What is a Computer?
Lesson Two
Middle School Cybersecurity Unit: Can you Hack the Cyber Attack?

Lesson Overview	Career Highlight
What is a computer? Is it just the sum of its parts, or is there more to it than that? Hardware consists of the parts of the computer you can touch, inside and out, while software is the code that runs the computer. In this lesson, students will explore the parts that make up computers, and determine how they work together. Students will take a look at the inner parts of a computer and learn how software runs. As students go through this lesson, they will gain a better understanding of how computers work in order to help them identify possible vulnerabilities computers have to cyberattacks. Students may then apply this knowledge to help them develop their app idea for their final project in this unit.	Students play the role of a computer hardware engineer as they take apart a computer and put it back together again. **Computer hardware engineers** research, design, develop, and test computer systems and components.

STEM Course Connections	Timing
Computer Science Course Intro to Engineering General Science	Three class sessions at 45 minutes each

Engineering Activity	
Science and Engineering Practice #	Students will work in teams disassembling a computer in order to create a diagram to represent the relationships between the hardware and software of a computer. 2. Developing and using models 6. Constructing explanations (for science) and designing solutions (for engineering)

Essential Questions
1. What makes up a computer? 2. How does software relate to the hardware of a computer? 3. What are the different kinds of software? 4. How can a computer be vulnerable to cyberattacks?

Lesson Objectives
Learning Goals: • Students will identify different parts of a computer and locate where the hardware and software of a

computer communicate.
- Students will compare and contrast the hardware and software of a computer.

Materials

All materials in Student Handouts, unless otherwise noted.

- Day One
  - Cybersecurity App Project Journal *(This journal will be used for every lesson)*
  - Computer Hardware Note Catcher (answer key)
  - Emoji Exit Ticket
- Day Three
  - Computer Software Note Catcher (answer key)
  - What is a Computer? Mindmap

- Physical Materials Needed
  - Computers for students to use
  - Old desktop computers and/or laptop computers
    - Where to find computers ready for recycling:
      - Ask your school district's IT department
      - Go to Best Buy, Office Depot, or other office supply store to see if they are willing to donate old computers to your classroom.
      - Find computer manuals online by searching for the model number. Good resources for computer manuals are Manuals Lib and iFixit.
      - Make sure the computer manuals identify all of the essential parts.
      - Make sure the manual provides tips on opening the computers and removing parts.
  - Screwdrivers: #2 Phillips screwdrivers
  - 8.5 X 11 size paper, poster paper, or whiteboards for each group.
  - Coloring supplies or dry-erase markers if using whiteboards
- Other devices like remote controls, game controllers, etc. can be opened if not enough computers are available. Be sure to find manuals or diagrams online for remote controls or other non-computer devices not being used.

Lesson

- **Day One - Computer Hardware**
  Teacher Note: Students will be working with tools. Be sure to give them a brief tutorial on how to use the screwdrivers safely. You will need to find computer manuals for each type of computer you will be giving the students. Each group should have an assigned area or box to hold the parts in until they reassemble the computer again.

  - **Whole Group (15 minutes)**
    i. Tell students: "As you watch this video, write down at least three things you notice or wonder about the video." Show students Video #2: What Makes a Computer a Computer?

    ii. After Video: Think-Pair-Share
      - Have tables share out one thing they wonder about the video.

    iii. Have students fill out their Computer Hardware Note Catcher from Student Handouts

using the video *Computer Basics: Inside a Computer*, 2020.

- Remind students to take good notes so they can identify the different parts of the computer when it's their turn to become the computer hardware engineer.

iv. After students have completed the handout, have them review their answers with each other.

