Key Student Learnings:

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 be able to meet and hear about the careers of three engineers who enable this technology.

Key Vocabulary:

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

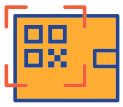
- **Algorithm:** a set of instructions or rules that a computer follows to perform a task.
- **Cloud Computing:** The delivery of technology resources—including computing, storage, databases, networking, and intelligence—through the Internet.
- **Sensor:** a device that detects and responds to its physical environment.
- **Efficiency:** the ability to reduce or eliminate waste in a process.
- **Database:** an organized collection of structured information, or data, typically stored electronically in a computer system.
- **Quality Control:** A process used to ensure that product or service is free from error.
- **Machine Learning:** The science of getting computers to perform or make predictions based on examples or past experience.
- **Hardware:** the physical parts of a computer or device (stuff you can touch).
- **Software:** collection of instructions and data that tell the computer how to work (the code!).

Key Learnings by Tour Stop:

Below is an outline of the tour's key learnings by tour stop. Each tour stop starts with an interactive question. The tour guide reveals the answer and explains how it relates to a specific computer science term. The tour guide will then provide real-life context of how this computer science learning shows in the fulfillment process.

Stop:	Interactive Questions:	CS Learnings and FC Context Summary:
Welcome (0 - 8 min) 	**1) Right now, I am interested in career opportunities in computer science, technology, or engineering.** **2) After a customer clicks order on Amazon.com, what do you think is the next thing that happens?** Open response. **3) What was the shortest recorded Amazon delivery (from the customer clicking buy to the order being in their hand)?** **a.** Under 3 minutes **b. Under 30 minutes** **c.** About 1 hour **d.** About 3 hours	First, the tour guide will give an overview of the tour and set expectations. Then, the tour guide will explain how your order is assigned to an fulfillment center using algorithms. **Algorithms** are a set 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. Watch this tour stop in Video 1, Video 2, and Video 3.

Key Student Learnings:

Stop:	Interactive Questions:	CS Learnings and FC Context Summary:
Robotic Field (8 - 15 min) 	**4) How does Amazon arrange items in the warehouse and in the pods to stay organized?** **a. Randomly — no organization method** **b.** By their purpose (cleaning supplies, art supplies, sports items, clothes, etc). **c.** By their color (orange items, green items, blue items). **d.** Alphabetically by name	After a customer completes their purchase, the order is processed in the Amazon Web Services Cloud Computing Network. **Cloud computing** allows us to deliver technology resources – like computing, data storage, networking, and intelligence – through the Internet. We simply call it "the Cloud" for short. After assigning a customer order to a fulfillment center, we need to determine where the item is stored. Inside the FC, items are stored in tall, moveable shelves called pods. Since items are stored randomly, the item may be stored in more than one pod. An algorithm in **the Cloud** calculates the most efficient combination of picker, pod and drive unit to process each customer order. The FC floor is a grid system and each square has a unique QR code. As the drive unit moves, the robot uses a camera **sensor** underneath it to constantly scan and update its new location in the Cloud. A **sensor** is a device that detects and responds to its physical environment. This combination of real-time sensing and cloud processing allows the drive units to work together and fulfill orders as efficiently as possible. Watch this tour stop in Video 3 and Video 4.
Pick (15 - 22 min) 	**5) How many miles of conveyor belt do you think are in the Fulfillment Center in New Jersey?** **a.** 5 miles **b.** 10 miles **c.** 20 miles **d. 30 miles**	After the drive unit locates the item in the correct pod, the drive unit delivers one of these pods to a picking station. A light shining on the compartment of the pod that contains the item along with information about the product on the computer screen helps an associate pick the item off for packing. The picker scans the item's barcode and sensors let the associate know which tote to place the item in. A quick tap of the sensor, and the item is sent to the next station, pack. Watch this tour stop in Video 4 and Video 5.
Pack (22 - 28 min) 	**6) How does a packer choose the most efficient box for packing?** **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 that is big enough	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. When an item arrives at Amazon to be sold, we record many facts about it like its height, width, and weight. These facts are stored in a database. A **database** is an organized collection of structured information, or data, typically stored electronically in a computer system. When an item is ordered, the cloud pulls the item's dimensions and weight for the database and automatically calculates (using an algorithm!) which box will be best (even when combined with other items!). Using a database to estimate package size helps us stay more efficient with shipping. Watch this tour stop in Video 5 and Video 6.
SLAM (28 - 33 min) 	**7) The last station performs one final check to ensure the item is correct. How does it make sure the order is correct?** **a. Weighs the item as it goes over the conveyor belt** **b.** Uses and 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	The SLAM station addresses the customer order and completes **quality control** — checking to make sure every order is correct. At the SLAM station, the 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. Watch this tour stop in Video 6 and Video 7.

