PUBLIC SCHOOLS OF EDISON TOWNSHIP
DIVISION OF CURRICULUM AND INSTRUCTION

ELECTRICAL ENGINEERING AND DESIGN (STEM 3)

Length of Course:	Full Year
Elective/Required:	Required
School:	High Schools
Student Eligibility:	Grades 11 STEM Academy Only
Credit Value:	5 Credits
Date Approved:	September 21, 2015

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Modifications will be made to accommodate IEP mandates for classified students.

Statement of Purpose

The Electrical Engineering and Design Course within the Science and Engineering Academy is designed to create a broad-based foundation for students who desire a career pathway in a variety of engineering fields. Core concepts and principles of engineering design combined with unique laboratory settings will be the key elements of this course.

Stakeholders will use Electrical Engineering and Robotic driven designs in conjunction with Computer Aided Machining (CAM) and 3-dimensional prototyping. Components of this course will give students a hands-on engineering laboratory experience while exposing them to different concepts specific to Electrical Engineering and Robotics. The content and methods of this course will provide a foundation for future engineering pathways and prerequisites for additional Science and Engineering Academy courses.

Software

- Parametric Technology Corporation; PTC –Creo/ Pro-Engineer (student site license included)
- Choreograph via NAO Robotics

Robotics:

- Vex Robotics
- First Robotics

Career Pathways

- Exposure to a multitude of current and emerging engineering fields, including but not limited to; electrical, robotic, computer, and green engineering

Prototyping

- Makerbot, Replicator 2.0

Course Objectives

The student will be able to:

- Understand and implement sustainable designs and engineering.
- Design and implement socially conscience and responsible engineering designs.
- Read and interpret schematic diagrams and technical documents.
- Use appropriate terminology for electricity and electronics in context.
- Become knowledgeable about various principals and characteristics of electricity and electrical engineering.
- Analyze circuits and predict their output.
- Knowledgeable and skilled with different materials and devices and their applications in the electrical engineering field.
- Design and build circuits or systems to an acceptable standard capable of producing a desired output.
- Work safely and cooperatively with other students and handle materials in a safe manner.
- Demonstrate the safe use and knowledge of meters, hand and power tools used in the electrical industry.
- Read and interpret multi-meter readings.
- Test and evaluate the integrity of electrical and electronic components.
- Be knowledgeable about career opportunities in electrical and electrical engineering fields.
- Become aware of post-secondary programs in the electrical and electrical engineering fields.
- Increase self-esteem from success with equipment, materials and techniques, in the field of electrical engineering.
- Obtain knowledge about career and post-secondary decisions.

Timeline

First Quarter Units

- What is Electrical Engineering?
- Problem Solving Model
- History of Electricity and Electrical Engineering
- Principles of Electricity
- Tools and Equipment
- Magnetism and Electricity

Second Quarter Units

- What is Robotics?
- Principles of Electricity
- Electrical Engineering components
- Tools and equipment
- Digital Electricity and Logic circuits

Third Quarter Units

- Magnetism and Electricity
- Digital Electricity and logic circuits
- Robotic Componentry
- Robotic Manipulators
- Tools and equipment

Fourth Quarter Units

- Senior Design Challenge and Capstone Experience
- Robotic Manipulators
- Tools and Equipment
- Electrical Mechanics

Unit 1: What is Robotics?

Targeted State Standards:
8.2.12.A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits.
8.2.12.C.3: Evaluate the positive and negative impacts in design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
8.2.12.B.3: Analyze the full costs, benefits, trade-offs and risks related to the use of technologies in a potential career path
8.2.12.F.1 Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
9.4.12.B.(1).2 Employ appropriate representational media to communicate concepts and design.
9.4.12.B.54 Apply ethical reasoning to a variety of situations in order to make ethical decisions

Unit Objectives/Enduring Understandings: What is a robot, and how do their Benefits and limitations affect humans' capacity for technological change?

Essential Questions:
- Why are robots used?
- How have robots changed over time?
- How has public perception of robots changed over time?
- What are the limitations of using robots?
- In what ways can/will robots replace human abilities/ capabilities?
- What are the safety considerations related to working with robots?

Unit Assessment:
Preparation of a Robot profile display board that includes why it is a robot, features, human capabilities, history, public perception, influences, limitation, and etc.
Students will identify the primary purpose/function on a series of robots.
Compare/Contrast robot functions of teacher provide examples.
Student discussion about robots the 1930s, 1950s, 1970s, 1990s, and present (teacher prepared video clips of robots of each era).
Students will complete safety worksheets.
Students will identify Asimov's Three Laws of Robotics (Exit Ticket)
Describe the features that make anything a robot.

Summative Assessment:
Passing safety Test for tools equipment and materials.
The Rise of Personal Robots Activity (Rubric-Based) – Designing your own robot
Robot profile display board (Rubric-Based)
Students will analyze perceptions from pre- and post-survey about robots.
Pose to a variety of robots and discussion reasoning to be a robot or not. (player piano, pick and place arm, CD player)

