Unit 4: Mechanical Engineering and Computer Science

Content Area:	**Applied Technology**
Course(s):	
Time Period:	**Marking Period 1**
Length:	**7 Weeks**
Status:	**Published**

Essential Questions/Enduring Understandings

Essential Questions:

What is a robot?

What is mechanical engineering?

What is computer engineering?

Enduring Understandings:

robotics is primarily a mechanical engineering pursuit.

different types of engineers are involved with complicated problems

each computer languages has unique syntax, but many languages are structured similarly.

Objectives

Students will know:

the career path of a mechanical engineer.

the career path of a computer engineer.

the characteristics of a robot.

the components of a computer.

computer language concepts and use: continuous loops, loops with counters, nested loops, declaration of variables, condition structures (IF/THEN/ELSE), main programs and subroutines, comment lines and formatting code for understanding; conventions used to describe code.

unit vocabulary, including but not limited to: algorithm, syntax, computer, microcontroller, computer language, end effecter, etc.

there are societal impacts to robots.

there are environmental impacts to robots.

Students will be skilled at:

Breaking large tasks into smaller tasks

Programming a robot in a high-level language

Troubleshooting hardware and software problems

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.

Students will develop programming skills using TinkerCAD. The teacher will guide students through a series of sketches that students will use as a basis for programming. The sketches explore different aspects of programming and are focused. The teacher reviews student work through the software and helps students individually. Each activity students perform has specific goals that are graded with a rubric.

Design problem and major unit activities: the BOE-BOT 'bot' will be used as a learning tool for students to practice the programming/robotic concepts. A possible sequence: use the bot for text and math input and output, program and add accessories to the bot i.e. LEDs- programming them to flash, program the bot to move, program the bot to move a specific way, designing an end effecter to solve a problem, design sensors and program the bot to use them.

Summative assessments will be conducted throughout to evaluate skills acquisition.

Design analysis: students will analyze the sensor circuit in the Boe-Bot, draw it, and explain what the components are, and what they do.

Design logs will be maintained to document the application of the design loop.

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

Complete unit test.

Assessment

Formative assessment:

answer the essential questions of the mechanical engineering and computer science unit.

participate in guided question and answer sessions, group and individual discussions, and demonstrate an understanding of the purpose of the unit lesson(s), and the key terms and concepts.

make a robot solve problems with increasing degrees of complexity.

demonstrate the ability to utilize the design loop as a problem-solving tool.

use unit vocabulary in a design log.

demonstrate the ability to make a design log.

Summative assessment:

written quizzes and tests on Mechanical Engineering and Computer Science

complete writing prompts. Examples: "The end effecter is one of the ways a robot is distinguishable from a machine…" "Using the design loop as an outline, explain how your design for the end effecter evolved." "Development of subsystems helped/didn't help prototype the different variations of the car in these ways…"

Benchmark:

Final exam

Alternate assessment:

Project/Presentation on Mechanical Engineering

Materials

Online videos and tutorials

Email and e-board

Web sites

CAD and other software programs

SmartBoard use for presentation and interactive lessons

Batteries

Computers with editors for programming robots. Cables

Robotics lab supplies: resistors, motors, LEDs, distance sensors, wire, solder, soldering iron, safety glasses

Robots: BOE-BOT, Arduino or other programmable robot

Computers with Internet access.

Standards

MATH.9-12.A.REI	Reasoning with Equations and Inequalities
MATH.9-12.A.REI.A	Understand solving equations as a process of reasoning and explain the reasoning
CS.9-12.8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
CS.9-12.8.1.12.AP.6	Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.
CS.9-12.8.1.12.AP.8	Evaluate and refine computational artifacts to make them more usable and accessible.
CS.9-12.8.1.12.AP.9	Collaboratively document and present design decisions in the development of complex programs.
CS.9-12.8.1.12.CS.2	Model interactions between application software, system software, and hardware.
CS.9-12.8.1.12.CS.3	Compare the functions of application software, system software, and hardware.
CS.9-12.8.1.12.CS.4	Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors.
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.3	Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
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.AP	Algorithms & Programming
CS.9-12.CS	Computing Systems
CS.9-12.ED	Engineering Design
SCI.HS.ESS3.D	Global Climate Change
SCI.HS.ETS1.C	Optimizing the Design Solution
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.
SCI.HS-ESS3	Earth and Human Activity
SCI.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
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.
WRK.9.2.12.CAP	Career Awareness and Planning
WRK.9.2.12.CAP.1	Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession.
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.
WRK.9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
WRK.9.2.12.CAP.13	Analyze how the economic, social, and political conditions of a time period can affect the labor market.
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).
	Constructing explanations and designing solutions 9–12 builds on K – experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.
	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.
	An individual's income and benefit needs and financial plan can change over time.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
	Successful troubleshooting of complex problems involves multiple approaches including research, analysis, reflection, interaction with peers, and drawing on past experiences.
	A computing system involves interaction among the user, hardware, application software, and system software.
	With a growth mindset, failure is an important part of success.
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
	Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.

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.

Constructing Explanations and Designing Solutions

Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. Modules allow for better management of complex tasks.

Constructing explanations and designing solutions 9–12 builds on K – experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

Innovative ideas or innovation can lead to career opportunities.

Constructing Explanations and Designing Solutions

Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Career planning requires purposeful planning based on research, self-knowledge, and informed choices.

There are strategies to improve one’s professional value and marketability.

Integrated Accommodations and Modifications, Special Education Students,

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