Key Student Learnings:

Stop:	Interactive Questions:	CS Learnings and FC Context Summary:
Shipping & Delivery (33 - 38 min) 	**8) How do you think our packages are organized when loading?** **a.** Random - like our storage locations. **b.** Robotic arms pick up each item and sort them onto trucks. **c. Packages are pre-sorted using our high tech conveyor system.** **d.** Packages are sorted by hand, employees read the address. **9) What part of the fulfillment process most surprised you? Why?** (Open Response Question)	All around the world, humans are constantly constructing new buildings and roads. So, how does Amazon keep its maps updated to deliver to even the newest locations? The answer: machine learning. **Machine learning** is teaching computers to perform or make predictions based on examples or past experience. To keep our maps up to date, we train computers to use satellite images to detect new roads and buildings on their own! Computers can learn? Yes, but it depends on how well they are trained. To train a computer to detect new roads, we show it thousands of examples of satellite images to compare to existing maps. The computer learns what roads and houses usually look like and then creates its own "road detection" algorithm. It uses this algorithm to find and predict roads on new satellite images. Machine learning enables us to process infinitely more data than would ever be possible on our own. Thank you, computer science! Watch this tour stop in Video 7 and Video 8.
Career Video (38 - 45 min) 	**10) Right now, which career most interests you? (Poll question)** **a.** Designing and building robots (hardware engineer) **b.** Coding the robots and computer systems (software engineer) **c.** Designing how the whole process works (systems engineer) **d.** Troubleshooting robots when they break down (field technician)	Students meet three Amazon Robotics employees. One from Hardware, Software, and Solutions. **Hardware** is the physical parts of a computer or device (stuff you can touch) and **software** is a collection of instructions and data that tell the computer how to work (the code!). Students learn how hardware and software must work together to make the best Amazon Robotics **Solution** possible. Watch this tour stop in Video 8, Video 9, and Video 10.
Rapid Fire and Survey (45 - 50 min) 	At the end of the tour, students will answer rapid fire quiz questions then be asked the following questions in Kahoot!. Amazon Future Engineer uses these responses to help improve future Career Tours. **11) When a customer clicks orden on Amazon.com, a(n) ___ finds the closest FC to the customer that has that item. Answer:** Algorithm **12) ___ allows for technology resources, such as storage, computing, and networking to be delivered through the internet. Answer:** cloud computing **13) __ on the bottom of the robot scan QR codes on the floor to let the computer know where the robot is at all times. Answer:** sensors **14) At the SLAM station, information from a __ is used to compare an item's expected weight to its actual weight. Answer:** database **15) The SLAM station is a form of __ to ensure that a product or service is free from error. Answer:** quality control **16) The robots and sensors used in a fulfillment center are an example of software. Answer:** false **17) Amazon uses __ to predict new roads and buildings to make more efficient delivery routes. Answer:** machine learning **18) Overall, rate your tour experience on a scale of 1-5. (Poll)** **19) How interested are you in pursuing careers in technology? (Poll)** **20) How did this tour affect your interest in pursuing careers in technology? (Poll)** **21) 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 receive a $5 Amazon gift card (US only).
- **Test your students' vocabulary:** Assign this Kahoot! to students to test their new computer science vocabulary knowledge.
- **Learn more from our tour leaders:** View this Kahoot! to hear answers to frequently asked questions submitted by students.
- **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.

Standards Alignment:

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

- CSTA K-12 Standard Alignment
- ISTE Standards
- NGSS
- Ontario Curriculum

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

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

1B-AP-08: Compare and refine multiple algorithms for the same task and determine which is the most appropriate

1B-AP-09: Create programs that use variables to store and modify data.

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

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

1B-NI-04: Model how information is broken down into smaller pieces, transmitted as packets through multiple devices over networks and the Internet, and reassembled at the destination.

1B-NI-05: Discuss real-world cybersecurity problems and how personal information can be protected.

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

2-AP-10: Use flowcharts and/or pseudocode to address complex problems as algorithms.

2-CS-02: Design projects that combine hardware and software components to collect and exchange data

2-NI-05: Explain how physical and digital security measures protect electronic information.

2-IC-20: Compare tradeoffs associated with computing technologies that affect people's everyday activities and career options

3A-IC-24: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices.

3A-IC-29: Explain the privacy concerns related to the collection and generation of data through automated processes that may not be evident to users.

3B-IC-25: Evaluate computational artifacts to maximize their beneficial effects and minimize harmful effects on society.

3B-IC-27: Predict how computational innovations that have revolutionized aspects of our culture might evolve.

Next Generation Science Standards (See the standards here.)

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

MS-ETS1-1 Engineering Design: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2 Engineering Design: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

HS-ETS1-1 Engineering Design: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2 Engineering Design: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3 Engineering Design: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

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.

Ontario Curriculum (See the **curriculum here.**)

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

Oral Communication -1: Listen in order to understand and respond appropriately in a variety of situations for a variety of purposes

Media - 1: Demonstrate an understanding of a variety of media texts.

Media - 4: Reflect on and identify their strengths as media interpreters and creators, areas for improvement, and the strategies they found most helpful in understanding and creating media texts.