

INVESTIGATION STATION: *COMPUTER GUTS*

(note: this lesson plan is intended for middle school students and to be executed in a 60 min block)

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Purpose: Students will be able to discover the basic components and operational theory of a desktop personal computer (PC).

Learning objections: At the end of this lesson, students will be able to

1. Correctly name at least 3 of the major internal components of a disassembled desktop computer placed in front of them
2. Explain the major function of the RAM, hard drive, and processor
3. Disassemble and reassemble a functional computer
4. Justify the push for smaller electronic devices (scaling)

Major research concepts: Scaling of microelectronics, computer architecture, carbon-based nanoelectronics.

AAAS Benchmarks addressed (Grades 6-8)

3. The Nature of Technology

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| <p>A. Technology and Science: Engineers, architects, and others who engage in design and technology use scientific knowledge to solve practical problems. They also usually have to take human values and limitations into account. 3A/M3*</p> <p>B. Design and systems: In almost all modern machines, microprocessors serve as centers of performance control. 3B/M3d</p> <p>C. Issues in Technology: Scientific laws, engineering principles, properties of materials, and construction techniques must be taken into account in designing engineering solutions to problems. 3C/M8** (BSL)</p> |
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Materials: Aluminum foil, 1 small egg, 6 desktop PCs, 6 Philips screw drivers, periodic table of elements.

Some suggested resources for obtaining used computers for this lesson plan include:

- State and Federal Surplus Warehouses

The State of Illinois maintains State and Federal surplus property warehouses, which University of Illinois departments may access. Departments may visit the State and Federal surplus equipment warehouses, which are operated by the Illinois Department of Central Management Services (CMS), if they have first obtained an authorization letter.

Contact UPAR via e-mail to obfsuafprproperty@uillinois.edu to obtain an authorization letter to visit the State surplus warehouse. Equipment from the State warehouse may be obtained free of charge.

Obtaining equipment from the Federal warehouse requires a nominal charge. For information about charges and to obtain an authorization letter for the Federal warehouse, contact Amy Roberts via e-mail at alrobert@uillinois.edu.

The warehouses are located at:
1924 South 10 ½ Street
Springfield, IL 62703

Phone: 217-782-7786

Hours: 8:00 a.m. to 4:00 p.m. Monday through Friday

- University of Illinois Campus Surplus

Urbana Surplus Warehouse
Horticulture Field Lab Annex
1801 S. Orchard Street, MC 062
Urbana, IL 61801

The warehouse is in the steel building behind the Horticulture Field Lab. Turn south on Orchard Street from Florida Avenue.

Phone: 217-333-6011

E-mail: uiucsurplus@uillinois.edu

Hours: 10:00 a.m. to 12:00 p.m. and 1:00 p.m. to 4:00 p.m.
Monday - Friday (except holidays)

- Advertise on craigslist.com – disposing of older computers can be problematic. Many people would probably be willing to donate computers.
- Visit this website for more information:
http://www.edu-cyberpg.com/Technology/Computers_for_Learning_pro.html

Teacher Prep:

- Copies of lab worksheet ready for each student
- Setup 4-6 PC stations
- Prepare teacher demo computer for egg cooking:
 - Step-by-step instructions here:
http://www.phys.ncku.edu.tw/~htsu/humor/fry_egg.html
 - Open teacher PC and remove heat sink
 - Form a foil “frying pan” that will fit over the processor and has walls high enough to hold a raw egg. The bottom should be very flat to ensure good contact with the processor. A small aluminum box (found at Radio Shack) also works well for this.

- May or may not need the homemade coin heat sink shown on the website. The use of thermally conductive “Arctic Silver” is essential for good thermal transfer from the processor to the foil.
- Try this ahead of time. If contact between the pan and the processor is poor, the processor will over heat and the PC will shut off. You will either need more thermal grease or a flatter pan that makes good contact with the processor.
- The processor sometimes is very stuck to the heat sink, so try removing it before hand. You may need to carefully use pliers to twist off the processor from the heat sink if they are stuck together.