Unit 1: What is Robotics? (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities. Diagnose a malfunctioning product and system using appropriate critical thinking methods.	▪ Representation in media over time. ▪ The role of humans in robotic ▪ Development and operation. ▪ Categories and uses of Robots. ▪ History and Pioneers. ▪ Socially conscious and responsible engineering	▪ -Present and discuss a significant milestone in the development of robotics over time. ▪ -Articulate the direction they perceive robotics heading in the future.	• Teacher introduces students to robotic course ○ Pass out course syllabus ○ Review class rules & expectations • Teacher presents-What is a Robot? PPT. ○ Function/Purpose ○ Classifications ○ Limitations ○ Students complete guided worksheet related to PPT presentation • Teacher discusses Asimov's/Three Laws of Robotics PPT. ○ Discussion ○ Video clip from iRobot movie • Teacher introduces the rise of personal robots activity & rubric ○ Students work individually on activity and present solutions on class.	• Explanation ○ Students will communicate their understanding of robotics and its importance. ○ Students will discuss the types of robots and the common perceptions. • Interpretation ○ Students will identify common features, characteristics and influences of various robots throughout history. • Application ○ Students will use skills learned in the class to design a history profile display board of a chosen robot in history

Unit 1: What is Robotics? (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**

Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.			• Teacher shows Robots in History video and discusses attributes and common misconceptions with students.
			  ○ Students complete chalk talk activity on provided example robots.
			  ▪ Fact or fiction
			  ▪ Success and failures
			• Teacher introduces pioneer robots in history profile display board & rubric.
			  ○ Prominent robots are listed on the board and students select on to research.
			  ○ Students work presented discussed and displayed in classroom.
			• Teacher initiates discussion on tools and design lab safety.
			  ○ Safety procedures are demonstrated and discussed.
			  ○ Students model practice safety procedures as teacher observes.
			  ○ Students pass safety quizzes on tools and machines in the design lab.
				• Perspectives
				  ○ Students will select a robot that they like best and explain what features appeal to them and why.
				• Empathy
				  ○ Students will assess the role robots play through out the world.
				• Self-knowledge
				  ○ Students will recognize the complexity of robots and they can be used to solve a vast quantity of technological issues.

Unit 1: What is Robotics? (Con't)

Resources:	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
Carnegie Mellon Robotics Curriculum: History of Robotics http://www.education.rec.ri.cmu.edu/roboticscurriculum/curriculum/introductiontorobotics.htm VEX Curriculum: http://www.education.rec.ri.cmu.edu/roboticscurriculum/vex_online/curriculum/index.htm Carnegie Mellon Robotics Curriculum: Safety Information http://www.education.rec.ri.cmu.edu/roboticscurriculum/vex_online/safety/safety.html Wikipedia: Robotics and Robots http://en.wikipedia.org/wiki/Robot http://en.wikipedia.org/wiki/Robotics *Robot Technology Fundamentals*, J.G. Kermas *Robotics: Theory and Industrial Applications,* Ross et. al. Activity sheet, template and rubric for the Robot profile display board assignment Video/Movie clips of robots throughout history PowerPoint Slides of various robots Pre and Post Survey Safety packet with worksheets Safety Test Robot Artifacts	

Unit 2: Robotic Componentry

Targeted State Standards:
8.2.12. A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits.
8.2.12. F.2: Explain how material science impacts the quality of products.
8.2.12.C.3 Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and address the negative impacts
8.2.12.F.3 Select and utilize resources that have been modified by digital tools in the creation of a technological product or system (CNC equipment, CAD software.
9.4.12.B.7 Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication.
9.4.12.B.74 Read, interpret, and use technical drawings, documents, and specifications to plan a project.
9.4.12.B.75 Use and maintain appropriate tools, machinery, equipment, and resources to accomplish project goals.

Unit Objectives/Enduring Understandings: What are the fundamental components of all robots?

Essential Questions:
- How is the form and function of a robot affected by its structural system?
- How does the purpose of a robot determine the type of power source?
- How does the purpose of a robot determine the type of actuation necessary?
- How does the purpose of a robot determine the type of locomotion necessary?
- How does the purpose of a robot determine the type of manipulators necessary?
- How does the purpose of a robot determine the type of sensors necessary?
- What processes should be incorporated to maximize the reliability of a robot??

Unit Assessment:
Students will practice building simple chassis design to familiar themselves with the TETRIX robot building platform.
Students will setup the basic platform of motors and servos along with their controllers, power source and connectors to wire a TETRIX robot to the NXT Intelligence Brick.
Students will follow a CAD software tutorial to create a 3D model representation of a TETRIX sample robot (Tools of Design in Inventor, LEGO/TETRIX).

Summative Assessment:

TETRIX sample robot in Autodesk Inventor (Rubric-Based)

Unit 2: Robotic Componentry (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities. Diagnose a malfunctioning product and system using appropriate critical thinking methods.	▪ How the various types of actuators work and what their strengths/ weaknesses are. ▪ The various types of manipulators and what their strengths and weaknesses are. ▪ The differences between and open and closed loop feedback system. ▪ The various types of sensors and what their strengths and weaknesses are. ▪ Safety rules and procedure for tools, machines, processes and materials to be used in class.	▪ Utilize appropriate tools, machines, processes, and materials in a safe and efficient manor to design, create, test and modify the structural system of a robot that meets design criteria. ▪ Design the power/ locomotion system of a robot that meets design criteria. ▪ Design manipulators to meet design criteria. ▪ Create and read a feedback loop chart. ▪ Utilize appropriate sensors to meet design criteria. ▪ Utilize engineering software to analyze the effectiveness and operation of all robotic components/ systems. ▪ Utilize technical drawing and Computer aided Design skills to design and model a solution to a technological problem.	▪ Teacher discusses similarities and differences between LEGO and TETRIX parts and construction. o Students receive TETRIX basic component building kits and building packet. ▪ Teacher demonstrates using a document camera proper procedures for fastening TETRIX components together o Students use kits to construct the basic chassis as documented in building packet. ▪ Teacher provides individual instruction and guidance as needed. ▪ Teacher demonstrates using document camera proper procedures for motors and servo mounting and wiring and power setup. ▪ Teacher provides individual instruction and guidance as needed. o Students will build sample TETRIX robot from building packet.	▪ Explanation o Students will explain the purpose of TETRIX components when constructing the structure of a robot. o Students will discuss the importance of CAD when designing a robot. ▪ Interpretation o Students will discuss how well their robot is constructed and moves based on its structure and assembly. ▪ Application o Students will construct a basic TETRIX robot chassis and program it to incorporate movement. ▪ Perspectives o Students will discuss what it is like to construct a robot from a set of CAD plans.

