Meet the Microchip

(4-5 class meetings)

Authors

Dr Shelley Montgomery

Karen Hammonds

Nicole Aquino

SUBJECT/GRADE LEVEL

Subject Area: MS Science

Grade Level: Adaptable, standards for math and science are for Middle Science Life Science

Materials

- List of materials needed for the activities.
- Paper, pencil, access to smart board or projector for showing video links
- Visual aide items that contain microchips such as calculators, computers, phones, watches; if possible acquire via donation broken/discarded versions as well

STANDARDS

Next Generation Science Standards

- NGSS MS-LS1-8 - Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
- NGSS SEP Developing & Using Models
- NGSS SEP Planning & Carrying out Investigations
- NGSS SEP Engaging in Argument from Evidence
- NGSS CCC Interdependence of Science, Engineering, & Technology

Mathematics Standards | Common Core State Standards

- 6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another

English Language Arts Standards | Common Core State

- CCSS.ELA-LITERACY.SL.11-12.1.A: Come to discussions prepared, having read and researched

material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.

LESSON OBJECTIVE(S)

Students will be able to explain microchip technology and use via real world engineering and design.

CAREER CONNECTION(S)

Mentor Background: Dr. Oluseyi Ayorinde is the team lead for the Integrated Circuit Engineering (ICE) team at the Combat Capabilities Development Command Army Research Lab (DEVCOM ARL WEST) in Ca. He is currently involved on projects related to low-power digital circuits, Machine Learning Acceleration, Swarming Algorithm Acceleration, Digital Application-Specific Integrated Circuit Design, and Low-Power FPGA hardware design. He also serves on the ARL-West Outreach committee where he passionately strives to bring STEM education to all, but particularly to underrepresented communities. He also is working on developing a high school curriculum for a microchip design course.

STEM Careers: The career industry involving microchips in a world that is quickly growing and changing. There is an increasing need for students to go into the semiconductor industry at all levels.

Jobs such as:

System & Application software development

System integration & testing

Heat & Mass transfer

Imaging & lithography performance

Electronics

Mechatronics

Electron optics

Equipment Engineer

Process Support Technician

Fab Operator

Test & Development Device Engineer

There are also jobs testing the devices that the chips go into, designing and ensuring proper packaging for the chips and products they go into, research and development to use chips and semiconductors (and areas that could use smaller, faster, or more sustainable chips), marketing for the chips, quality control, even careers like customer support and administrative support are needed in this industry. The desire to grow an education program for undergraduate and high school students is also increasing, so teachers who are interested in teaching this content are important.

According to Indeed, jobs are very plentiful in the semiconductor world in Ca. The starting rate is $17.73/hr upwards to $163,000/year. There are other positions posted with private companies that do not post the salaries related to their position. There are many opportunities in many other countries around the world also.

ENGAGEMENT

Brief Description:
Students will be introduced to the concept of microchips in a life science setting via a short video and modeling activity.

Procedures:
Show short video clip:

Prosthetic leg with microchip helps amputee feel normal (1:26)

A.I. assisted brain implant helps quadriplegic man move his arms again | NBC New York

With a partner or small group, have students brainstorm how they think the man's prosthetic leg operates and how it is able to help him feel sensations as if it was his real leg. Draw a diagram or model representing their ideas.
*Help guide students through the connection between prosthetic legs and microchips as they are discussing and brainstorming.

EXPLORATION

Brief Description: Opportunity for hands-on exploration of everyday items that contain microchips.

Procedures:

1. Share what you know about microchips: Turn and talk then whole class discussion. Anticipated topics: Pets, computers, smartphones, smart watches, calculators
2. Provide students with items such as calculators, smartphones, digital watch, laptop to examine.If possible, provide older items that can be disassembled in order to locate and identify parts. Discuss the items as they use vocabulary associated with microchips.

Vocabulary

Microchip
Transistor
Resistor
Capacitor
Integrated circuit
Prosthetic
Prototype
Analogous
Circuit
Semiconductor
Sustainability

3. Have students read & summarize the following article: The basics of microchips The basics of microchips | ASML
4. Play this kahoot as a pre-assessment of knowledge

EXPLANATION

Brief Description: Teacher clarifies misconceptions and guides students to make connections between microchips and their uses in medical devices.