- **Small Group (30 minutes)**
  i. SAFETY PRECAUTIONS WHEN OPENING:
     - Orientation on how to use the tools: screwdrivers
     - Be careful with sharp edges on parts

  ii. Each group of three to four students will have a computer device to disassemble.
     - Here are possible group roles to give the students:
       1. Manual Engineer: Student is in charge of going through the computer manual with the group before the group begins. Student is also in charge of making sure the group is identifying the pieces correctly according to the manual.
       2. Lead Engineer: Student is in charge of helping other group members with their assigned tasks and making sure students stay on track with time.
       3. Tool Engineer: Student is in charge of the screwdriver and unscrewing all of the screws.
       4. Recorder: Student is in charge of creating the diagram of computer parts.

  iii. Instruct students to first read through the computer's manual and then begin opening up their computer.

  iv. Remind students to create a diagram of the inside of a computer in their Computer Hardware Note Catcher from Student Handouts before taking out different parts.

  v. Tell students to identify the motherboard, CPU, heat sink & fan, RAM, hard drive, and power supply unit in their diagrams.

  vi. Have students keep all of their materials together in an assigned box or basket for them to reassemble the computer on Day Two.

- **Whole Group (five minutes)**
  i. Emoji Exit ticket:
     - Distribute Emoji Exit Ticket from Student Handouts and have them record their responses to the following questions:
       1. "How do you feel after today's lesson?"
       2. "Why do you think computer hardware engineers need to consider when designing and making computers?"
       3. "After today's activity, what are you still left wondering? What would you like to know more about?"

- **Day Two - Computer Hardware Continued**
  - **Small Group (40 minutes)**
    i. Instruct students to go back to their groups from Day One and get their materials.

ii. Instruct students to lay out the different parts on their desk.

iii. Computer Diagram Check:
- Have one group member leave their computer design face down on the table for other groups to check their answers for this activity.

- Instruct groups to move to a different group's computer and give them five minutes to try to identify all the parts they learned on Day One: motherboard, CPU, heat sink & fan, RAM, hard drive, and power supply unit. Instruct students to check their guesses with the diagram on the table. Repeat this activity one more time.

iv. Give students three minutes to answer the questions on their Computer Hardware Note Catcher from Student Handouts about the quick Gallery Walk to other disassembled computers.

v. Groups will now have 30 minutes to reassemble the computer.

- **Whole Group (five minutes)**
  - **i. Discussion**
    - Ask students the following question and have them write responses in their Cybersecurity App Project Journal:
      1. "What parts of a computer's hardware could become vulnerable to cyberattacks?"

- **Day Three - Software Versus Hardware**
  - **Individual (20 minutes)**
    - i. Have students choose their own adventure about system and application software using the videos and articles in the Software Menu from the Student Handouts, and fill out the Computer Software Note Catcher.

    - ii. Have students research and list the type of software they are using on all of their devices at home.

  - **Small Group (10 minutes)**
    - *i. Teacher Notes: It is recommended that the What is a Computer? Mind Map from the Student Handouts be made on 8.5x11 paper, poster paper, or whiteboards and with coloring utensils. Students may do this digitally if materials are limited.*

    - ii. Have students work in pairs to create a What's a Computer? Mind Map poster showing the definitions and relationship between software and hardware.

    - iii. Instruct students to make sure they answer the question at the bottom of their poster: "How do you think the hardware and software of computers are vulnerable to cyberattacks?"

  - **Whole Group (10 minutes)**
    - **i.** Gallery Walk of What is a Computer? Mindmap Posters
      - Give students sticky notes or have them leave a blank sheet of paper by their What is a Computer? Mindmap for students to write comments on.

- Give students three to five minutes to walk around to look at others' mindmaps. Instruct them to leave kind, specific and helpful feedback or a celebration at five of the other mindmaps. They will leave their comments on a sticky note or on the blank sheet of paper placed near each mindmap.

- Give groups five minutes to revise their What is a Computer? Mindmap after looking at other group's work and from reading their peers' feedback.

- **Closing Activity (five minutes)**
  i. Have students record their responses to the question: "How do you think the hardware and software of computers are vulnerable to cyberattacks?" in their Cybersecurity App Project Journal.

  ii. Remind students that the notes they record in their journal will help them develop their app idea for their final unit project.

Extension

Rebuilding the Computers
Have students put the computer back together to see if they can make the computer turn on.

Computer City Analogy
Have students create a poster making an analogy of a computer to a city.
Prompt:

1. "If a computer was a city, what would be an analogy for any three different pieces of hardware, the system software, and the application software of the computer?" (Example: The computer case would be the city boundary.)

