

VOLUME 45, EPISODE 5 - 13:15 minutes

## COMPUTER SCIENCE: *THE IMPACT of COMPUTERS*

### SYNOPSIS

Perhaps no invention has impacted our everyday lives more than the computer. Computers have transformed the fields of science, medicine, education, entertainment and research, to name a few. In fact, it's hard to think of any area of our everyday lives that has not been affected by computer technology. Computers have become an indispensable part of our lives.

A computer is made up of Hardware, the machine, the hard drive, the boards and chips, which take instructions from Software – or applications. The result is a completed task, or epic graphics in a game or pin-point accuracy in a robot assisted medical procedure.

From a steam-driven prototype developed in the early 1800s, to the first computer built in 1941, which could process 29 equations simultaneously, to the microprocessor developed by Intel – the evolution of the computer is amazing. The first computers, developed in the mid 1940s took up an entire room. Today the microprocessor, smaller than a fingernail, delivers immense computing capabilities to run today's applications.

### CURRICULUM UNITS

- ROBOTICS
- COMPUTER SCIENCE
- SYSTEM ADMINISTRATOR

### CAREER POSSIBILITIES

- APPLICATION MANAGER
- PROGRAMMER ANALYST

### NEXT GENERATION SCIENCE STANDARDS & NATIONAL SCIENCE EDUCATION STANDARDS

NEXT GENERATION SCIENCE STANDARDS: [www.nextgenscience.org](http://www.nextgenscience.org)

#### Grades 5 - 8: Science and Technology (8EST)

- Identify appropriate problems for technological design (8EST1.1)
- Design a solution or product (8EST1.2)
- Implement a proposed design (8EST1.3)
- Evaluate technological designs or products (8EST1.4)
- Communicate the process of technological design (8EST1.5)

#### Grades 9 - 12: Science and Technology (12EST)

##### Abilities of technological design (12EST1)

- Identify a problem or design an opportunity (12EST1.1)
- Propose designs and choose between alternative solutions (12EST1.2)
- Implement a proposed solution (12EST1.3)
- Evaluate the solution and its consequences (12EST1.4)
- Communicate the problem, process, and solution (12EST1.5)

### CRITICAL THINKING EXERCISES

1. Research an industry and how computing has changed that industry over the last 30 years.
2. Name as many devices that run off a computer.
3. Discuss how computing has affected our lives in the past 5 years.
4. Describe a lab procedure that you would implement to investigate how to use build a computer from scratch.

## BACKGROUND

Computers have affected every aspect of society, from governments, large businesses, small businesses, and individuals. They have changed the way we do things and the way we think about things.

So what exactly is a computer? A computer is made up hardware and software. Hardware are the tangible building blocks of the computer, and the software are the programs and applications that are stored to perform specific tasks. The computer that used to fill a 20x40 foot room in the 1940s with 18,000 vacuum tubes are long gone. Today computers have become exceedingly small and efficient. The microprocessor, invented by Intel in the 1970s, has become the engine of computers. The size of a little fingernail, it delivers immense computing power to run today's applications. Some microprocessors have even been manufactured at an amazing width of only 32 nanometers! To put that into perspective, a human hair is 100,000 nanometers wide. Computing has made the world more efficient than ever. Online education has enabled the world to learn from even the most remote locations. Health care is also being revolutionized by computers, not only with incredible accuracy and results, but by reducing administrative paperwork. Medical files are more accurate and up to date as they become more electronic and doctors are able to keep up with new symptoms real-time. The internet allows us to exchange news, information, and reports about the latest developments around the world. With ecommerce taking hold, shipment tracking has added accountability to businesses. Homes are being built with software to turn on lights, view security cameras, or even learn temperatures. The common element of all these new applications: the computer. Almost every industry has been impacted by computers. Programming logic takes a large problem, and breaks it down into a smaller sequence of problems. This is called computational computing. Within the computing field, there are hundreds of job professions. Some examples include a Java Developer, Information Security Engineer, or a Software Development Engineer. As every individual becomes impacted by computers in today's digital age, computing is becoming an exponentially important skill to understand for the 21st century.

## ADVANCED ORGANIZERS

Prior to viewing the video students should have some understanding of the following Science Benchmarks from AAAS, Project 2061. This is a longterm initiative focused on improving science education so that all Americans can become literate in science, mathematics, and technology.

### Benchmark 3: The Nature of Technology

#### Section A. Technology and Science, Grades 6-8

By the end of the 8th grade, students should know that

- In earlier times, the accumulated information and techniques of each generation of workers were taught on the job directly to the next generation of workers. Today, the knowledge base for technology can be found as well in libraries of print and electronic resources and is often taught in the classroom. 3A/M1
- Technology is essential to science for such purposes as access to outer space and other remote locations, sample collection and treatment, measurement, data collection and storage, computation, and communication of information. 3A/M2
- 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\*

### Benchmark 3: The Nature of Technology

#### Section A. Technology and Science, Grades 9-12

By the end of the 12th grade, students should know that

- Technological problems and advances often create a demand for new scientific knowledge, and new technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research. The very availability of new technology itself often sparks scientific advances. 3A/H1\*
- Mathematics, creativity, logic, and originality are all needed to improve technology. 3A/H2
- Technology usually affects society more directly than science does because technology solves practical problems and serves human needs (and also creates new problems and needs). 3A/H3a\*
- One way science affects society is by simulating and satisfying people's curiosity and enlarging or challenging their views of what the world is like. 3A/H3b\*
- Engineers use knowledge of science and technology, together with strategies of design, to solve practical problems. Scientific knowledge provides a means of estimating what the behavior of things will be even before they are made. Moreover, science often suggests new kinds of behavior that had not even been imagined before, and so leads to new technologies. 3A/H4\*\* (SFAA)

## SUGGESTED REFERENCES

- Computer Science*: <https://www.khanacademy.org/computing>
- Computer Principles*: <http://www.explainthatstuff.com/howcomputerswork.html>
- Computer Architecture*: <http://www.digitaltrends.com/computing/how-to-build-a-computer/>
- Computer Construction*: <https://pcpartpicker.com>

## VOCABULARY

**Computational Thinking:** How to solve large problems by breaking them down into a sequence of smaller, more manageable problems.

