West Windsor-Plainsboro Regional School District
Principles of Engineering

Unit 0: Technology Education

Content Area: Technology Education

Course & Grade Level: Technology Education – Grade 12

Summary and Rationale

The West Windsor-Plainsboro Regional School District recognizes the importance of the study 21st Century Life and Careers standards. Additionally, it is also believed this learning should not be taught in isolation and cross curricular and career ready practices are embedded in every unit of study. Unit 0 is incorporated into each unit of study of this curricular document.

Recommended Pacing:

ELA Companion Standards and Career Ready Practices will be integrated throughout all units of study.

Interdisciplinary Connections

Grades 9-10

Progress Indicators Reading Science and Technical Subjects

Key Ideas and Details

RST.9-10.1. 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.

RST.9-10.2. Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

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.

Craft and Structure

RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9-10 texts and topics*.

RST.9-10.5. Analyze the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).

RST.9-10.6. Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Ideas

RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
RST.9-10.8. Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
RST.9-10.9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Range of Reading and Level of Text Complexity:

RST.9-10.10. By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

Career Ready Practices

CRP1. Act as a responsible and contributing citizen and employee.

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP7. Employ valid and reliable research strategies.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP9. Model integrity, ethical leadership and effective management.

CRP10. Plan education and career paths aligned to personal goals.

CRP11. Use technology to enhance productivity.

CRP12. Work productively in teams while using cultural global competence.

Competencies for 21st Century Learners			
X	Collaborative Team Member	X	Effective Communicator
X	Globally Aware, Active, & Responsible Student/Citizen	X	Information Literate Researcher
X	Innovative & Practical Problem Solver	X	Self-Directed Learner

Unit 1: The Engineering Design Process

Content Area: Engineering

Course & Grade Level: Principles of Engineering, 9-12

Summary and Rationale

The design/engineering loop is a problem-solving strategy, with criteria and constraints, used to develop many possible solutions to solve a problem or satisfy human needs and wants and to narrow down the possible solutions to one final choice. It is a fundamental system that guides students through a systematic yet flexible approach to solving a problem. This will be a key component in both student research and project-based work.

Recommended Pacing

10-15 days

State Standards

8.2: Technology Education, Engineering, and Design: 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.

Strand A - The Nature of Technology: Creativity and Innovation Technology systems impact every aspect of the world in which we live.

Stand C - Design: The design process is a systematic approach to solving problems.

Strand D - Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.

CPI #	Cumulative Progress Indicator (CPI)
8.2.12.A.3	Research and present information on an existing technological product that has been repurposed for a different function.
8.2.12.C.2	Analyze a product and how it has changed or might change over time to meet human needs and wants
8.2.12.C.3	Analyze a product, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).
8.2.12.C.6	Research an existing product, reverse engineer and redesign it to improve form and function.

8.2.12.D.2	Write a feasibility study of a product to include: economic, market, technical, financial, and management factors, and provide recommendations for implementation.

NGSS Standards

MS-ETS1 Engineering Design

CPI #	Cumulative Progress Indicator (CPI)
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.

Instructional Focus

Unit Enduring Understandings

- Problem based learning is interdisciplinary.
- Problems can be broken down into smaller simpler tasks.
- Failure should be viewed as an opportunity for learning.
- The Design Loop is an essential process in problem solving.

Unit Essential Questions

- What is STEM?
- What is Engineering?
- What is the interdependency between science, technology, engineering, and math?
- What are the steps in the Design Loop?
- What is technology?
- What is technological literacy?

Objectives

Students will know:

- How technology changes over time
- Resources of technology
- The relationship between technology and society

Students will be able to:

- Define “Technology”
- Identify the steps in the design process
- Recognize the product life cycle

Evidence of Learning

Assessment			
Common Assessment 1.1			
Competencies for 21st Century Learners			
	Collaborative Team Member		Effective Communicator
	Globally Aware, Active, & Responsible Student/Citizen	X	Information Literate Researcher
X	Innovative & Practical Problem Solver	X	Self-Directed Learner