CA NGSS Standards

MS-ETS1-3 Engineering Design

MS-ETS1-4 Engineering Design

Resources

Computer Basics: Inside a Computer. (2020, September 3). [Video]. YouTube. https://www.youtube.com/watch?v=HB4I2CgkcCo

Computer Basics: Understanding Applications. (2020, September 15). [Video]. YouTube. https://www.youtube.com/watch?v=3gMOYZoMtEs

Computer Basics: Understanding Operating Systems. (2020, September 1). [Video]. YouTube. https://www.youtube.com/watch?v=fkGCLIQx1MI

Computer software. (2017). In *New World Encyclopedia*. https://www.newworldencyclopedia.org/entry/Computer_software

Disassembling and Assembling a Laptop. (2017, March 14). [Video]. YouTube. https://www.youtube.com/watch?v=lbCyHKdJLZw

How Computers Work: Hardware and Software. (2018, January 30). [Video]. YouTube. https://www.youtube.com/watch?v=xnyFYiK2rSY

How Do Operating Systems Work? (2018, September 24). [Video]. YouTube. https://www.youtube.com/watch?v=GjNp0bBrjmU

HP 630 laptop disassembly, take apart, teardown tutorial. (2016, June 16). [Video]. YouTube. https://www.youtube.com/watch?v=GE_hqrxzX4E

Software facts for kids. (2021). In *Kiddle encyclopedia*. https://kids.kiddle.co/Software

Software. (2020, March 31). Techopedia. https://www.techopedia.com/definition/4356/software

TYPES OF SOFTWARE || APPLICATION SOFTWARE || SYSTEM SOFTWARE || UTILITY SOFTWARE || COMPUTER BASICS. (2020, September 23). [Video]. YouTube. https://www.youtube.com/watch?v=BTB86HeZVwk

How to UN-Build a Computer. (2019, May 5). [Video]. YouTube. https://www.youtube.com/watch?v=WqxQcePWAak

What is software and how do we use it nowadays. (2020, January). Amsterdam Standard. https://amsterdamstandard.com/en/post/what-is-software

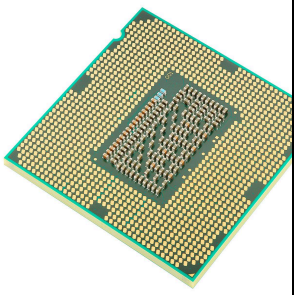
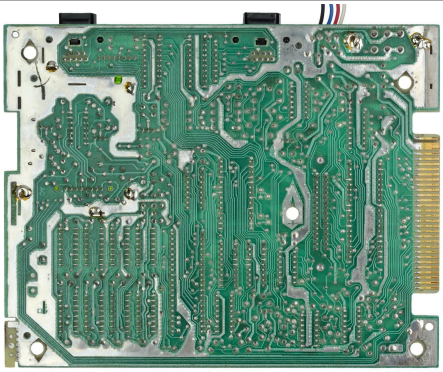
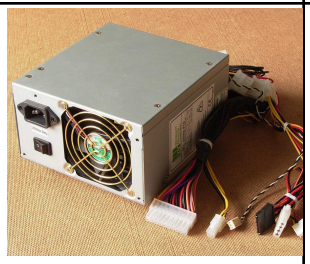
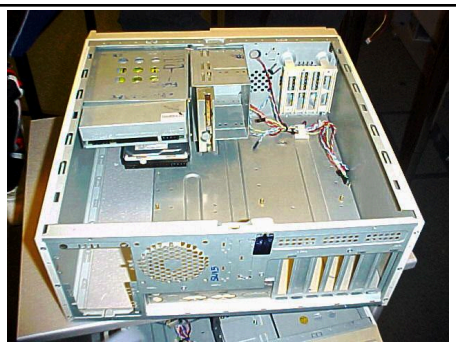
What's Inside a Computer? - TechGirlz Workshop Plan (12–2018). (n.d.). Google Docs. https://drive.google.com/file/d/0B4n-83xbNPT3MHRfbDJadlZNelE/view?resourcekey=0-CEUo652z6vvO06smms2w2Q

Computer Hardware Note Catcher - Answer Key

Directions:
As you watch the video: Computer Basics: Inside a Computer by GCFLearnFree.org, write down notes about each part of the computer.