Unit 2: Robotic Componentry (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.			▪ Teacher instructs students on how to make their robot move. o Students write program and edit changes ▪ Teacher provides guidance. ▪ Teacher discuss importance of CAD ▪ Teacher provides overview of CAD software and file storage to students. o Students will follow a tutorial to better understand utilizing CAD software to create a 3D model representation of the sample robot (Tools of Design, LEGO/TEXTRIX). o Students print and display CAD drawings and programmed robot.	o Students will discuss what impact "time" had on their ability to construct a quality robot. ▪ Empathy o Students will recognize issues and frustrations associated with building a robot from a set of CAD plans and what can be done to make things more clear. ▪ Self-knowledge o Students will realize that using building a quality robot in an efficient manner requires considerable talent and organization.

Unit 2: Robotic Componentry (Con't)

Resources:	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
Computers (one per student) Color & ink jet & large format printer Carnegie Mellon Robotics Academy ROBOTC Curriculum (LEGO MINDSTORMS and TETRIX) Tools for Design with LEGO MINDSTORMS NXT & TETRIX (one per student) Tools for Design Sample Robot/ rubric TETRIX Building Kits (one per student) TETRIX Resources Kits (one per student) LEGO & HiTechnic Sensors: • Ultra sonic, sound, light, color, touch, compass, gyro, HD color, magnetic, angle	

Unit 3: Robotic Manipulators

Targeted State Standards:
8.2.12.F.1: Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
8.2.12. A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits
9.4.12.B.74 Read, interpret, and use technical drawings, documents, and specifications to plan a project.
9.4.12.B.75 Use and maintain appropriate tools, machinery, equipment, and resources to accomplish project goals.
8.2.12.G.1 Analyze the interactions among various technologies and collaborate to create a product or system demonstrating their interactivity
9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.B.2 Create and respond to a feedback loop when problem solving.

Unit Objectives/Enduring Understandings: How does the purpose of a robot determine the type of manipulators that will be most effective?

Essential Questions:
- Explain the reasons why Gantry, Cylindrical, Polar, and Jointed-arm manipulators are used and their limitations.
- Describe the benefits and limitations of using the various types of effectors (mechanical, vacuum, and general purpose).
- Develop a manipulator/effector system that addresses the needs of a design scenario.
- Use CAD software to model a manipulator/effector system of a robot.

Unit Assessment: (What is the evidence (authentic) that students have achieved the targeted standards/unit objectives?)
Students will submit initial design work to instructor for FIRST Robot Challenge prior to obtaining materials.
Students will continue to test and analyze for the best possible solution and necessary modifications to complete the TETRIX /VexRobot Challenge

Summative Assessment:

TETRIX Robot Challenge (Design Rubric)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.	-The purpose of manipulators and effectors. Why industrial robots require exact tolerances in their design.	-Explain the reasons why Gantry, Cylindrical, Polar, and Jointed-arm manipulators are used and their limitations.	▪ Teacher presents and discusses the classifications of manipulator PPT.	▪ Explanation o Students will communicate their understanding of robotics and its importance.

Unit 3: Robotic Manipulators (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods. Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	-The benefits and limitation of various manipulator and effector designs. Why humanoid hand simulation is such a challenge to design. What the term "degrees of freedom" means.	-Describe the benefits and limitations of using the various types of effectors (mechanical, vacuum, and general purpose). -Develop a manipulator/effector system that addresses the needs of a design scenario. -Use CAD software to model a manipulator/effector system of a robot.	○ Students complete a worksheet on various robots and what types of work they do. ○ Students describe or draw how the manipulators on the robots work. ▪ Teacher discusses variations of manipulators, degrees of freedom and control systems ▪ Teacher presents the design scenario for the role of IED detecting robots. ▪ Teacher introduces design brief for the FIRST FRC Robot Challenge ○ Students work collaboratively in small groups to document, design, build, test and evaluate solution to design problem. ▪ Teacher guides group through documentation and time management details. Students present final designs to teacher and peers	○ Students will discuss the types of robots and the common perceptions. ▪ Interpretation ○ Students will identify common features, characteristic and influences of various robots throughout history. ▪ Application ○ Students will use skills learned in class to design a History Profile display board of a chosen robot in history. ▪ Perspectives ○ Students will select robot that they like best and explain what features appeal to them and why.

Unit 3: Robotic Manipulators (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
				▪ Empathy o Students will assess the role robots play throughout the world ▪ Self-knowledge o Students will recognize the complexity of robots and they can be used to solve a vast quantity of technological issues.
Resources: Computers (one per student) ROBOTC Software (one seat license per student) Robotic Arms/ Manipulators PPT. Manipulators Guide sheet Sample robot manipulator arms/ basic movement activity LEGO & HiTechnic Sensors: • Ultra sonic, sound, light, color, touch, compass, gyro, HD color, magnetic, angle FIRST FRC Robot Challenge VEX Robotics			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 4: What is Electrical Engineering?