Resources

- The Art of Invention (Steven J. Paley)
- Standards for Technological Literacy: Content for the Study of Technology - Third Edition: http://www.iteaconnect.org/TAA/PDFs/xstnd.pdf
- https://www.teachengineering.org/view_curricularunit.php?url=http://www.teachengineering.org/collection/cub_/curricular_units/cub_creative/cub_creative_curricularunit.xml
- www.legoeducation.com
- www.tryengineering.org
- Engineering Design: An Introduction (Karsnitz, O'Brien, Hutchinson)

Materials

- Cardboard
- Masking tape
- Hot glue guns / glue
- Craft knives
- Rulers
- Popsicle sticks
- Scissors
- Manilla paper/folders
- Construction paper
- Index cards

Unit 2: Structural Engineering and Fabrication

Content Area: Engineering

Course & Grade Level: Principles of Engineering, 9-12

Summary and Rationale

The Structural Engineering and Fabrication section of the course is intended to develop knowledge and capability relative to two fundamental building blocks of our modern technological world. Students will study structural and mechanical systems, underlying scientific principles, applications, and techniques and skills used in the design and development of these systems. Students will be able to utilize these systems and skills to solve new problems. This section of the course is about appreciating the innovative thought and action that goes into everything in the designed world. It is also about recognizing your individual creativity and learning how to tap it more effectively.

Recommended Pacing

30 days

State Standards

8.2 Technology Education, Engineering, and Design: All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world, as they relate to the individual, global society, and the environment.

Strand C - Design: The design process is a systematic approach to solving problems

Strand D - Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.

CPI #	Cumulative Progress Indicator (CPI)
8.2.12.C.5	Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
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.
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review

8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
8.2.12.D.5	Explain how material processing impacts the quality of engineered and fabricated products.

NGSS Standards

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.

Instructional Focus

Unit Enduring Understandings

- Following safety procedures and using personal protection equipment will reduce the risk of injury.
- Planning is an essential component to design, construction, material usage, and efficiency
- Tools and machinery have specific functions and methods for usage.
- Methods of construction and assembly determine the difference in strength and quality
- Identify and use various types of hand tools, gages, and measuring tools
- Identify and use various types of portable power tools and stationary power tools. The proper implementation of personal protective equipment
- The understanding of machine/tool safety and instruction regarding correct shop procedure is crucial in a fabrication lab.

Unit Essential Questions

- What are the safety concerns to be considered when working in a lab setting in school or on the job?
- What protection can be used in a laboratory environment?
- What should be part of an effective safety program?
- What characteristics are essential to a functional team?
- What are the benefits of working in a team environment as opposed to individually?
- Why is planning an important aspect to project work?
- How does planning influence efficiency?
- Why is planning vital to material usage and construction?

Objectives

Students will know:

- Structures and Mechanisms
  - Introduction to materials and their characteristics
  - Introduction to the processes used to change the form or properties of materials to expand their usefulness in meeting human needs and wants
  - Emphasis is placed on students understanding how materials are processed using tools and machines
- Industrial/Creative Design

Students will be able to:

- Use the elements and principles of design to create pleasing products and designs
- follow safety procedures and use personal protective equipment to reduce the risk of injury. identify and implement proper safety in a work environment, including working as a team.
- use planning as an essential component to design, construction, material usage, and efficiency. successfully complete a bill of materials, a plan of procedure and select appropriate materials for each of their projects
- understand that tools and machinery have specific functions and methods for usage.
- properly select and utilize the appropriate hand tools for the necessary task.
- Students will be able to utilize different methods of construction and assembly and determine the difference in strength and quality.
- properly assemble their pieces into a project using appropriate methodology.
- understanding how materials are processed using tools and machines.
- Properly and safely use the following power tools:
  - Band Saw
  - Scroll Saw
  - Cordless Drill
  - Sanders
  - Drill Press
  - Various Hand Tools

Evidence of Learning

Assessment

Common Assessment 2.1

Competencies for 21st Century Learners

	Collaborative Team Member		Effective Communicator
	Globally Aware, Active, & Responsible Student/Citizen		Information Literate Researcher
X	Innovative & Practical Problem Solver	X	Self-Directed Learner

Resources

- https://www.istructe.org/resources-centre/teaching-resources
- West Point Bridge Design Program (Free) - http://www.cesdb.com/west-point-bridge-designer.html
- Engineering Calculators - http://www.calculatoredge.com

Materials

- ¼ x ¼ , ⅛ x ⅛ Balsa wood
- Wood glue
- Wax paper
- Staples
- 11 x 17 graph paper
- Lumber
- Coping saws
- Sandpaper
- Fasteners
-WP bridge designer
-Structural testing apparatus

Unit 3: Electrical Engineering

Content Area: Engineering

Course & Grade Level: Principles of Engineering, 9-12

Summary and Rationale

The study of electronic systems including sensors, control and output devices, and utilization of these systems will be included in this section of the course. Introduction to control logic, switching, timing and other control devices and systems will be addressed along with the analysis of circuits and use of instrumentation.