Action

Phase 1: Engage

(10 mins)

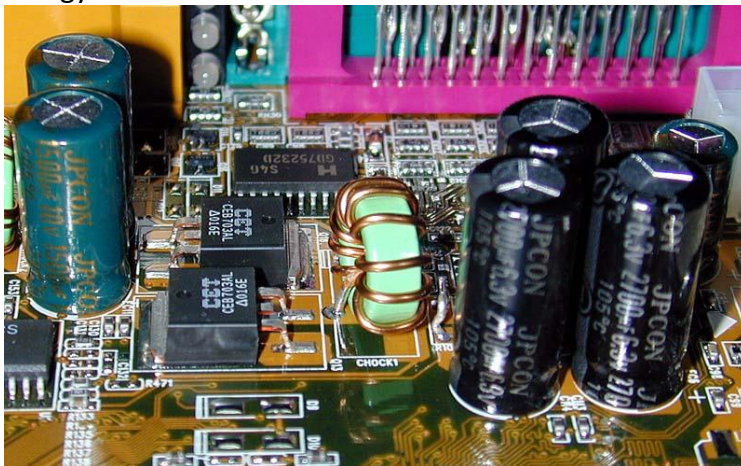
✚ **Why do you think computers have fans? How hot do they get? Which part gets the hottest?**

✚ **Demonstration: Cook an egg**

- Teacher computer is turned off, cover is removed, and heat sink is removed. Crack an egg into the foil frying pan and place the foil on top of the processor. Turn computer on.
- Take guesses as to if the egg will fry, and how long it will take.
- The egg may take 10 minutes or more to cook. In the mean time, talk about the heat sink and why it is used. If egg isn't done within a few minutes, move on to Phase 2 and have students come back to see the egg when it is finished.

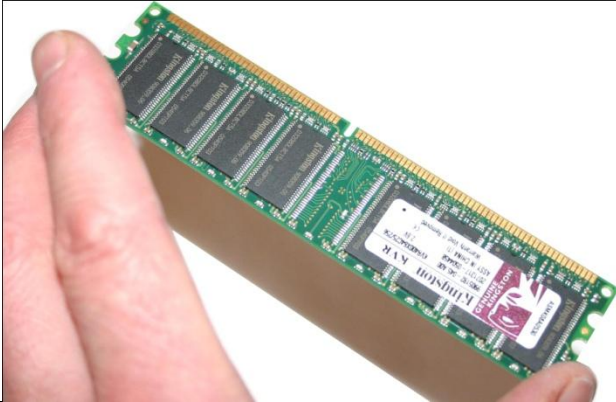
✚ **“Today we’ll be learning about the major parts of a computer, what they do, and what can be done to make computers smaller, faster, and cooler (not as hot).”**

✚ **Safety explanation:** “You’ll all get the chance to open a computer today. Before you open it, be sure the power cord is unplugged.” Point out a capacitor (tall green and black “barrels” in the image below), and tell students not to touch these. These store energy and can deliver a harmful shock.



✚ **“Our bodies carry charge that can damage electronic devices. Be sure to only handle components by the edges, touching only the plastic. Don’t touch the metal parts. Touching a nearby metal table leg will help to discharge you and prevent damage to**

devices.” Demonstrate how to handle RAM by the edges so as not to damage them with electrostatic discharge.



Phase 2: Explore

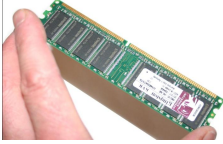
(25 mins)

- ✚ **Divide students equally among the 5 PC stations.**
- ✚ **Students turn on PCs.**
 - **Ask students:** Do they correctly boot up? Everything works?
- ✚ **Students turn off PCs, unplug from power, and OPEN the cases.** Screwdrivers may be needed for this.
- ✚ **Instruct students to unplug internal connectors and remove screws in order to take out the devices they see.** Remind them to either write down or remember what connector plugs into the device so they can reassemble it. They should also keep track of any screws they remove. “You have to put this all together again when you are done!”
 - To encourage students to remember how to reassemble the PC and to slow down the disassembly procedure, the students could be instructed to label each device connector and the corresponding cable with numbered or lettered stickers. For example, place an “A” sticker on the cable end that inserts into the hard drive, and place another “A” sticker on the hard drive where the cable is inserted.
 - Different labels for each group will help prevent the parts from becoming mixed up during the next section. It is best to keep the parts with the computer from which they were pulled.
- ✚ **Ask students to guess what each part might do and what it is called.**
- ✚ **Teacher walks around and encourages them to take out as many parts as can easily be removed.** This is a good time to briefly discuss with the students the various parts they are touching.

Phase 3: Explain

(15 mins)

- ✚ **Have a student from each group present one of the major components and its function to the class.** Point out the various types of connectors, color codes, card slots, etc.
- ✚ **The answers:**



Random Access Memory (RAM): This is type of memory that can be read from quickly but loses the information when the computer is turned off. Information from the hard drive is temporarily stored in RAM to allow for quicker access.



Hard Drive: A magnetic disk where all of the programs and data for the system are stored. Information written here is not lost when the computer is turned off.



Optical disk drive: Ask the students; they can likely explain this device. This drive reads programs from CDROMs or DVDs.



Video card: generates the graphics that are displayed on the screen.



Sound card: generates any sound that is supplied to the speaker.