Targeted State Standards:
8.2.12. A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits.
8.2.12. F.2: Explain how material science impacts the quality of products.
8.2.12.C.3 Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and address the negative impacts
8.2.12.F.3 Select and utilize resources that have been modified by digital tools in the creation of a technological product or system (CNC equipment, CAD software.
9.4.12.B.7 Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication.
9.4.12.B.74 Read, interpret, and use technical drawings, documents, and specifications to plan a project.
9.4.12.B.75 Use and maintain appropriate tools, machinery, equipment, and resources to accomplish project goals.

Unit Objectives/Enduring Understandings(Students will understand that)

Essential Questions:

- What is Electrical Engineering?
- Explain the secondary and college level education requirements for employment in the Electrical Engineering profession?
- How do electrons move on an atomic level?
- What are the characteristics of voltage, power, current and resistance?
- What is Soldering?
- What is the role Schematics play in electrical engineering design?
- What is the role of IEEE?
- What is OHMS Law?
- What are series, parallel and series in parallel circuits?

Unit Assessment: (What is the evidence (authentic) that students have achieved the targeted standards/unit objectives?)
Formative quiz
Solder Project checkpoints
Ohms Law worksheets/quiz
Parallel and series circuit schematics

Summative Assessment:

Summative Test
Summative blog Posting /Projects
Solder Project
Ohms Law Test
Parallel and series circuit schematics & test

Unit 4: What is Electrical Engineering? (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods	-Demonstrate ability to communicate electrical circuits. -Demonstrate ability to create appropriate electrical circuits -Describe the role and scope of the Institute of Electrical and electronic Engineers. -Identify and describe the education requirements for Electrical Engineering profession. -Clearly identify and practice electrical safety rules.	-Demonstrate Ability to Solder -Calculate Ohms Law. -Identify various electrical components and their use, including; resistors, LEDS, Capacitors, motors, switches, potentiometers and breadboards.	-Paperless class format -PowerPoint -Video- Electrical Safety -Chapter 8 of Text -Laboratory safety -Laboratory learning experiences -Web Portfolio -Blog Postings -Student reflections -Class discussions	-Web Portfolio -Unit Project -Circuitry Design Challenge -Unit Reflection via Blog -Unit Test

Unit 4: What is Electrical Engineering? (Con't)

	Core Content		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Create a technological product, system, or environment using given design specifications and constraints by applying.				
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Carnegie Mellon Robotics Curriculum: History of Robotics http://www.education.rec.ri.cmu.edu/roboticscurriculum/curriculum/introductiontorobotics.htm VEX Curriculum: http://www.education.rec.ri.cmu.edu/roboticscurriculum/vex_online/curriculum/index.htm Carnegie Mellon Robotics Curriculum: Safety Information http://www.education.rec.ri.cmu.edu/roboticscurriculum/vex_online/safety/safety.html Wikipedia: Robotics and Robots http://en.wikipedia.org/wiki/Robot http://en.wikipedia.org/wiki/Robotics *Robot Technology Fundamentals*, J.G. Kermas *Robotics: Theory and Industrial Applications,* Ross et. al. Activity sheet, template and rubric for the Robot profile display board assignment Video/Movie clips of robots throughout history PowerPoint Slides of various robots Pre and Post Survey Safety packet with worksheets Safety Test Robot Artifacts			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 5: Safety

Targeted State Standards:
8.2.12. A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits.
8.2.12. F.2: Explain how material science impacts the quality of products.
8.2.12.C.3 Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and address the negative impacts
8.2.12.F.3 Select and utilize resources that have been modified by digital tools in the creation of a technological product or system (CNC equipment, CAD software.
9.4.12.B.7 Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication.
9.4.12.B.74 Read, interpret, and use technical drawings, documents, and specifications to plan a project.
9.4.12.B.75 Use and maintain appropriate tools, machinery, equipment, and resources to accomplish project goals.

Unit Objectives/Enduring Understandings Students will be able to comply with mandated with state and local mandated safety requirements. The students will be able to use tools and equipment safely by implementing safe classroom procedures.

Essential Questions:
- What the safety rules of an engineering lab?
- What are the safety parameters of various tools?
- What are the safety parameters of Various machines
- How can one proactively promote safety in a laboratory setting?
- Identify the safety hazards among projects and class setting.

Unit Assessment: Students will demonstrate a working knowledge of the safe use and care of tools and equipment by implementing safe classroom procedures.

Safety discussion with question and answer
Safety identification throughout room
Summative Assessment:

Safety identification throughout room
Machine specific safety test and visuals
Tool Specific safety test and visuals.

Unit 5: Safety (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Select and safely use appropriate tools and materials in analyzing, designing, modeling or making a technological product, system or environment.	**-**Proper use of tools and equipment in order to maintain a safe classroom environment.	-Properly use equipment and tools to maintain a safe classroom environment.	• Creating a safety checklist • Helping to develop safety policies based on classroom events and observations • Completing tasks while maintaining a safe environment	-Safety test -Classroom observations
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Safety posters, text books, equipment manuals, instructor demonstrations			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 6: Problem Solving Model

Targeted State Standards:
8.2 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, society and the environment.
5.1 All students will develop problem-solving, decision-making and inquiry skills, reflected by formulating usable questions and hypotheses, planning experiments, conducting systematic observations, interpreting and analyzing data, drawing conclusions, and communicating results.

Unit Objectives/Enduring Understandings Students will be able to recognize that all systems have inputs, process, outputs and feedbacks. Students will be able to design and implement systems related to construction, transportation, energy, electronics and power.

Essential Questions:

- What is the design loop?
- What is the engineering design model?
- What the phases of problems solving?
- What is the KISS method of problem solving?
- What makes a good problem solver?