Procedures:

1. Explain that a microchip, also known as an integrated circuit, is a small electronic device made up of interconnected electronic components such as transistors, resistors, and capacitors. Discuss how these components work together to perform various functions within electronic devices.
    - Show intro 1st 1.5 min; video is long (27 mins)
      How are Microchips Made? 🖥️🛠️ CPU Manufacturing Process Steps
    - Or this video 💻 How Are Microchips Made? (5:34)
    - For a challenge, use this simulation here to help teach how to draw a resistor and a capacitor.
2. Discuss current microchip technology in use today in common medical devices such as the cochlear implant and the pacemaker defibrillator. Show the following short videos if needed:
    - How does a cochlear implant work? 2-Minute Neuroscience: Cochlear Implants (1:43)
    - How does a pacemaker defibrillator work?
      Implantable Cardioverter-Defibrillator (ICD) (3:28)
3. Discuss how our military need medical devices that address specific needs for their job
    - What is a Cochlear Implant? What is a Cochlear Implant? | FDA.
    - Article about soldier and cochlear implant- Implant turns on the world to Evans patients Implant turns on the world to Evans patients | Article | The United States Army
    - NIH article about severe hearing loss in veterans and cochlear implant- Cochlear Implants in Veterans: 10-Year Experience at a Single Referral Center Cochlear Implants in Veterans: 10-Year Experience at a Single Referral Center - PMC

ELABORATE

Brief Description: Students apply knowledge gained from previous lessons in order to make considerations for individual needs in extreme environments such as military missions.

Procedures:

1. Use this website Medical | Microchip Technology for ideas of current medical technology controlled by microchips to help you identify some common devices. Read this article Elon

Musk's Neuralink Has Implanted it's First Chip in a Human Brain. What's Next? about the first brain computer interface implanted in a human brain. Use section 3.1 in this research article Microchips in Medicine: Current and Future Applications - PMC by having students interpret and explain the graph. Students should argue from evidence within and amongst groups then develop a claim that supports the use of microchips in medicine. Use the text leveler function in Magic School Ai as needed for grade level adjustments.

2. Identify a common medical device that is currently used by US soldiers in the field. Provide at least 3 reasons why the design of this current medical device needs to be improved. (Ex. battery life needs to be improved)
3. Design a new medical device that would address these issues. You may also choose to design an improvement for a current medical device.
4. Use this pdf Electronic Solutions for Medical and Fitness (downloadable from the website) to help you in your design. The design should help address the following sustainability issues:
    a. Be portable or wearable
    b. Be less expensive
    c. Have more powerful features
    d. Be easier to use
    e. Have a longer battery life
    f. Be reliable and able to connect in several ways to smartphones and tablets
    g. Withstand various environmental conditions

EVALUATION

Brief Description:

Students have the opportunity to share their design via peer and teacher review.

Procedures:

Present your findings using a detailed diagram or digitally using a Google slideshow. Make sure it identifies the improvements to the current device that is in use.

Project Jobs

Job Title	Job Description	Lab Report Section Responsibility
Design Project Manager	Prepares all sketches (preliminary & final); fills out design challenges section of lab report	Sketches Design Challenges

Prototype Engineer	Provides leadership in designing device, performs research, fills out function of final design section	Functions of final design
Anatomical Expert	Labels diagrams and fills out analogous structures section	Diagram labels Analogous structures
Materials Manager	Fills out materials needed and recap summary section	Materials needed Recap Summary

Lab Report

Each member of the team should complete his/her section of the lab report. Refer to the Project Jobs chart for section responsibilities.
Preliminary sketch of our medical device design
What challenges does our design have? (ex. Expensive to produce)
What materials do you need for your design?

Explain the function of your final design.
How did your design address the 3 challenges you identified in the beginning? Challenge #1: Challenge #2: Challenge #3:
Recap Summary- Write a paragraph (5 sentences) explaining why your medical device is an improvement on the medical device used currently. How will it benefit US soldiers in the field? How does this translate into an improvement for the general population? Does it help populations in poor/ underserved countries or communities? Is it sustainable?

Analogous Structure Diagram

In the spaces below, compare your medical device to the actual anatomical structure that it is designed to replace/ enhance. Draw and label both diagrams and show how your device directly replaces the anatomical structure.	
Drawing of your device. Be sure to label all the parts.	Drawing of the anatomical structure your device is designed to replace or enhance. Be sure to label the structure. In a different color, indicate which parts of this anatomical

	structure your device replaces/ enhances.

Grading Rubric

	Point Value
Lab Report including preliminary sketch and materials list	10 points
Final Presentation	30 points
Recap summary showing analogous biological parts of prosthetic hand ● All parts labeled	10 points

Additional Articles:
ZOLL Military Medical Products and Critical Care Technologies (examples)
https://www.zoll.com/markets/Military

Diabetes

- Soldiers and Diabetes w/ continuous monitoring devices (NIH article)
  US Army Soldiers With Type 1 Diabetes Mellitus US Army Soldiers With Type 1 Diabetes Mellitus - PMC

- Current research with implantable device with wounded soldiers
  Implantable Monitor Can Save Wounded Soldiers and Improve Diabetes ManagementImplantable Monitor Can Save Wounded Soldiers and Improve Diabetes Management | Seed

REFERENCES

- Career resources:
  - 12 Emerging Career Paths in the Semiconductor Industry
  - Is Semiconductors a Good Career Path?
  - SEMI Careers
  - https://www.indeed.com/q-microchip-jobs.html?vjk=ff4d95eb972205c1
  -
  -
-