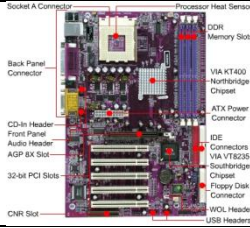
Ethernet card/port: allows the computer to talk to other computers on a network.



CPU: (point to it, don't take it out) This is the brain of the computer and does all of the thinking and processing.



Heat sink: Removes the heat from the CPU.

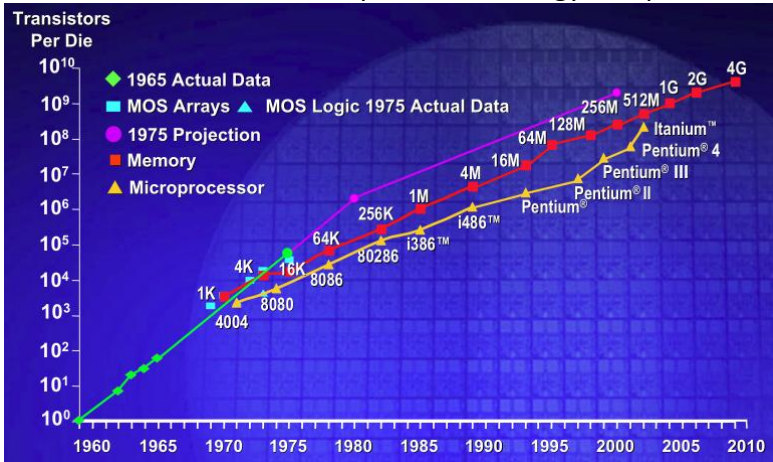


Motherboard: (just point to it, don't take it out) Has many chips which help the computer parts communicate with the CPU.

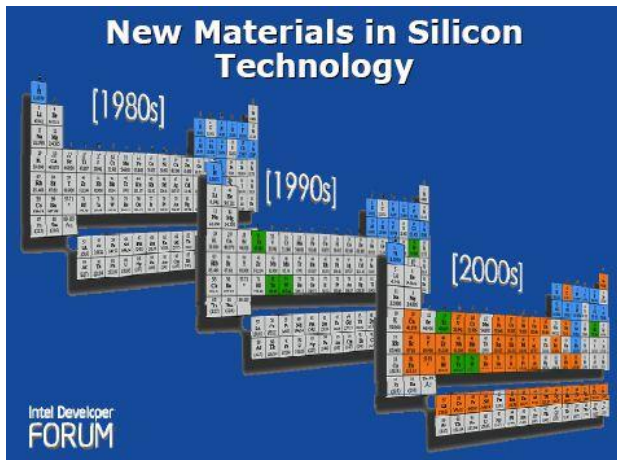
Phase 4: Elaborate (see teacher notes for more information)

(5 mins)

- + **Emphasize:** The computer processor is the *brain* of a PC. It is made of billions of transistors which form the circuits need to do computation. Each transistor dissipates a finite amount of heat. Therefore power density limits processor speed and transistor density.
- + **Introduce the concepts of transistor scaling and materials science:** Introduce the student to Moore's Law (the number of transistors on a given chip area doubles every two years) and the benefits to the semiconductor industry (lower cost, faster operation, more computational power). Show the students a periodic table highlighting the elements used in older computer technology compared to modern PCs



<http://thenextwavefutures.wordpress.com/2009/08/02/the-end-of-moores-law/>



http://www.digital-daily.com/cpu/intel_penryn/index2.htm

- ✚ **Briefly Introduce the ideas of Nanotechnology:** Explain the scale of nanotechnology.
 - Compare the scale of natural things to those which are man made:
http://www.nano.gov/html/facts/The_scale_of_things.html
 - Do the students understand the concept of a nanometer? Ask the students if a nanometer was the size of a quarter, how far would they reach if you laid 1 billion of them side by side (enough for 1 meter)? How much money would you have? **Answer: 15783 miles. Enough to cross the United States about 5 times. You would have 250 million dollars.**
- ✚ **Provide the student the opportunity to draw parallels between PCs and mobile devices:** Think of other computers such as the iPad, game systems, smart phones. Can the student describe what components are necessary in these types of computers? Can the student think of what might limit battery life in laptops and phones?

Phase 5: Evaluate

- ✚ **Reassemble PCs:** Have the students begin to reassemble their PCs. Walk around the room while student have computer case open. Point to major PC components and ask students about the function of that component to check for understanding.

Exit Cards: Boot up your reassembled PC. If it works, they pass!

Ask on the way out:

- Why is it beneficial to make transistors (inside the computer chips) smaller? (A: smaller electronics, faster operation, more powerful, longer battery life).
- Tell me two things you learned today.
- Do you have a question about what we discussed today?