Recommended Pacing

15 days

State Standards

8.2 Technology Education, Engineering, and Design: All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world, as they relate to the individual, global society, and the environment.

Strand C - Design: The design process is a systematic approach to solving problems.

Strand D - Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.

CPI #	Cumulative Progress Indicator (CPI)
8.2.12.C.1	Explain how open source technologies follow the design process.
8.2.12.C.4	Explain and identify interdependent systems and their functions.
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.

NGSS Standards

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.

Instructional Focus

Unit Enduring Understandings

- Understand how simple circuits work and the fundamentals of electricity and magnetism.
- The attributes and application of engineering design.
- The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.
- All electrical circuits must be comprised of a power source, a load and a path for electricity to flow. Advancements in the field of electronics have led to a number of great inventions throughout history which have helped to shape the way we live our lives.
- Electrical signals can be manipulated and changed to perform a number of useful tasks in our daily lives.

Unit Essential Questions

- Why is it important to solder connections?
- How can a multimeter be used to diagnose problems with electrical systems?
- Why is it important to use resistors to control current flow?
- What are some methods used to produce electrical power?
- How can movement, temperature, sound, and infrared heat control an electronic circuit?
- How can we detect a fire using electronic devices and circuits in the real world?
- Why must all circuits power something (light, motor, etc.) to be considered a complete circuit?
- How do we direct the flow of electricity to go where we want it to go?
- How do we measure electricity?
- Why must all circuits power something (light, motor, etc.) to be considered a complete circuit?
- How do we direct the flow of electricity to go where we want it to go?
- What is the relationship between voltage, current and resistance?
- What are some different types of circuits which change electrical signals?

Objectives

Students will know:

Electrical Components and Electronic Measurement

- Various Switches and Switch Types
- Read Resistor Codes
- Ohm's Law
- Power Supplies – Battery and Line power. - Alternating/Direct Current
- Relative Resistances of materials
- Use of Voltage Multimeter
- Electric Circuits
- Programmable Timer
- Sensor Circuits
- Infrared Sensors and Amplifiers

Students will be able to:

- Identify and implement proper safety in a work environment.
- Understand the importance of collaboration and effective teamwork skills.
- Utilize technological tools and equipment safely to create products and systems.
- Explain how electricity flows and how it can be directed using conductors.
- Explain the various types of electrical power sources
- Identify and utilize a variety of electrical components in circuits
- Explain how the flow of electrical current can be manipulated by the designer of a circuit.
- Use a multimeter to test for continuity.
- Use a soldering iron to solder connections.
- Read resistor codes.

Evidence of Learning

Assessment

Common Assessment 3.1

Competencies for 21st Century Learners

X	Collaborative Team Member		Effective Communicator
X	Globally Aware, Active, & Responsible Student/Citizen		Information Literate Researcher
X	Innovative & Practical Problem Solver	X	Self-Directed Learner

Resources

- http://www.instructables.com/id/How-to-solder/
- 123D Circuits (Free Circuit Modeling Program) - http://www.123dapp.com/circuits
- Adafruit Circuit Playground ($2.99 application for Apple mobile/tablet devices)
- http://www.electronicsteacher.com
- http://www.electronics-tutorials.ws
- Decimal to Binary - http://m.wikihow.com/Convert-from-Decimal-to-Binary
- Make: Electronics (Charles Platt)

Materials

- Soldering irons
- Solder
- Spools of wire
- “Helping hands”
- Multimeter
- LEDs
- AA batteries
- 9 volt batteries
- Assorted switches
- Battery holders
- Breadboards
- Resistors
- Jumper wire
- 555 timers
- Hobby motors
- Unit 1 materials
- Autodesk 123d Circuits

Unit 4: Energy and Power

Content Area: Engineering

Course & Grade Level: Principles of Engineering, 9-12

Summary and Rationale

A complete grasp of electrical systems includes an understanding of the large scale generation and distribution of energy. This is what provides us with many of the utilities we take for granted every day. This unit will lead into a discussion of different energy sources, how they work, how they are obtained, and their impact on the local and global environment.

