NASCENT
NANOMANUFACTURING SYSTEMS FOR MOBILE COMPUTING AND MOBILE ENERGY TECHNOLOGIES
A NATIONAL SCIENCE FOUNDATION NANOSYSTEMS ENGINEERING RESEARCH CENTER

Introduction to Computer Science

Subject Area(s) science & technology

Activity Title Introduction to Computer Science

Header Insert image 1 here, align right, wrap text

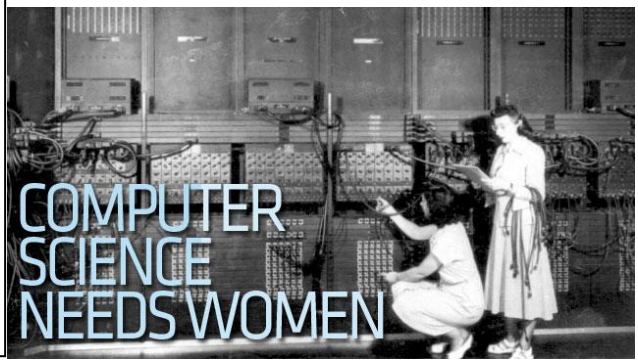
Image 1

Image file: computerscience.jpg

ADA Description:

Source/Rights: Copyright © http://kotaku.com/5756900/luring-women-into-computer-science-through-gaming

Caption: Shown is a picture, probably from the 1950s of two women in front of a computer, which is very large. They are holding large cords and appear to be working on the computer. Caption reads, "Computer Science needs women."



Grade Level 8 (6-8)

Activity Dependency none

Time Required 360 minutes

Group Size 3

Expendable Cost per Group US $0

Summary

Students are introduced to the world of science through little bits microcontrollers and a small bit of soldering. This approach is specifically targeted to girls and purposely engages students to the possibilities of microcontrollers without coding.

Engineering Connection

Students will use computer and electrical engineering concepts when experiementing with microcontrollers.

Engineering Category = #1. Relating science and/or math concept(s) to engineering

Keywords biomedical, technology, coding, simulations, heart, science, engineering, data, math

Educational Standards

Texas – Technology 6-8 Subchapter B: Middle School, 2011

Research and information fluency. The student acquires, analyzes, and manages content from digital resources. The student is expected to: process data and communicate results. *(Grades 6 - 8)*
Technology operations and concepts. The student demonstrates a thorough understanding of technology concepts, systems, and operations. The student is expected to: create and edit files with productivity tools, including: a spreadsheet workbook using advanced computational and graphic components such as complex formulas, advanced functions, data types, and chart generation;

ITEEA 2000

The Nature of Technology

Standard 3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study. In order to appreciate the relationships among technologies and other fields of study, students should learn that:
F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems. *(Grades 6 - 8)*

J. Technological progress promotes the advancement of science and mathematics. *(Grades 9 - 12)*

NGSS Standard (strongly recommended)

CCSS Standard (strongly recommended)

Pre-Requisite Knowledge
None.

Learning Objectives
After this lesson, students should be able to:
- Define computer science.
- Use the design process to manipulate a microcontroller to complete a task.

Materials List
Each group needs:
- One littleBits Deluxe Kit
- One littleBits Cloud Starter Bundle
- Crafting materials students can use to build accessories: paper, glue, scissors, pipe cleaners etc.
- Whiteboard and dry erase markers (optional)

To share with the entire class:
- Soldering Iron

Introduction / Motivation
Students will work as a group to define computer science. First they will make a list of examples of what they know to be considered part of computer science. Then they will work together to come up with a definition.
Questions to guide discussion:
- What are some simple examples of computers?
- What are some complex examples of computers?
- What do these have in common?

Vocabulary / Definitions

Word	Definition
Computer science	the scientific and practical approach to computation and its applications.
Computer Engineering	a discipline that integrates several fields of electrical engineering and computer science required to develop computer hardware and software.
Hardware	the collection of physical elements that constitutes a computer system
Software	any set of machine-readable instructions that directs a computer's processor to perform specific operations.
Microprocessor	A microprocessor, sometimes called a logic chip, is a computer processor on a microchip.The microprocessor contains all, or most of, the central processing unit (CPU) functions and is the "engine" that goes into motion when you turn your computer on. A microprocessor is designed to perform arithmetic and logic operations that make use of small number-holding areas called registers. Typical microprocessor operations include adding, subtracting, comparing two numbers, and fetching numbers from one area to another. These operations are the result of a set of instructions that are part of the microprocessor design.
Microcontroller	(sometimes abbreviated µC, uC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals.
Computer Programming	(often shortened to programming) is a process that leads from an original formulation of a computing problem to executable programs.