Motherboard	• Every computer has a motherboard • Contains most important parts of computer • Contains CPU • Contains RAM (Random Access Memory) • Contains expansion slots
Computer Processing Unit (CPU)	• Considered the brain of the computer • Processes information and carries out command • Tends to get hot
Heat Sink & Fan	• Draws heat away from processor
Random Access Memory (RAM)	• Short-term memory that computer uses whenever it performs calculations • Cleared whenever computer is shut off
Hard Drive	• Provides long-term storage • Keeps computers data, even when it's turned off • Many use a magnetic platter to store data • Newer computers have solid state drives, which are faster and more durable yet more expensive
Expansion Slots	• Allows user to upgrade by adding expansion cards • Can add video card to get better graphics performance • Can get wireless card to connect to wireless home network
Power Supply Unit	• Designed to take power from wall outlet and send to components that need power
Other Notes	• Laptops contain a built-in battery that allow you to use them anywhere • Most laptops don't have expansion slots

Computer Parts: Can you identify the pictures of computer parts? Use the list on the other side of this sheet to label the parts below.

		
Central Processing Unit (CPU)	Motherboard	Heat Sink & Fan
		
Power Supply Unit	Hard Drive	Expansion Slots
		
RAM		

Day 2: Gallery Walk to Other Disassembled Computers

1. Was your group able to identify all the different parts for all of the computers you saw? Explain why or why not.
   Answers may vary. ("I was able to identify all of the different parts from the computer. It was difficult to decide which parts were the correct ones because the video had animated parts and not the actual images of the parts.")

2. What was the hardest part about identifying different parts of the computer?

Answers may vary. ("The hardest part about identifying the different parts of the computer was figuring out which parts are the smaller pieces like in Picture 1. The video featured an animated version of the computer parts, so it was more difficult to figure out the resemblance from a real perspective.")

3. What was the most interesting part about this activity?
   Answers may vary. ("The most interesting part about this video was seeing the way the parts were being described. I really enjoyed how it was straight to the point and how each computer part was described in detail. It's interesting to see the hidden, tiny parts and how they each contribute to operating our computers.")

Computer Software Note Catcher - Answer Key

Directions:

1. Choose one article and one video from the Software Menu to answer the following about each term in blue:
    a. What is the definition of the term?
    b. What is its role in a computer?
    c. What are at least two examples?

2. For the questions highlighted in yellow, answer them to the best of your ability.

Software	a. Software is a generic term used to describe everything that runs on a computer. It describes all of the functional aspects of a computer that do not refer to its physical components. b. The role of software in a computer is to instruct a computer to do specific tasks. c. Apps, games, webpages, data science.
System Software (OS)	a. System software is a base for application software. It includes the utilities that help the computer operate more efficiently. b. The role of system software is to manage the hardware components and provide basic non-task-specific functions. c. Device drivers, compilers, disk formatters, text editors, servers, windowing systems (Apple, Microsoft Windows, Android).
Q1: What types of system software do you use?	Answers may vary (e.g., "I mainly use Microsoft Windows, but I also use Apple on a daily basis.")
Application Software	a. Application software is an independent program, apart from the operating system, that is intended to perform certain tasks. b. Application software helps an end-user to perform one or more specific tasks. c. Office suites, gaming applications, database systems, educational software.
Q2: What are different application software you use every day?	Answers may vary (e.g., "I use Microsoft Office Suites, educational software, and gaming applications every day.")
Programming Software	a. Programming software is a type of software that comes with a set of tools that are used to aid developers in writing programs and software. b. The role of programming software is to help a programmer write programs and software using different programming languages in a convenient way. c. Text editors, compilers, interpreters, linkers, debuggers.

Q3: After learning about software, what do you think are vulnerabilities in software a company might face in keeping information safe online?	Answers may vary and are based on student opinion. A possible answer may be that software is made up of code that is vulnerable to hackers manipulating the code.
Watch the video “Hardware & Software” on the Software Menu. Q4: How does the software communicate with the hardware?	The software communicates with the hardware through the operating system and CPU. The CPU has circuits which send and receive information from different parts of the computer. The CPU receives simple commands from the software that tells it which circuit to use, and then the hardware actually translates and runs those instructions.
Other Notes	