Unit 4: Computer Science: Microcontrollers and Microprocessors

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 1**
Length: **25 days**
Status: **Published**

Summary

Introduction:

Students will use a micro controller to explore inputs, processes and outputs to invent a game. Using a microcontroller (BASIC Stamp or Arduinio), students will explore how to integrate sensors, i.e. switches, process the information, and the output the information-i.e. making a game piece advance. As in the spirit of open ended design, student teams are guided with their choice of game, but are invited to explore the feasibility of any of their ideas.

Revision Date: July 2020

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.ED	Engineering Design
LA.RST.11-12	Reading Science and Technical Subjects
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.
CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.

CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
SCI.HS	Engineering Design
SCI.HS.ETS1.B	Developing Possible Solutions
SCI.HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
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-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.
WRK.9.2.12.CAP	Career Awareness and Planning
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.A	The Nature of Technology: Creativity and Innovation: Technology systems impact every aspect of the world in which we live.
TECH.8.2.12.A.CS1	The characteristics and scope of technology.
TECH.8.2.12.A.CS3	The relationships among technologies and the connections between technology and other fields of study.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.C.1	Explain how open source technologies follow the design process.
TECH.8.2.12.C.4	Explain and identify interdependent systems and their functions.
TECH.8.2.12.C.6	Research an existing product, reverse engineer and redesign it to improve form and function.
TECH.8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.
TECH.8.2.12.C.CS1	The attributes of design.
TECH.8.2.12.C.CS2	The application of engineering design.

TECH.8.2.12.C.CS3	The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.
TECH.8.2.12.E	Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.
TECH.8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
TECH.8.2.12.E.2	Analyze the relationships between internal and external computer components.
TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
TECH.8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).
TECH.8.2.12.E.CS1	Computational thinking and computer programming as tools used in design and engineering.
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CT	Critical Thinking and Problem-solving
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
	Key Ideas and Details
	Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.
	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.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
	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.

Essential Questions/Enduring Understandings

Essential Questions:

What are microcontrollers?

How are microcontrollers used?

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.

Objectives

Students will know:

microcontrollers are commonly used in industry.

the time line of the development of microprocessors.

that microcontrollers are small computers.

that microcontrollers interact primarily with machines.

terms and vocabulary: EEPROM (Electrically Erasable Programmable Read-Only Memory), hardware, software, BASIC (Beginner's All-purpose Symbolic Instruction Code), BASIC STAMP, 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)

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)

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

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