Recommended Pacing

15 days

State Standards

8.2 Technology Education, Engineering, and Design: All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world, as they relate to the individual, global society, and the environment.

Strand C - Design: The design process is a systematic approach to solving problems.

Strand D - Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.

CPI #	Cumulative Progress Indicator (CPI)
8.2.12.C.4	Explain and identify interdependent systems and their functions.
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.

NGSS Standards

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.

Instructional Focus

Unit Enduring Understandings

- Research and development, experimentation and troubleshooting and invention and innovation plays an important role in problem solving.
- All electrical systems must be comprised of a power source, a load and a path for electricity to flow.
- Advancements in the field of electrical engineering have led to a number of great inventions throughout history which have helped to shape the way we live our lives.
- Power/energy is derived from nonrenewable sources such as fossil fuels and renewable "green" sources such as solar, water and wind.
- Each method of power generation has its social, economic, and environmental advantages and disadvantages.
- The future of renewable energy is a slow progression with social, political and economic trade offs.
- Technology constantly improves and becomes more cost-effective.
- Renewable energy technologies have an enormous potential and that potential can be realized at a reasonable cost.

Unit Essential Questions

- What are some methods used to produce electrical power?
- What forms of fossil fuels are available and how can they be used generate electricity?
- How does energy production differ in different countries throughout the world?
- What are the advantages and disadvantages of using fossil fuels and "green" energy sources?
- How do different forms of renewable energy compare to each other and what are the advantages and disadvantages of different renewable sources?
- How might an organization go about designing a renewable energy plan?

Objectives

Students will know:

Students will be able to:

- Identify and implement proper safety in a work environment.
- Understand the importance of collaboration and effective teamwork skills.
- Utilize technological tools and equipment safely to create products and systems.
- Investigate multiple avenues for generating electricity from renewable sources
- Understand the role of technology in today's society
- Create a model that demonstrates an understanding of a renewable energy source

Evidence of Learning

Assessment

Common Assessment 3.1

Competencies for 21st Century Learners

X	Collaborative Team Member	X	Effective Communicator
X	Globally Aware, Active, & Responsible Student/Citizen	X	Information Literate Researcher
X	Innovative & Practical Problem Solver	X	Self-Directed Learner

Resources

- http://energy.gov/science-innovation/energy-sources
- http://energy.gov/eere/education/education-homepage
- http://www.kidwind.org/#!teach/g2lub
- http://parc.wustl.edu/files/parc/imce/u29_bio5925_student_engagement_in_energy.pdf
- http://www.nrel.gov/education/pdfs/educational_resources/high_school/energy_audit_hs.pdf

Materials

- Fan(s)
- Foam sheets
- Hole saw
- Unit 1 materials
- Hobby motors
- Multimeters
- Model wind turbine

Unit 5: Robotics

Content Area: Engineering

Course & Grade Level: Principles of Engineering, 9-12

Summary and Rationale

Students will utilize programing languages such as Java, C, and C++ and will use these to control, problem solve and learn using robotic systems and Artificial Intelligence.

Recommended Pacing

30 days

State Standards

8.2 Technology Education, Engineering, and Design: All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world, as they relate to the individual, global society, and the environment.

Strand D - Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.

Strand E - Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge

CPI #	Cumulative Progress Indicator (CPI)
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
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).
8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

NGSS Standards	
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.
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
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.

Instructional Focus

Unit Enduring Understandings

- Appreciate the ability of programming to create solutions to problems
- Programming languages have specific syntax which must be followed.
- Computer programs are made up of precise instructions.

Unit Essential Questions

- What is robotics?
- How can robots be used to solve problems?
- What are the components of the design process in computer programming?
- What is the relationship between a programming instruction and a resulting outcome?
- What is the cause and effect relationship between software and hardware?