Procedure

1. Students will use the littleBits kits to design a computer that performs a specific task. Explain to students that littleBits are microcontrollers, meaning they are preloaded with instructions on how to operate. Inside each little bit are a variety of controllers that are programmed with instructions. We can combine these littleBits to do lots of neat things! Let's play!
2. The first step will be allowing students to "tinker" with the kits. Significant time should be allotted for this (at least an hour). Ask students to document what they are able to do with the "bits," and to jot down bigger things they could do if they had more time.
3. Ask students to think of a problem they could solve, or a human need or want they could satisfy using the littleBits.
4. Once they have an idea, they should document their design process.
    a. Who would be their client? Who would use the product?
    b. What need/want would this provide for your client?
    c. What constraints might you come across in your design?
5. Ask students to create a sketch of how the littleBits would need to be assembled in order to complete the task. If any other supplies are needed they should list these and decide how to acquire them.
6. When students are finished designing they can start building.
7. When their "computer" is complete ask students to create a short video showing how their design works. This video can be shared with the class or posted on a class website, YouTube or social networking.

Standards-based Rubric:

Progression (D and below)	Proficient (B and C Grades)	Advanced (A Grades)

• Students display evidence of use of some steps of the design process	• Students display evidence of use of each step of the design process (must be documented)	• Students display evidence of thorough use of each step in the design process. Students have clearly documented their use of this process.
• Students have some parts of prototype completed	• Students have a completed prototype that meets all design constraints	• Students have a sometimes or always functioning prototype for client that meets all design constraints and is creative
• Students function as a team on a superficial level, may lack contributions from some members or consistent communication	• Student contributes to process and completion of prototype	• Students work fluidly as a team using a high level of communication and cooperation

Background

Girls are underrepresented in the Computer Science field. Technology increasingly permeates every aspect of society and provides the foundation for most modern innovation. Girls and women in the U.S. are avid users of technology, but they are significantly underrepresented in its creation. (National Center for Women & Information Technology) Irrelevant curriculum and reliance on lecturing instead of hands-on projects and lack of opportunities to take risks and make mistakes deters girls from computing. By introducing girls to computer science though approachable and tinker-friendly devices in this lesson we can spark curiosity that will encourage further engagement.

Before the Activity

- Set up each station with the littleBits kits and dry erase boards if using.
- Tinker with the kits yourself!

With the Students

It's important to allow students to work in groups in this activity.

Image Insert Image # or Figure # here (use Figure # if referenced in text)

Figure 1

Image file: littlebits.jpg

ADA Description: Pictured are a pig and cat that have been crafted out of paper and other crafting supplies. They have LED lights for eyes and are attached to littleBit microcontrollers.

Source/Rights: Copyright Gigom.com

Safety Issues

- none

Troubleshooting Tips

It's a good idea to have extra littleBit kits in case a part malfunctions.

Investigating Questions

How do simulations assist different types of engineers? How are there simulations changing the way we experiment and collect data?

Assessment

Pre-Activity Assessment

Math and Science: What is the relationship between math and science? Are they two separate ideas? Does one support the other? Give a real world example.

(We are hoping students see through this activity that we are using math to simulate our scientific processes. The results of these simulations are both mathematical and scientific.)

Activity Embedded Assessment

Teacher Observation

The best way to assess students is by reviewing their design brief and ensuring all students are participating in the process.

Post-Activity Assessment

Reflection

1. Describe how you and your partner came up with an idea for a design.
2. What are some challenges you and your partner faced during the design process? How did you overcome them?
3. What is computer science and why is it important?
4. Overall, on a scale of 1 to 5, how much did you enjoy this activity? Would you be interested in doing more activities like this? Why or why not?

Activity Extensions

Now that students have the based knowledge of computer science, they can move on to more complex computer science activities such as working with simple circuit boards.

Activity Scaling

- For lower grades, students could follow the same general procedure, but with a narrower options of littleBits.
- For higher grades, the activity could be extended, allowing students to use laser cutters and other tools to design the accessories.

Additional Multimedia Support

None

References

None

Contributors

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