Unit Assessment:

Problem solving and Engineering design loop quiz
Discussion and presentation of solutions

Summative Assessment:

Ongoing dialogue within class design loop
Class Critique and reflection

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.	-Scientific Method -Problem Solving Model -6 Resources of Technology -The Systems Model	-Use the problem solving model to logically work though a teacher designed problem. -Use the problem solving model to solve real world problems	-Evaluation of the operation and quality of the project -Evaluation of each step of the problem solving process. -Evaluation of the oral presentation	-Evaluation of the project -Evaluation of the oral presentation -Evaluation on group work -Portfolio assessment

Unit 6: Problem Solving Model (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities. Diagnose a malfunctioning product and system using appropriate critical thinking methods. Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	**-**Use the problem-solving model to solve any real-world problem. -That there is not solution for a problem, but a variety of them.	-Use resources and the Internet software to assist in the design and implementation of the prototype.	-Evaluation of efficient use of lab time and materials	-Testing prototypes

Unit 6: Problem Solving Model (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Diagnose a malfunctioning product and system using appropriate critical thinking methods. Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer.				
Resources: Essential Materials, Supplementary Materials, Links to Best Practices, Various tools, machines, materials and computers			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 7: History of Electricity and Electronics

Targeted State Standards:
8.2.12.A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits.
8.2.12.C.3: Evaluate the positive and negative impacts in design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
8.2.12.B.3: Analyze the full costs, benefits, trade-offs and risks related to the use of technologies in a potential career path
8.2.12.F.1 Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
9.4.12.B.(1).2 Employ appropriate representational media to communicate concepts and design.
9.4.12.B.54 Apply ethical reasoning to a variety of situations in order to make ethical decisions

Unit Objectives/Enduring Understandings Students will be able to trace the development of electrical technology and its effects on the development of man in the past present and future.

Essential Questions:

- What are the key terms or electronics?
- What are the key terms of technology?
- Who are paramount technologists/engineers in our history?
- Who is Michael faraday?
- Who is Simon Ohm**?**

Unit Assessment:

In class conversation with question and answer
In class discussion on the developments and impacts electricity has made on our society and technological world

Summative Assessment:

History of Electronics blog posting/test

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Examine the lives and contributions of important scientists who affected major breakthroughs in our understanding of the natural and designed world.	• Definition of Technology • How technology affects us: past, present and future	-Will be able to list several important developments past and present -Will be able to identify key figures and their contributions to electronics technology.	-Students will research key developments in modern electronics -Students will orally present their projects to their peers	-Evaluation of the oral presentation

Unit 7: History of Electricity and Electronics (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Discuss significant technological achievements in which science has played an important part as well as technological advances that have contributed directly to the advancement of scientific knowledge.	• Learn the key terms used in electrical engineering and design • Historical figures in the history of electronic technology			
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Resource Materials, Internet, Text, and Multimedia Presentations			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 8: Principles of Electricity

Targeted State Standards:
8.2 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, society and the environment.
5.7 All students will gain an understanding of natural laws as they apply to motion, forces, and energy transformations.
5.2 All students will develop an understanding of how people of various cultures have contributed to the advancement of science and technology, and how major discoveries and events have advanced science and technology
5.3 All students will integrate mathematics as a tool for problem-solving in science, and as a means of expressing and/or modeling scientific theories.

Unit Objectives/Enduring Understandings (Students will be able to identify the Basic Units of Electricity, including Ohms, Alternating Current, Direct Current, Series and Parallel Circuits and explain their use and relationship to one another.)

Essential Questions:
What is alternation current?
What is direct current?
How fast does electricity travel?
What is electricity?
What a schematic?
What direction does current flow?
What is ohms law?
What is a parallel circuit?
What is a series circuit?

Unit Assessment: Students will be assessed through written and practical exams.
Various hands on electrical wiring project checkpoints
Ability to use power supply

Summative Assessment:

Ability to draw schematics in groups
Build an electrical circuit from a schematic translation
Test on components and schematics
Various hands on electrical wiring projects

Unit 8: Principles of Electricity (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Explain how the electricity moves through materials and identify the factors that affect that movement. Explain that while energy can be transformed from one form to another, the total energy of a closed system is constant Recognize that electrically charged bodies can attract or repel each other with a force that depends upon the size and nature of the charges and the distance between them and know that electric forces play an important role in explaining the structure and properties of matter.	• Definition of Alternating Current • Definition of Parallel Circuits • Definition of Direct Current • Definition of Series Circuits • Definition of Simple Circuits • Socially conscious and responsible engineering	-Successfully Wire a complete series circuit. -Successfully draw schematics of a Series Circuit. -Successfully Wire a Parallel Circuit. -Successfully Draw and identify schematic of a parallel circuit	-In the process of building electronic circuits, students will apply series and parallel circuitry to real world problem solving applications. -Students will demonstrate the use series and parallel circuits and alternating and direct current by solving predetermined problems in a classroom setting. -Students will be able to build, analyze and troubleshoot both Series and Parallel circuits.	-Laboratory experiences -Written Tests -In class projects -Class project portfolios -Class Project Presentations
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Glue, Magazines, Construction Paper, Internet Computer, Tape, Scissors, Text Book			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 9: Electronic Components

Targeted State Standards:
8.2.12.A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits.
8.2.12.C.3: Evaluate the positive and negative impacts in design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
8.2.12.B.3: Analyze the full costs, benefits, trade-offs and risks related to the use of technologies in a potential career path
8.2.12.F.1 Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
9.4.12.B.(1).2 Employ appropriate representational media to communicate concepts and design.
9.4.12.B.54 Apply ethical reasoning to a variety of situations in order to make ethical decisions

Unit Objectives/Enduring Understandings Students will be able to comply with mandated with state and local mandated safety requirements.

