Unit 4: Computer Science: Microcontrollers and Microprocessors

Content Area:	**Applied Technology**
Course(s):	
Time Period:	**Marking Period 2**
Length:	**4-5 weeks**
Status:	**Published**

Summary

Introduction:

Students will use a microcontroller to explore inputs, processes, and outputs and create a game. Using a microcontroller like an Arduino, students will explore how to integrate sensors and output devices. Students will apply 3-D printing skills to develop the game. Students will make an exploratory version of the game and then a final prototype.

Revision Date: July 2025

Learning Plan

Preview the essential questions and connect to learning throughout the unit.

Formative assessments will be conducted throughout the process using class discussion, student writing and practice quizzes.

Formative assessments will be conducted to determine background knowledge in atomic theory.

Lectures and lessons will be provided to develop student understanding of electrical engineering concepts: Ohm's Law, Kirchhoff's law, series, circuits, batteries, switches, parallel and series-parallel circuits.

Lecture and demonstrate and summative assessment regarding soldering safely.

Summative assessments will be conducted throughout to evaluate skills acquisition.

Formative assessments will be conducted throughout the design process.

Problem based learning in mechanical/computer science engineering unit: students will design a touch sensor for use in a circuit in a robot. Students will draw a schematic drawing of the circuit and explain how it works. Students will demonstrate correct use of a breadboard.

Summative assessment will be conducted by the student and teacher using a rubric specific to the design problem.

Students will develop skills and follow safety practices when soldering.

Complete unit test

Assessment

Formative Assessment:

exit tickets

proper use of unit vocabulary

skills and follow safety practices when soldering

participation in class discussions on Ohm's Law, Kirchhoff's law, series, circuits, batteries, switches, parallel and series-parallel circuits.

quizzes

demonstrate knowledge of computer memory capability and limits through hands-on activities.

Summative assessment:

use flow charts to represent how microcontrollers are integrated into systems

use the design process to develop solutions that employ microcontrollers

complete written tests and quizzes on the history of microprocessors and the function of microcontrollers

complete writing prompts: The microprocessor in a microwave oven performs the following functions: The memory in an EEPROM is limited. This effects…

answer the essential questions.

Alternate Assessment:

presentation how to use an Electrically Erasable Programmable Read-Only Memory

Benchmark assessment:

Final exam

Materials

Arduino, Basic Stamp, LEGO NXT, and peripheral supplies (motors, sensors-distance, light, touch and others, jumpers, power supplies, breadboards, output displays).

Email and e-board

Web sites, including YouTube tutorials and TinkerCAD

CAD and other software programs

Smartboard use for presentation and interactive lessons

Soldering irons, solder

Drill press, scroll saw

Goggles/safety glasses

3-D printer

Standards

ELA.L	Language
ELA.L.SS.9–10.1	Demonstrate command of the system and structure of the English language when writing or speaking.
LA.RST.9-10	Reading Science and Technical Subjects
	Key Ideas and Details
	Key Ideas and Details
LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.11-12.2	Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
LA.RST.11-12.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
MATH.9-12.N.VM	Vector and Matrix Quantities
SCI.HS-PS4	Waves and Their Applications in Technologies for Information Transfer
SCI.HS-PS4-5	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
	Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.
SCI.HS-LS2	Ecosystems: Interactions, Energy, and Dynamics
SCI.HS-ESS3	Earth and Human Activity
SCI.HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
	Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such

	as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.
	Constructing Explanations and Designing Solutions
	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories.
	Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
SCI.HS.ESS3.A	Natural Resources
	Resource availability has guided the development of human society.
SCI.HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
	Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).
SCI.HS.ESS3.D	Global Climate Change
SCI.HS-ETS1	Engineering Design
SCI.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
SCI.HS.ETS1.B	Developing Possible Solutions
	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
CS.9-12.8.2.12.ED.1	Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
CS.9-12.8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
CS.9-12.8.2.12.ED.4	Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
CS.9-12.8.2.12.ED.5	Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).
CS.9-12.8.2.12.ED.6	Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
CS.9-12.ED	Engineering Design
WRK.9.2.12.CAP	Career Awareness and Planning
WRK.9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as

	structured learning experiences, apprenticeships, and dual enrollment programs.
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.TL	Technology Literacy
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
	With a growth mindset, failure is an important part of success.
	There are strategies to improve one's professional value and marketability.
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
	Collaborative digital tools can be used to access, record and share different viewpoints and to collect and tabulate the views of groups of people.
	An individual's income and benefit needs and financial plan can change over time.
	Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.
	Innovative ideas or innovation can lead to career opportunities.

Integrated Accommodations and Modifications...

Integrated Accommodation and Modifications, Special Education students, English Language Learners, At-Risk students, Gifted and Talented students, Career Education and those with 504s

Essential Questions/Enduring Understandings

Essential Questions:

What is a microcontroller, and how does a microcontroller's ability to integrate a processor, memory, and I/O peripherals on a single chip enable the creation of compact and efficient embedded systems?

How do microcontrollers serve as the "brain" behind a wide range of everyday devices, from a remote control to a car's engine management system?

What are the key stages of product production, and how do engineers ensure that a product can be manufactured efficiently and cost-effectively from a design? 🏭

How does a production plan and quality control process ensure that a product consistently meets design specifications and customer expectations?

Essential Understandings:

microcontrollers are small computers that can be programmed to solve problems.

microcontrollers primarily interface with machines.

microprocessors and microcontrollers are commonly used in industry.

products are made by applying the iterative design loop.

Objectives

Students will know:

microcontrollers are commonly used in industry.

the timeline of the development of microprocessors.

that microcontrollers are small computers.

that microcontrollers interact primarily with machines.

how to solder.

syntax and computer structures like finite and infinite loops, conditions, variables, analog and digital inputs and outputs, pulse width modulation, and how to integrate libraries.

terms and vocabulary: EEPROM (Electrically Erasable Programmable Read-Only Memory), hardware, software, algorithm, memory, microprocessor, microcontroller, flow chart. C++ computer language, Arduino, servo motor, sensor.

Students will be skilled at:

how to program a microcontroller.

how to make a flow chart for a system.

how to write code in a computer language.

how to compile code.

how to use an Electrically Erasable Programmable Read-Only Memory.

applying the design loop to solve a problem (Unit 1)

how to solder.

how to apply the design loop.