	**11) How does Amazon check that an order is correct if the box is already sealed?** **a. Weighs the item as it goes over the conveyor belt** **b.** Uses an X-Ray to check the item inside is correct **c.** Uses the robotic arm to rattle the box and microphones to listen for the correct sound **d.** It doesn't perform any more checks, you are trying to trick us **12) The SLAM station uses an algorithm to see if an order is correct. The algorithm is an example of _____** **a.** hardware **b. software** **c.** systems **d.** databases **13) The SLAM algorithm looks up the expected weight of the items from ___.** **a.** hardware **b.** software **c.** sensors **d. a database**	After the order is packaged in an efficient box, the order is double-checked. At this station, customer address label is applied and a sensor weighs the box. The system references the **database** to calculate how much the items in the box should weigh and compares that to how much it does weigh. An **algorithm** decides if the weight is accurate or not. If it is not accurate, the box is pulled off, inspected, and corrected by an associate. If it is correct, it heads onto shipping. At the ship station, more data is analyzed by computer programs to choose the most efficient truck and route for shipping to the customer's home or business! As the packages move down the conveyor belt toward the trucks, the computer software triggers hardware to push the packages down a chute, or a slide, to its correct truck. Watch this stop in Video 7, Video 8, and Video 9.
Careers 	**14) Which career interests you most?** **a.** Designing and building robots (hardware engineer) **b.** Coding the robots and computer systems (software engineer) **c.** Designing how the whole process works (solutions/systems engineer)	Students meet three Amazon Robotics employees. One from Hardware, Software, and Solutions. Students learn how hardware and software must work together to make the best Amazon Robotics **Solution** possible. Watch this stop in Video 9 and Video 10.
Survey and Review 	At the end of the tour, students will be asked the following questions in Kahoot!. Amazon Future Engineer uses these responses to help improve future Tech Tours. 15) What was your favorite part of the tour? 16) __ on the robots scan QR codes so the computer knows where the robot is on the FC floor? A: Sensors 17) A(n) __ matches the expected weight to the actual weight of items to perform a quality check? A: algorithm 18) __ design and build complicated products, machines, and systems, like Amazon's fulfillment system and robotics. 19) A sensor is a piece of hardware? A: True 20) Data and information, such as an item's height and weight, are stored in a ___? A: Database 21) Overall, rate your tour experience on a scale of 1-5 (Poll) 22) How interested are you in pursuing careers in technology? (Poll) 23) How did this tour affect your interest in pursuing careers in technology? (Poll) 24) Do you agree or disagree with the following statement: I feel like I belong in careers in technology. (Poll)	

After the tour:

- **TEACHERS: Get an Amazon Gift Card!** Complete this tour survey and you'll receive a $5 Amazon Gift Card.
- **Test your students' vocabulary:** Assign this Kahoot! to students to test their new computer science vocabulary knowledge.
- **Celebrate:** Print and distribute student certificates to celebrate completing the tour!
- **Lead a discussion:** Use these discussion questions to debrief with your students after the tour. PDF Word Google Doc

Standards Alignment:

The Amazon Future Engineer Virtual FC Tour is aligned to a variety of educational standards:

- Next Generation Science Standards (NGSS)
- CSTA K-12 Standard Alignment
- ISTE Standards

Next Generation Science Standards -NGSS (See the standards here.)

The following standards are fully or partially addressed during the tour:

K-2-ETS1-1 Engineering Design: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

3-5-ETS1-1 Engineering Design: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2 Engineering Design: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3 Engineering Design: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

CSTA K-12 Standard Alignment (See the standards here.)

The following standards are fully or partially addressed during the tour:

1A-CS-01: Select and operate appropriate software to perform a variety of tasks, and recognize that users have different needs and preferences for the technology they use.

1A-CS-02: Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware).

1A-CS-03: Describe basic hardware and software problems using accurate terminology.

1A-DA-05: Store, copy, search, retrieve, modify, and delete information using a computing device and define the information stored as data.

1A-AP-08: Model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks.

1A-AP-11: Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.

1A-AP-12: Develop plans that describe a program's sequence of events, goals, and expected outcomes.

1A-AP-15: Using correct terminology, describe steps taken and choices made during the iterative process of program development.

1A-IC-16: Compare how people live and work before and after the implementation or adoption of new computing technology.

1B-CS-01: Describe how internal and external parts of computing devices function to form a system.

1B-CS-02: Model how computer hardware and software work together as a system to accomplish tasks.

1B-CS-03: Determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies.

1B-DA-07: Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea.

1B-AP-11: Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process.

1B-IC-18: Discuss computing technologies that have changed the world, and express how those technologies influence, and are influenced by, cultural practices.

1B-AP-15: Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.

ISTE Standards Alignment (See the standards here.)

The following standards are fully or partially addressed during the tour:

Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

1a: Students articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.

1d: Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

Digital Citizen: Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

2b: Students engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.

2c: Students demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.

Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

3d: Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.

4a: Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.

4d: Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.

Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

5a: Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.

5d: Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

Global Collaborator: Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.

7c: Students contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

7d: Students explore local and global issues and use collaborative technologies to work with others to investigate solutions.