Objectives

Students will know:

- Java
- C and C++
- Arduino
- Basic robotic components
- Sensors and actuators
  - Mobile Robots
  - Manipulator Robots

Students will be able to:

- Analyze and design logical solutions to programming problems
- Code, debug, and refine solutions to programming problems
- Work in groups to solve a problem
- Implement basic programming concepts of: loops, conditional logic, variables, subroutines, input, output, data types
- Understand the relationship between programming instruction and resulting outcome.
- Recognize input/output cause and effect.
- Control hardware behaviors by programming software.

Evidence of Learning

Assessment

Common Assessment 4.1

Competencies for 21st Century Learners

X	Collaborative Team Member	X	Effective Communicator
X	Globally Aware, Active, & Responsible Student/Citizen	X	Information Literate Researcher
X	Innovative & Practical Problem Solver		Self-Directed Learner

Resources

- 123D Circuits (Free Circuit Modeling Program) - http://www.123dapp.com/circuits
- Make: Getting Started with Arduino (Massimo Banzi and Michael Shiloh)
- Arduino Companion (Free application for Apple and Android mobile/tablet devices)
- Adafruit Circuit Playground ($2.99 application for Apple mobile/tablet devices)
- C Programing Tutorial - http://www.tutorialspoint.com/cprogramming/cprogramming_tutorial.pdf
- http://profesores.fi-b.unam.mx/cintia/cc.pdf
- www.arduino.cc
- learn.sparkfun.com
- http://www.electronics-tutorials.ws

Materials

- Arduino
- LEGO EV3 Education kits
- VEX robotics kits
- Unit 3 Materials

Unit 6: EOY Capstone

Content Area: Engineering

Course & Grade Level: Principles of Engineering, 9-12

Summary and Rationale

The Principles of Engineering Capstone Project is intended to help students develop more expertise in a chosen area of investigation and development. During this experience, students follow the design process to develop a solution to a technological problem, including research, brainstorming, modeling, prototyping, testing and evaluation. Of particular importance is quantitative analysis throughout the project. Students will provide an in-depth technological experience from conception to completion through the design, development, construction, and testing of a product that solves a specific problem.

Recommended Pacing

30 days

State Standards

8.2 Technology Education, Engineering, and Design: All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world, as they relate to the individual, global society, and the environment.

Strand A - The Nature of Technology: Creativity and Innovation Technology systems impact every aspect of the world in which we live.

Stand C - Design: The design process is a systematic approach to solving problems.

Strand D - Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.

Strand E - Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge

CPI #	Cumulative Progress Indicator (CPI)
8.2.12.A.1	Propose an innovation to meet future demands supported by an analysis of the potential full costs, benefits, trade-offs and risks, related to the use of the innovation.
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

8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review
8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world
NGSS Standards	
HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
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.
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
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.
Instructional Focus	
Unit Enduring Understandings	
● Technology is a process by which humans use scientific knowledge for practical purposes. ● The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving. ● Appreciate the ability of programming to create solutions to problems. ● There is not always one 'right answer' when dealing with creative problem solving. ● Failure should be viewed as an opportunity for learning. ● The Design Loop is an essential process in problem solving. ● Design plays an important role in the creation of products and prototyping.	

Unit Essential Questions

- What is the significance/importance of the project you wish to undertake?
- What kinds of technical expertise you will need and/or develop as a result of undertaking this project?
- What are the specifications/limitations of this project?
- How would you improve upon your design given the opportunity for redesign?

Objectives

Students will know:

- How to recognize a problem and turn it into an opportunity
- How to address a problem using technology and the design process
- Integrate different fields of engineering to design a prototype
- Incorporate math and science principles in relation to technology and engineering
- How to improve technological systems to meet the changing needs of society

Students will be able to:

- Research, identify, and evaluate a design challenge to solve a real-world problem.
- Use the design process to solve a problem by developing a system of hardware and/or software.
- Work collaboratively to build and program a system of hardware and/or software.
- Design and construct working products on a variety of platforms.
- Troubleshoot non-functioning products.

Evidence of Learning

Assessment

Common Assessment 5.1

Competencies for 21st Century Learners

X	Collaborative Team Member	X	Effective Communicator
X	Globally Aware, Active, & Responsible Student/Citizen	X	Information Literate Researcher
X	Innovative & Practical Problem Solver	X	Self-Directed Learner

Materials

Unit 1-5 Materials