UNIT 3: What Is Hardware and How Do Computers Work?

Estimated Time in Hours: 7

Big Idea(s)	Enduring Understandings	Projects & Major Assignments
5 System Security 8 Implications	5.2, 5.4	- Practice building a computer from scratch using old computer desktop hardware. - Research computer hardware and plan a compatible computer system for a specific task (gaming, computation, light office use, etc.) using PCPartPicker. - Practice converting numbers between decimal and binary. Optionally, introduce Internet of Things (IoT as another type of computer system being integrated with society.

Guiding Questions:

- What are the individual parts of a computer? What is the role of each?
- What is external hardware, and how does it differ from internal hardware?
- Is hardware in all computer systems?
- Why are binary numbers, 0's and 1's, so important for computers?
- How is hardware present in infrastructure, military systems, hospitals, etc.?
- How can hardware be protected?
- What are information campaigns, and do they benefit or harm society?

Learning Objectives & Respective Essential Knowledge Statements	Materials	Instructional Activities and Classroom Assessments
5.2.1a EK: Internal hardware devices include motherboards, hard drives, memory, and internal peripherals such as a CD-ROM drive, CD-R drive, or internal modem.	• Computer, lecture slides, projector, graphic organizers, access to Internet • Graphic organizer for internal hardware components.	• Be sure to describe the basic function of each internal hardware component (CPU, GPU, HDD/SSD, RAM, Motherboard, PSU, etc.). • Pair with a computer hardware graphic organizer to let students label where internal hardware is while they learn about the specific components.

	• Old computer desktops for students to take apart and reassemble in a guided activity. Your school's IT dept or community may have these available. Phillips screwdrivers and safety measures are required for this activity. • Computer Hardware: "What does what in your computer? Computer parts Explained." *YouTube*, uploaded by Basics Explained H3Vtux, 17 Jan 2018, https://www.youtube.com/watch?v=ExxFxD4OSZ0 • Kahoot!	• Show students the summary video of internal hardware function. • Review internal hardware identification and function using Kahoot!.
5.2.1c EK: Hardware is the bottom level component of systems that are critical to telecommunications, health, US economic system, and national defense.	• Flippy-do: "CS Principles 2018 | Unit 1 | Ch. 1| Lesson 5: Binary Numbers." *Code.org*, https://curriculum.code.org/csp-18/unit1/5/ • Binary blitz: "Binary Blitz." *Penjee*,	• Teach binary structured as a bottom level component of computers. • Task students with paper-crafting a flippy-do to help them convert between binary and decimal notation. • Challenge the students with Binary blitz, a web-based binary conversion game with score tracking. Once they are familiar with the game, give the class 1 minute to earn as

	https://games.penjee.com/binary-numbers-game/index.html • IoT Introduction: "What is the Internet of Things?" *YouTube*, uploaded by GCFLearnFree.org, 19 July 2017, https://youtu.be/EKRVILAohck	many points as possible in a competition. Alternatively, students can work to earn points together to achieve a class-wide prize. • Later in the unit, expand on the criticality of hardware system. Discuss with students how computer hardware can be found in critical systems like military, infrastructure, and financial. • IoT can also be introduced here. Ask students how IoT might impact daily lives in the future, whether those are positive or negative impacts, and what some cybersecurity concerns are with IoT. Optionally, they can research different technologies that may make IoT secure/vulnerable.
5.4.1 LO: Students will identify historical consequences of software and hardware vulnerabilities, e.g., power outages, death, theft of trade secrets from other sovereign nations.	• Info about Meltdown and Spectre: "Meltdown and Spectre." *meltdownattack.com,* https://meltdownattack.com/ • Meltdown demo (spying on passwords): "Spectre & Meltdown – Computerphile." *YouTube*, uploaded by Computerphile, 5 Jan 2018, https://youtu.be/I5mRwzVvFGE	• Introduce the concept of hardware vulnerabilities and challenge the students to identify hardware vulnerabilities, or challenge them to describe why scenarios are considered to have hardware vulnerabilities. • Use Meltdown and Spectre as recent examples. • Introduce the Stuxnet attack here. You can pivot this example into 8.1.1 LO.

	• Graphic of how Stuxnet worked: "How Stuxnet Worked." *IEEE Spectrum*, 2013, http://farm9.staticflickr.com/8371/8515879321_b323dd534f_b.jpg	
5.2.1b EK: External hardware devices include monitors, keyboards, mice, printers, scanners, routers, switches, servers, IoT devices industrial control systems, security cameras.	• Kahoot!	• Discuss types of external hardware: this is probably familiar to most of the class. • Use Kahoot! to review external hardware alongside internal hardware. Students should be familiar with these terms and how to classify hardware.
5.2.1d EK: Tamper resistant hardware aims to detect if someone attempts to modify them and aim to become non-functional if that occurs. For example, credit card readers at a store are designed to be no longer usable if someone physically opens the credit card reader system.		• Provide examples of tamper resistance in the real world (security stickers, bottle seals) and how it relates to computers (cable lock, backup power). • Task the students with researching tamper resistant devices.
8.1.1 LO: Students will summarize and interpret the impact of cybersecurity ideas and events on the evolution of the field.		• Revisit Stuxnet as a major cyber attack and ask students why they think it was such a big deal. Stuxnet was a prime example of what cyber warfare can resemble.

		• You can task students with researching news articles about Stuxnet or attacks against infrastructure.
8.1.1a EK: Information campaigns were used and considered vital throughout history.	• Deepfake video example: "Full House of Mustaches – Nick Offerman [deepfake]." *YouTube*, uploaded by DrFakenstein, 11 Aug 2019, https://youtu.be/aUphMqs1vFw	• Introduce information campaigns and the concept of propaganda. Relate this to promoted social media content and advertisements. • Ask the students to list examples of information campaigns they have seen and the purpose of them. • Show your class deepfake videos on YouTube and ask them to discuss the repercussions.
8.1.1h EK: Cybersecurity events have led to the development of various cybersecurity career paths and various needs in order to prepare people for these new types of jobs.		• Discuss a relevant career, such as computer technician or computer engineer.