Essential Questions:
What is the purpose of; resistors, capacitors, transistors, switches, actuators, led, power supplies?
How can you differentiate among each of the above components?
What are the schematic symbols for each component?

Unit Assessment:
Daily component drawings with schematics
Quiz on component identification

Summative Assessment:
Test on components.
Blog post on component
Various Hands on electrical component projects

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.	-Students will know proper electronic component uses, safety features and how to appropriately apply each component. -Students will know different methods of attaching components in a circuit.	-Students will be able to properly select, install, evaluate and troubleshoot various electronic components in different circuits. -Students will know different methods of attaching components in a circuit.	• Identify, define and apply six electronic components required to complete assignments • Completing tasks while maintaining a safe environment	-Safety Test -Classroom Observations -Student - teacher interaction and discussion

Unit 9: Electronic Components (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer.	- Socially conscious and responsible engineering	- Students will know how to solder electronic components on breadboards and Printed Circuit Boards.	• Demonstrations • Laboratory experiments	
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Safety posters, text books, equipment manuals			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 10: Tools and Equipment

Targeted State Standards:
8.2 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, society and the environment.
9.1 All students will develop employability skills, and foundational knowledge necessary for success in the workplace
Unit Objectives/Enduring Understandings Students will be able to recognize that all systems have inputs, process, outputs and feedbacks. Students will be able to design and implement systems related to construction, transportation, energy, electronics and power.

Essential Questions:

- What are common tools found in engineering / technology lab?
- What is an oscilloscope?
- What is a multicenter?
- What is a power supply?
- How do you utilize a pilot hole?
- What are key safety rules and understandings?
- How can one promote safety?
- What is solder/ solder iron?

Unit Assessment:
Students will demonstrate a working knowledge of how various systems work together to assist in the understanding of everyday needs.
Daily laboratory safety and cleanup
Visual interaction and maintenance of equipment and tools

Summative Assessment:
End of year lab prep and maintenance
Safety tests

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Refer to Standard 8.2,9.1 5.4 (C)(1)	-How to use various hand tools and machines. -How to use various fasteners and adhesives as well as, and calculate the amounts needed.	-Use specific tools to make prototypes in a safe and efficient way.	-Students will research a thematic unit and use tool and machine use knowledge to develop a prototype that can solve a specific problem .	-Evaluation of the project -Evaluation of the oral presentation

Unit 10: Tools and Equipment (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
	-Proper and safe use of various hand and power tools in the Electronics Shop -Understand the use of systems in construction, transportation, energy, electronics, and power. -Socially conscious and responsible engineering.	-Use the Internet and computer software to assist in the design and implementation of the prototype. -Use tools, machines and materials to build prototypes.	-Students will orally present their projects to their Peers. -Students will work on projects in a cooperative working environment. -Students will develop working prototypes in construction, energy, power, electronics and transportation.	-Evaluation on group work -Portfolio Assessment -Testing Prototypes
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Various tools, machines, materials and computers			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 11: Electro Mechanics

Targeted State Standards:
5.4/8.2 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, society and the environment.
5.7 All students will gain an understanding of natural laws as they apply to motion, forces, and energy transformations.
8.2.12.G.1 Analyze the interactions among various technologies and collaborate to create a product or system demonstrating their interactivity

Unit Objectives/Enduring Understandings Students will be able to apply principles of electricity to manipulate objects to perform various tasks. Demonstrate how electricity can be used to manipulate objects. Be able to analyze a situations, design and appropriate device, and implement it as a solution.

Essential Questions:

- How are torque, speed, and power of a motor related?
- How do gear ratios affect speed and torque
- How does the purpose of a robot determine the type of locomotion necessary?
- Why must the purpose of the robot be factored into the design of the locomotion system
- How do the size, alignment, and number of wheels or tracks affect the performance of a robot?

Unit Assessment:
Students will complete a worksheet on how to calculate gear ratios.
Students will complete and online based learning worksheet on mechanical advantage
In a class discussion, students will identify the forces act on robots.
Students will apply gear calculations when developing the powertrain for their robot design. (Operation School Delivery)
Students will submit initial design work to instructor for VEX/ TETRIX Robot Challenge (Operation School Delivery) prior to obtaining materials.
Students will continue to test and analyze for the best possible solution and necessary modifications to complete the TETRIX Robot Challenge (Operation School Delivery)

Summative Assessment:
Robotic design challenge

Unit 11: Electro Mechanics (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution. Explain how the various forms of energy (heat, electricity, sound, light) move through materials and identify the factors that affect that movement. Explain that while energy can be transformed from one form to another, the total energy of a closed system is constant. Recognize that whenever mechanical energy is transformed, some heat is dissipated and is therefore unavailable for use.	-Principles of Levers -Principles of Gear Ratios -Natural forces such as shear, tension and torque, and how to overcome them and use them to their advantage. -Socially conscious and responsible engineering.	-Use Scientific and Electronic principles as basis for electro-mechanical designs. -Use mathematics to calculate requirements for their designs. -Use Tool skills previously learned to create solutions.	-Students will be involved in a variety of Electromechanical design challenges involving robotics, remote and radio control, and other Technology Learning Activities. -Students will demonstrate their knowledge of electro mechanics by solving predetermined problems in a classroom setting.	- Laboratory experiences -Written Tests -In class projects -Class project portfolios -Class Project Presentations