**Hardware:** Electronic components that makes up a computer and process computer instructions.

**Micro-processor:** The main "engine" of a computer that processes all functions and computing power.

**Nanometers:** One billionth of a meter. Some micro-processors range between 32 and 45 nanometers. In contrast, a human hair is 100,000 nanometers wide.

**Software:** Programs or applications stored on a computer than perform specific tasks.

**Vocabulary Learning Tool:** Make a Jeopardy Game. <http://www.superteachertools.us/jeopardyx/brandnewgame.php>

## INQUIRY ACTIVITIES

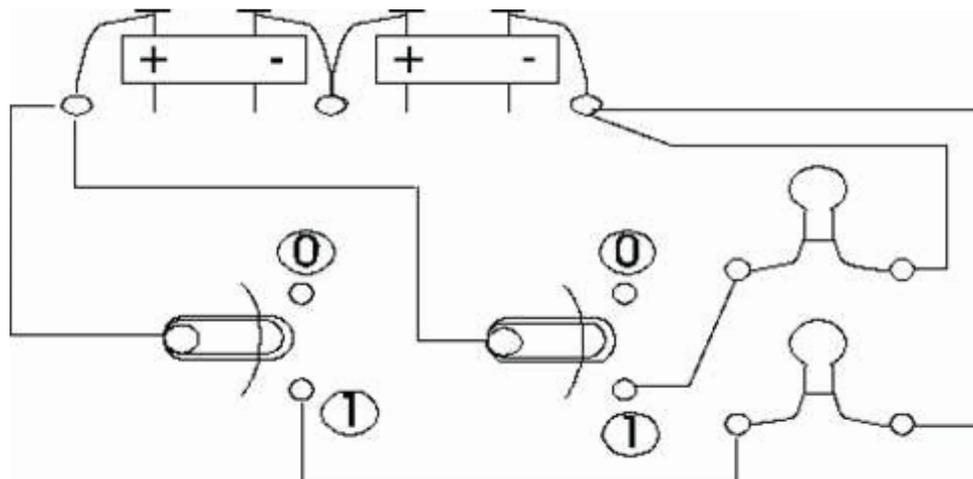
### Grades 6-8: Activity for computer basics

**Overview:** Students will build a simple computer.

**Time:** 45 minutes

**Materials:** 2 batteries in holders 1 breadboard, 2 light bulbs, 2 paper clips, 6 wires with washers  
4 labels, push pins 2 washers

**Background:** Computers are made up of 1000's of simple circuits like this one.



### Procedure:

1. Look at the schematic above and try to predict how many lights will be lit when the switches are in different positions. Use the table below to record your predictions.
2. Build the **switched, parallel circuit** shown in the diagram. Label the switches as shown.
3. Use your circuit to complete the following tab:
4. What type of calculation is your circuit performing?

Source: <http://www.galaxy.net/~k12/electric/adder.shtml>

		Number of Bulbs Lit	
First Switch	Second Switch	Predicted	Observed
0	0		
0	1		
1	0		
1	1		

## Grades 9-12: Activity for computer data

**Overview:** Students will investigate file sizes with different file formats.

**Time:** 50 minutes

### Procedure:

1. From any computer, choose a digital image to use for your project. Save a copy of the photo in a new folder on your desktop, labeled Image File Experiment, so it will be easy to find.
2. Open an image editing software, like GIMP, Adobe, or Photoshop.
3. Open the digital image you saved in Step 1.
4. You should see your photo open in a new window of your image editing program.
5. Now you are ready to save several versions of your file, each as a different type of file. You should first make a data table in your lab notebook in which to keep track of your results.

Trial #	File Name	File Format	File Size (MB)

6. From the menu bar, select "File" and then "Save As".
7. In the "Save As" dialog box, type in a new name to save the new image. You should change the name of the file; for example, you might change a file named "Family" to "Family1", "Family2", "Family3", etc.
8. In the "Save As" dialog box, there will also be a place where you can select the file format. Choose one of the file formats from the list (TIFF, JPEG, GIF, BMP, EPS, PICT, etc.) and click "OK," "Choose," or "Select," depending upon your program.
9. Another dialog box will appear, offering a selection of different settings for the type of image file format you have selected. For this project, keep all of these options as the **pre-selected default settings**. Click "OK." The image should now be saved as a new file with a new file format. Write the name of the file and the format of the file in your data table.
10. Repeat steps 7–12, choosing a new and different file format each time you save the photo.
11. After you have saved your photo in several different file formats, close all of your open images and your image editing program.
12. Open the desktop folder you created - the one labeled Image File Experiment.
13. In this folder, you will see a list of the files you saved. Select "View" from the menu bar and you might see options such as "thumbnails," "list," and "details." Click on "Details" (or whatever is comparable, depending on your computer). You should now see listed information about each file. In one of these columns, you should see a column labeled "Size". Write the information from this column in your data table.
14. Make a graph of your results. Which file format resulted in the largest file? The smallest file? Were there any file formats that were very similar in size? Can you make recommendations for how or when to use each type of file?

Source: <http://www.sciencebuddies.org/>