Unit 11: Electro Mechanics (Con't)

	Core Content		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Explain how electromagnetic, gravitational, and nuclear forces can be used to produce energy by causing chemical, physical, or nuclear changes and relate the amount of energy produced to the nature and relative strength of the force.				
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Carnegie Mellon Robotics Curriculum: History of Robotics http://www.education.rec.ri.cmu.edu/roboticscurriculum/curriculum/introductiontorobotics.htm VEX Curriculum: http://www.education.rec.ri.cmu.edu/roboticscurriculum/vex_online/curriculum/index.htm Carnegie Mellon Robotics Curriculum: Safety Information http://www.education.rec.ri.cmu.edu/roboticscurriculum/vex_online/safety/safety.html Wikipedia: Robotics and Robots http://en.wikipedia.org/wiki/Robot http://en.wikipedia.org/wiki/Robotics *Robot Technology Fundamentals*, J.G. Kermas *Robotics: Theory and Industrial Applications,* Ross et. al. Activity sheet, template and rubric for the Robot profile display board assignment Video/Movie clips of robots throughout history PowerPoint Slides of various robots Pre and Post Survey Safety packet with worksheets Safety Test Robot Artifacts			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 12: Magnetism and Electricity

Targeted State Standards:
5.4/8.2 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, society and the environment.
5.7 All students will gain an understanding of natural laws as they apply to motion, forces, and energy transformations.

Unit Objectives/Enduring Understandings Students will be able to identify the Basic Units of Electricity, including Ohms, Alternating Current, Direct Current, Series and Parallel Circuits and explain their use and how magnetism and polarity effect outcomes. Demonstrate how magnetism and electricity are interwoven. Demonstrate energy transformation through magnetism.

Essential Questions:
Students will be able to identify the basic units of electricity, including; ohms law, alternating current, direct current, polarity, magnetism, series and parallel circuits and explain their use and relationship with one another.

Unit Assessment:
Unit based quizzes
Blog postings
Ability to wire circuits via schematic translation
Use of Multi-Meter

Summative Assessment:
Unit project

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.	-Students will know: The Law of Magnetism The operation of an electromagnet. The Spin Theory -The Difference between solenoids and electromagnets	-Define Magnetism -Explain and demonstrate the Laws of Magnetism -Determine the polarity of the electromagnet.	-In the process of building electronic projects, students will apply electromagnetism to real world situations. -Students will demonstrate their knowledge of electromagnetism by solving predetermined problems in a classroom setting.	-Laboratory experiences -Written Tests -In class projects Class project portfolios

Unit 12: Magnetism and Electricity (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Demonstrate that moving electric charges can produce magnetic forces and moving magnets can produce electric forces. Explain how the various forms of energy (heat, electricity, sound, light) move through materials and identify the factors that affect that movement. Explain how electromagnetic, gravitational, and nuclear forces can be used to produce energy by causing chemical, physical, or nuclear changes and relate the amount of energy produced to the nature and relative strength of the force.	-The Difference between solenoids and electromagnets. -The difference between magnetic and electrostatic fields. -How to determine the polarity of an electromagnet. -Socially conscious and responsible engineering.	-Wind their own electromagnet and apply it. -Incorporate electromagnetic principles in new projects.	-Students will be able to convert electrical energy into motion by creating their own electric motor	-Class Project -Presentations
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Glue, Magazines, Construction Paper, Internet Computer, Tape, Scissors, Text Book			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 13: Digital Electronics and Logic Circuits

Targeted State Standards:
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, society and the environment**.**

Unit Objectives/Enduring Understandings Students will be able to design, build and analyze Digital Circuits. Students will be able to explain the difference between Analog and Digital Circuits. Students will be able to identify symbols for the following Logic Gates: AND, OR, NOT, NAND, NOR, XOR, and XNOR. Use the basic principles of Boolean Logic, design logic circuits and build them. Students will use Truth Tables to determined outcome of various digital circuits.

Essential Questions:
What are logic gates?
What is difference among; AND, NOR, NAND, XOR AN XNOR GATES?
What is binary code?
What is analog?
What is digital?
Identify which circuit and/or gate is appropriate?

Unit Assessment:
Quiz on logic gates
Blog/ website postings

Summative Assessment:
Unit test on logic gates, circuitry identification and binary code

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.	-Definition of Digital Electronics -Definition of Analog Circuits -Principles of Boolean Logic	- Successfully construct several Digital Circuits. -Successfully predict the outcome of logic gate circuits using truth tables. -Successfully Design a digital circuit.	-In the process of building electronic circuits, students will apply Logic Gates and Boolean Logic to real world problem solving applications. -Students will demonstrate the use of logic gates and Boolean Logic to solve predetermined problems in a classroom setting.	-Laboratory experiences -Written Tests -In class projects -Class project portfolios

Unit 13: Digital Electronics and Logic Circuits (Con't)

	Core Content		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	-Socially conscious and responsible engineering.	-Successfully Draw and identify schematic symbols of logic gates.	-Students will be able to successfully identify and apply logic gate symbols in a digital circuit schematic.	-Class project presentations
Resources: Essential Materials, Supplementary Materials, Links to Best Practices, electronics Components, other materials as necessary.			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 14: Career Opportunities and Training

Targeted State Standards:
9.1 All students will develop career awareness and planning, employability skills, and foundational knowledge necessary for success in the workplace.

Unit Objectives/Enduring Understandings Students will be able to identify Career Options and recognize employability skills. Students will be able to identify six career choices in the electronics technology field. Students will be able to identify six institutions of study which directly relate to the six career choices in electronics technology. Students will be able to provide a positive and negative reflective rationale for each career in electronics technology.

Essential Questions:

- What careers opportunities are there in Electronics?
- What are emerging career opportunities in electrical engineering?
- Why is electrical engineering right for you?
- What aspects of electrical engineering interest you?
- What colleges are top choices for electrical engineering?

Unit Assessment:
Question and answer participation with guest speaker

Summative Assessment:
Blog posting on career specific choices in electrical engineering
Blog posting on Guest Speaker

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Refer to Standard 9-1 (a) 9-2(b)	-Define job training Apprentice -Define Journeyman -Explain application process. -Relevant and important questions to ask when identifying career opportunity.	-Write a 1 page essay for an electronics technology instruction application process. -Identify and determine an electronics technology field of interest.	-Students will be required to identify one electronics technology field of interest. They will be required to research one institution or career in which their electronics technology field is of interest. Write a one page application essay and present it to the class.	- Reflective application essay -Class presentation

Unit 14: Career Opportunities and Training (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
	-Socially conscious and responsible engineering.			
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Glue, Magazines, Construction Paper, Internet Computer, Tape, Scissors, Text Book			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 15: Voltage Current and Resistance

Targeted State Standards:
4.1 All students will develop number sense and will perform standard numerical operations and estimations on all types of numbers in a variety of ways.
4.5 All students will use mathematical processes of problem solving, communication, connections, reasoning, representations, and technology to solve problems and communicate mathematical ideas.
5.2 All students will develop an understanding of how people of various cultures have contributed to the advancement of science and technology, and how major discoveries and events have advanced science and technology.
5.4 All students will understand the interrelationships between science and technology and develop a conceptual understanding of the nature and process of technology.
5.7 All students will gain an understanding of natural laws as they apply to motion, forces, and energy transformations.
5.3 All students will integrate mathematics as a tool for problem-solving in science, and as a means of expressing and/or modeling scientific theories.

Unit Objectives/Enduring Understandings Students will be able to identify the Basic Units of Electricity, including Ohms, Volts, watts, Amperes and explain their use and relationship to one another. Students will be able to Define Voltage, Current, Resistance and Power and their corresponding units. Define and use Ohm's Law to determine unknowns. Select appropriate equipment to measure Volts, Ohms and Amperes and demonstrate its proper use.

Essential Questions:
What is a basic unit of electricity?
What is a volt?
What is an amp?
What is an OHM?
What is a Farad?
What is ohms law?
How amps, ohms, watts and volts tied together
What is a watt?
How can we calculate ohms law?
What is difference in ohms law among parallel and series circuits?

Unit Assessment:
Quiz
Worksheet
Blog posting
Interactive classroom schematic work

Summative Assessment:
Unit test and application of circuit via schematic translation

Unit 15: Voltage Current and Resistance (Con't)

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Refer to Standard 4-1,4-5, 5-2 and 5-4,5-7	• Definition of Voltage • Definition of Resistance • Definition of Current. • Definition of Power Socially conscious and responsible engineering	-Correctly use a Voltmeter to measure Voltage. -Correctly use an Ammeter to measure Current -Correctly use an Ohmmeter to measure Resistance. -Correctly apply Ohm's Law to determine Current, Voltage, Resistance, or Power.	-In the process of building electronic circuits, students will measure Voltage, Resistance, and Current and use Ohm's Law to determine Power. -Students will demonstrate the use of Ohm's Law by solving predetermined problems in a classroom setting.	-Laboratory experiences -Written Tests
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Glue, Magazines, Construction Paper, Internet Computer, Tape, Scissors, Text Book Guest Speaker – Chris Anderson, TCNJ			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 16: Senior Design Challenge and Capstone Experience

Targeted State Standards:
8.2.12.A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits.
8.2.12.C.3: Evaluate the positive and negative impacts in design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
8.2.12.B.3: Analyze the full costs, benefits, trade-offs and risks related to the use of technologies in a potential career path
8.2.12.F.1 Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
9.4.12.B.(1).2 Employ appropriate representational media to communicate concepts and design.
9.4.12.B.54 Apply ethical reasoning to a variety of situations in order to make ethical decisions.

Unit Objectives/Enduring Understandings Engineering sustainability and progression.
Engineering often has unforeseen outcomes.

Essential Questions:

- What are real world engineering problems
- What are the positive and negative impacts of this problem
- Who is affected?
- What aspect of STEM/Engineering interests you?
- What possible problems may arise from solutions?
- Is this problem/solution sustainable?
- Is this problem/solution socially conscious and responsible

Unit Assessment:
Blog/website posting
Various checkpoints throughout the year

Summative Assessment:
Senior design presentation and proposal

	Core Content		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design	-Engineering Design Model -Computer aided Design -Engineering Graphics	-Conduct interviews via phone and email. -Identify a real world engineering problem.	-Identify a real world engineering problem of choice. -Research and investigate solutions, prototypes.	-On going -Paperless class format -Research portfolio

Unit 16: Senior Design Challenge and Capstone Experience (Con't)

	Core Content		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
specification limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities. Diagnose a malfunctioning product and system using appropriate critical thinking methods. Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	-Psychology of color -Electrical Engineering -Socially conscious and responsible engineering		-Present project design and portfolio rationale to panel for approval -Paperless class format	-PowerPoint portfolio

Unit 16: Senior Design Challenge and Capstone Experience (Con't)

Resources: Essential Materials, Supplementary Materials, Links to Best Practices Internet, instructor, internet, interviews, prior learnings and prerequisites	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings