FREEHOLD REGIONAL HIGH SCHOOL DISTRICT

OFFICE OF CURRICULUM AND INSTRUCTION

TECHNOLOGY EDUCATION DEPARTMENT

ELECTRONICS 1

Grade Level: 9-12

Credits: 5

BOARD OF EDUCATION ADOPTION DATE:

SUPPORTING RESOURCES AVAILABLE IN DISTRICT RESOURCE SHARING
APPENDIX A: ACCOMMODATIONS AND MODIFICATIONS
APPENDIX B: ASSESSMENT EVIDENCE
APPENDIX C: INTERDISCIPLINARY CONNECTIONS

Electronics I - Introduction

Introduction

Course Philosophy

Technology is growing at an exponential rate due to the numerous advances in electronics. Our present society is dependent upon the application of electronics and it has become an essential component of our nations' economic growth. A technologically literate citizen will draw upon their knowledge and skills in electronics concepts to solve real world problems. Electronic applications connect math, science and language arts skills in the real world. This course provides an overview of electronics as a continual and expanding field with relation to its importance and impact on today's society.

This course of study will provide the student opportunity to explore fundamental electronic theory, principles, and applications. Differentiated instruction within the course will include such activities as experiments, problem solving activities, individual and cooperative based student projects, and computer aided instruction. Students will relate the applications of electronics technology to the planning and completion of personal, social and career goals. Students will also demonstrate proper safety procedures as they develop skills in using technological equipment, materials and processes.

This course will help the student assess his/her interests and aptitude in electronics. Career and job opportunities will be explored to assist students in deciding their career paths.

Course Description

Electronics I is designed to be a full year introductory course for students who wish to further understand how their world is shaped by electricity and the electronic devices that surround them. The course blends electronic concepts and theory with practical hands on activities. Students will learn about safe practices concerning electronics, basic circuits and components, reading and interpretation of schematic diagrams, testing of electronic circuits and devices, construction of analog and digital electronic circuits, robotic applications as well as possible career directions.

Course Map and Proficiencies / Pacing

Course Map

Relevant Standards	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic	**Formative**	**Summative**
8.2.F.1 9.1.F.2 9.1.F.3 9.1.F.4 9.1.F.5	The proper implementation of personal protective equipment, the understanding of machine/tool safety and instruction regarding correct shop procedure is crucial in an electronics laboratory.	What are the safety concerns to be considered when working in a lab setting in school or on the job? What personal protective equipment (PPE) can be used in a laboratory environment?	Do now Pre-test Student survey Oral questions/ discussion Anticipatory set questions	Journals Quizzes Written assignments Oral presentations Observations Participatory rubrics Research assignments	Portfolios Project-based learning rubric assessment Self and peer assessment Performance assessment Open notebook tests Midterm and final examinations
4.5.C.4 4.5.E.2 5.6.A.3 5.6.A.4 5.7.A.4 8.2.F.1	We would not be able to use electricity without having learned about atomic structure and change.	How did we first learn about electricity? What were some of the breakthroughs in harnessing electricity?	Do now Pre-test Student survey Oral questions/ discussion Anticipatory set questions	Journals Quizzes Written assignments Oral presentations Observations Participatory rubrics Research assignments	Portfolios Project- based learning rubric assessment Self and peer assessment Performance assessment Open notebook tests Midterm and final examinations

5.7.A.5 6.2.E.9 8.2.C.3 8.2.F.1	All electrical circuits must be comprised of a power source, a load and a path for electricity to flow.	What are some methods used to produce electrical power? 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?	Do now Pre-test Student survey Oral questions/ discussion Anticipatory Set questions	Journals Quizzes Written assignments Oral presentations Observations Participatory rubrics Research assignments	Portfolios Projects based learning – rubric assessment Self and peer assessment Performance Assessment Open notebook tests Midterm and final examinations
4.5.A.1 4.5.C.4 4.5.C.6 4.5.E.2 4.5.F.3 4.5.F.4 4.5.F.1 4.5.F.6	With the proper equation, every aspect of an electrical circuit can be calculated mathematically.	How do we measure electricity? What is electrical power?	Do now Pre-test Student survey Oral questions/ discussion Anticipatory set questions	Journals Quizzes Written assignments Oral presentations Observations Participatory rubrics Research assignments	Portfolios Projects based learning – rubric assessment Self and peer assessment Performance assessment Open notebook tests Midterm and final examinations
5.7.A.4 5.7.A.5 5.7.A.6 5.7.A.7 5.7.A.8	Electrical circuits and magnetism have an interdependent relationship which can be harnessed and later utilized to do work.	Are all electricity signals the same? Can magnets be used to create electricity?	Do now Pre-test Student survey Oral questions/ discussion Anticipatory set questions	Journals Quizzes Written assignments Oral presentations Observations Participatory rubrics Research assignments	Portfolios Projects based learning – rubric assessment Self and peer assessment Performance assessment Open notebook tests Midterm and final examinations

6.1.A.1 6.2.E.9 6.6.E.8 8.2.A.3 8.2.C.3	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.	How do electrical products operate? What are some electrical products that use timing in their operation? How are electrical components classified? What are schematic symbols and how are they used to build electrical circuits?	Do now Pre-test Student survey Oral questions/ discussion Anticipatory set questions	Journals Quizzes Written assignments Oral presentations Observations Participatory rubrics Research assignments	Portfolios Projects based learning – rubric assessment Self and peer assessment Performance assessment Open notebook tests Midterm and final examinations
8.2.B.3 8.2.B.5 8.2.C.3 8.2.F.1	Electrical signals can be manipulated and changed to perform a number of useful tasks in our daily lives.	What are some different types of circuits which change electrical signals? How do electrical circuits gather data from the environment they are placed in?	Do now Pre-test Student survey Oral questions/ discussion Anticipatory set questions	Journals Quizzes Written assignments Oral presentations Observations participatory rubrics Research assignments	Portfolios Projects based learning – rubric assessment Self and peer assessment Performance assessment Open notebook tests Midterm and final examinations
9.1.12 A.2 9.1.12 A.3	Career Education provides the knowledge, skill and attitude essential to meet a lifetime of career challenges in a competitive global society by recognizing and drawing upon the strengths and interest of each student.	What can a student do to maximize their prospective employment potential? What areas provide the best opportunity for prospective employment?	Do now Pre-test Student Survey Oral questions/ discussion Anticipatory set questions	Journals Quizzes Written Assignments Oral presentations Observations Participatory rubrics Research assignments	Portfolios Projects based learning – rubric assessment Self and peer assessment Performance assessment Open notebook tests Midterm and final examinations

Proficiencies and Pacing

Unit Title	Unit Understanding(s) and Goal(s)	Recommended Duration
Unit 1: Lab, Equipment and Procedural Safety	**Enduring Understandings:** The proper implementation of personal protective equipment, the understanding of machine/tool safety and instruction regarding correct shop procedure is crucial in an electronics laboratory. **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? **Unit Goals:** Students will be able to identify and implement proper safety in a work environment. Students will understand the importance of collaboration and effective teamwork skills. Students will be able to utilize technological tools and equipment safely to create products and systems.	2 weeks
Unit 2: Electrical Theory	**Enduring Understandings:** We would not be able to use electricity without having learned about atomic structure and change. **Essential Questions:** How did we first learn about electricity? What were some of the breakthroughs in harnessing electricity? **Unit Goals:** Students will be able to identify and define the parts of an atom as they apply to electrical theory. Students will be able to explain how electricity flows and how it can be directed using conductors. Students will describe the historical discoveries in the field of electronics and electricity.	4 weeks

Unit 3: Sources of Electricity	**Enduring Understandings:** 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. We would not be able to use electricity without having learned about atomic structure and change. **Essential Questions:** What were some of the breakthroughs in harnessing electricity? What are some methods used to produce electrical power? How do we direct the flow of electricity to go where we want it to go? **Unit Goals:** Students will be able to explain the various types of electrical power sources. Students will be able to explain the difference between "green energy" and "conventional energy." Students will be able to describe the steps needed to get electricity from to power source to your home. Students will be able to construct their own models of various electrical power sources including (solar, wind, hydroelectric and mechanical)	4 weeks
Unit 4: Components and Schematic Symbols	**Enduring Understandings:** 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. **Essential Questions:** How do electrical products operate? How are electrical components classified? What are schematic symbols and how are they used to build electrical circuits? **Unit Goals:** Students will be able to identify and utilize a variety of electrical components in circuits. Students will be able to properly build circuits using schematic symbols. Students will be able to classify electrical components based on their uses and operation.	4 weeks

Unit 5: Basic Circuits	**Enduring Understandings:** All electrical circuits must be comprised of a power source, a load and a path for electricity to flow. **Essential Questions:** 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? **Unit Goals:** Students will be able to construct basic electrical circuits using a solder-less breadboard. Students will be able to utilize a variety of loads in an electrical circuit. Students will be able to utilize a variety of power sources in electrical circuits. Students will be able to explain how the flow of electrical current can be manipulated by the designer of a circuit.	4 weeks
Unit 6: Electrical Laws, Notations and Theories	**Enduring Understandings:** All electrical circuits must be comprised of a power source, a load and a path for electricity to flow. With the proper equation, every aspect of an electrical circuit can be calculated mathematically. **Essential Questions:** What is the relationship between voltage, current and resistance? **Unit Goals:** Students will become familiar with electrical notations and prefixes. Students will become familiar with Ohm's Law and its applications. Students will become familiar with Kirchoff's laws and their applications.	4 weeks

Unit 7: Magnetism	**Enduring Understandings:** Electrical circuits and magnetism have an interdependent relationship which can be harnessed and later utilized to do work. **Essential Questions:** How are alternating current and direct current different? What role does magnetism have in the creation of electrical power? How is magnetism utilized to create motion? **Unit Goals:** Students will be able to describe the operation of various devices that use magnetism to accomplish work such as solenoids, motors, and relays. Students will be able to incorporate one or more of these devices into a finished prototype or prototypes. Students will be able to describe the difference between alternating and direct current. Students will be able to explain how electrical energy can be produced using magnetism.	4 weeks
Unit 8: Electrical Timing, Control and Calibration	**Enduring Understandings:** Electrical signals can be manipulated and changed to perform a number of useful tasks in our daily lives. **Essential Questions:** What are some different types of circuits which change electrical signals? **Unit Goals:** Students will become familiar with 555 timers in monostable and astable modes. Students will become familiar with using a microcontroller	4 weeks

Unit 9: Rectification, Modulation and Amplification	**Enduring Understandings:** Electrical signals can be manipulated and changed to perform a number of useful tasks in our daily lives. **Essential Questions:** What are some different types of circuits which change electrical signals? **Unit Goals:** Students will be able to describe the operation of rectifiers, modulators and amplifiers. Students will be able to explain how these important devices are used in everyday devices. Students will construct rectifiers, modulators and amplifiers using schematic diagrams.	4 weeks
Unit 10: Robotics	**Enduring Understandings:** Electrical signals can be manipulated and changed to perform a number of useful tasks in our daily lives. **Essential Questions:** What are some different types of circuits which change electrical signals? How do electrical circuits gather data from the environment they are placed in? **Unit Goals:** Identify the parts of a "robotic" system. Design and construct a small mobile robot.	4 weeks
Unit 11: Careers in Electronics	**Enduring Understandings:** Career Education provides the knowledge, skill and attitude essential to meet a lifetime of career challenges in a competitive global society by recognizing and drawing upon the strengths and interest of each student. **Essential Questions:** What are examples of the employment/career opportunities open to the field of advanced electronics? What types of training/certification are needed for a career in advanced electronics? Where can training for a career in advanced electronics be obtained? **Unit Goals:** Identify different careers related to electronics. List some of the skills required for various electronics careers. Be familiar with educational requirements regarding various career choices.	4 weeks

Electronics I - Unit 01

Lab, Equipment & Procedural Safety

Enduring Understandings:
The proper implementation of personal protective equipment, the understanding of machine/tool safety and instruction regarding correct shop procedure is crucial in an electronics laboratory.

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?

Unit Goals:
Students will be able to identify and implement proper safety in a work environment.

Students will understand the importance of collaboration and effective teamwork skills.

Students will be able to utilize technological tools and equipment safely to create products and systems.

Recommended Duration: 2 weeks

Guiding/Topical Questions	Content/Themes/Skills	Resources and Materials	Suggested Strategies	Suggested Assessments
Why should safety be the first concern while working in a technology laboratory? How do we protect ourselves around dangerous equipment, tools and chemicals?	Understand and be able to follow the required safety rules for the equipment and tools in the laboratory.	Lab safety rues (will change based on resources available): Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Optional Textbooks: *Engineering Design: An Introduction*, ISBN: 1418062413 *Design and Problem Solving in Technology*, ISBN: 0827352468 Example Online Resources: Safety rules and regulations Example Worksheets: Safety and Regulations	Overview of all classroom equipment and safety guidelines Define PPE (personal protective equipment) and list the various forms it comes in Explain the role of OSHA *(Occupation Safety and Hazard Administration)* in the development of new safety guidelines Students will complete safety worksheets individually using unit content Students will design safety posters based on one of the machines they were tested on Complete practical activities for all equipment as demonstration of proper operation	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Safety quizzes Practical assessments for all equipment Self and peer assessments TSA rubrics Midterm and final examinations

Differentiation

A hands-on approach to assignments and projects is recommended as the most effective method of learning. Teacher should always adjust learning environment based on reluctant learners or special education needs.
Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods.

A wide variety of assessments and strategies complement the individual learning experience.

Technology

Multiple forms of technology will be used throughout this unit to teach the students effectively and to engage learners who might have trouble with more traditional instructional methods.

These methods include but are not limited to: web quests, video/audio clips, flash animations and instructional web tutorials.

College and Workplace Readiness

The Electronics program is designed to give students interested in engineering or technology based occupation, the skills and knowledge necessary to work within an electronics environment. The majority of the content can easily translate to a first year college level electronics course and might even count towards college credit at select schools and trade programs.

Electronics I - Unit 02

Electrical Theory

Enduring Understandings:

We would not be able to use electricity without having learned about atomic structure and change.

Essential Questions:

How did we first learn about electricity?

What were some of the breakthroughs in harnessing electricity?

Unit Goals:

Students will be able to identify and define the parts of an atom as they apply to electrical theory.

Students will be able to explain how electricity flows and how it can be directed using conductors.

Students will be able to describe the historical discoveries in the field of electronics and electricity.

Recommended Duration: 4 weeks

Guiding/Topical Questions	Content/Themes/Skills	Resources and Materials	Suggested Strategies	Suggested Assessments
What does it mean to create electrical charge?	Define the following terms: Atom, neutron, proton, electron, cation, anion, potential difference Explain the role ions play in the flow of electricity Properly wire a basic electrical circuit and trace the path of electrical current flow through the circuit	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Online Resources	Introduction to atomic theory and explanation of the role atoms play in electricity Discussion about how electricity is transferred harnessed and created Static electricity lab activity Lemon and potato battery lab activity	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examinations

How do humans use electricity to do work?	Explain the difference between electricity and electronics Describe the benefits and drawbacks of the invention of electricity and the roles it has played in our society Identify sources of electricity as well as methods of controlling the flow of electricity to and from those sources Calculate the amount of electricity used by a typical family home in one month's time	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Online Resource	Threaded discussion about the difference between electricity and electronics Presentation on power sources and how electricity gets to and from your house through electrical conductors Lab activity on reading an electrical meter and calculated energy usage	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examinations
What scientific discoveries in history led to the discovery of Electricity?	Identify the major contributors to the invention of electricity Explain the AC/DC battle between Thomas Edison and Nikola Tesla and how each type of electricity would have impacted our society Know and be able to explain some of the scientific theories which help explain how electricity works. Properly research and present a biography on one significant individual in the field of electricity and electronics	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Online Resources	Presentation of the contributions of both Thomas Edison and Nikolas Tesla to the application of electricity and electrical products in our society Video clips from Discovery Education about the AC/DC battle Worksheets covering the scientific theories that led to the discovery of electricity Research paper on one historical figure in the field of electronics discussing their major contribution and inventions	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examinations

SCI.9-12.5.6.12 A.3	Know that an atom's electron arrangement, particularly the outermost electrons, determines how the atom can interact with other atoms.
SCI.9-12.5.6.12 A.4	Explain that atoms form bonds (ionic and covalent) with other atoms by transferring or sharing electrons.
SCI.9-12.5.7.12 A.5	Know that there are strong forces that hold the nucleus of an atom together and that significant amounts of energy can be released in nuclear reactions (fission, fusion, and nuclear decay) when these binding forces are disrupted.
MA.12.4.5 C.4	Apply mathematics in practical situations and in other disciplines.
MA.12.4.5 E.2	Select, apply, and translate among mathematical representations to solve problems.
TEC.9-12.8.2.12.F.1	Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.

Differentiation

A hands-on approach to assignments and projects is recommended as the most effective method of learning. Teacher should always adjust learning environment based on reluctant learners or special education needs.
Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods

A wide variety of assessments and strategies complement the individual learning experience.

Technology

Multiple forms of technology will be used throughout this unit to teach the students effectively and to engage learners who might have trouble with more traditional instructional methods.

These methods include but are not limited to: web quests, video/audio clips, flash animations and instructional web tutorials.

College and Workplace Readiness

The Electronics program is designed to give students interested in engineering or technology based occupation, the skills and knowledge necessary to work within an electronics environment. The majority of the content can easily translate to a first year college level electronics course and might even count towards college credit at select schools and trade programs.

Electronics I - Unit 03

Sources of Electricity

Enduring Understandings:
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.

We would not be able to use electricity without having learned about atomic structure and change.

Essential Questions:
What were some of the breakthroughs in harnessing electricity?

What are some methods used to produce electrical power?

How do we direct the flow of electricity to go where we want it to go?

Unit Goals:
Students will be able to explain the various type of electrical power sources.

Students will be able to explain the difference between "green energy" and "conventional energy."

Students will be able to describe the steps needed to get electricity from to power source to your home.

Students will be able to construct their own models of various electrical power sources including (solar, wind, hydroelectric and mechanical)

Recommended Duration: 4 weeks

Guiding/Topical Questions	Content/Themes/Skills	Resources and Materials	Suggested Strategies	Suggested Assessments
How do the various types of power plants create the electricity we use on a daily basis?	Describe the pros and cons of the various types of power plants: (Coal, Nuclear, Natural Gas, Oil, Solar, Hydroelectric, Thermal, Wind) Explain the methods which are used to harness electricity using each of those methods Define the following terms: Power Plant, substation, transformer, electric meter, kilowatt hours	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Online resources	Presentation on the various types of power plants Flow chart activity where students will draw examples of a power grid to and from the home Lab activities where students produce electricity using various methods (heat, mechanical, electromagnets, etc.) Lesson and research assignment on energy efficiency both in the home and at power plants Discussions about the dangers of certain types of power plants	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examination
What methods are used to move electricity from a power source to our homes?	Explain the terms conductors and insulators as they apply to electricity Be able to describe the infrastructure which was built to move electricity to and from out homes Explain the dangers of electrical power and what safety precautions must be taken to ensure people stay safe Define the following terms: Step-Up-Transformer, Step-down-Transformer, Electricity distribution, Power Outages, Under-grounding, Advanced Metering/Smart Grids	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Online Resources	Presentation or video clips explaining how electricity uses high tension conductors to get electricity to your home Lab activity that tests the effectiveness of different type of conductors and insulators Worksheets which cover the topics of the electric power grid and power outages Lab activity on transformers and how they are used to step-up and step-down electrical voltage coming to your home Discussion and research assignment covering the new technologies used to make getting electricity to the home more efficient (Advanced Metering and Smart Grids)	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examination

What does the term "Green Energy" mean and how does this differ from "Conventional Energy"	Define the term "Green Energy" and explain how it differs from conventional energy Be able to describe the different types of "green energy" and the efficiency levels of each Build models of at least two types of "green energy" power systems using the design process. Explain how the application of "green power technologies have helped to better the environment and have lowered energy cost for consumers"	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Online Resources	Threaded discussion about the various types of "green power" which we see in our daily lives Presentation explaining how each type of "green energy" works and their efficiency levels Various worksheets covering "green energy" Solar powered car and/or boat project Wind turbine model project Lab activities which focus on hydroelectricity and geothermal power generation Video clips and class discussion on reducing your "carbon footprint" through the use of "green energy" in our lives	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examination

SCI.9-12.5.6.12 A.3	Know that an atom's electron arrangement, particularly the outermost electrons, determines how the atom can interact with other atoms.
SCI.9-12.5.6.12 A.4	Explain that atoms form bonds (ionic and covalent) with other atoms by transferring or sharing electrons.
SCI.9-12.5.7.12 A.4	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.
MA.12.4.5 C.4	Apply mathematics in practical situations and in other disciplines.
MA.12.4.5 E.2	Select, apply, and translate among mathematical representations to solve problems.
SOC.9-12.6.1.12 A.1	Analyze how historical events shape the modern world.
SOC.9-12.6.2.12 E.9	Discuss the impact of technology, migration, the economy, politics, and urbanization on culture.
SOC.9-12.6.6.12 E.8	Delineate and evaluate the environmental impact of technological change in human history (e.g., printing press, electricity and electronics, automobiles, computer, and medical technology).
TEC.9-12.8.2.12.A	Nature of Technology: Creativity and Innovation
TEC.9-12.8.2.12.C.3	Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
TEC.9-12.8.2.12.F.1	Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.

Differentiation

A hands-on approach to assignments and projects is recommended as the most effective method of learning. Teacher should always adjust learning environment based on reluctant learners or special education needs.
Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods.

A wide variety of assessments and strategies complement the individual learning experience

Technology

Multiple forms of technology will be used throughout this unit to teach the students effectively and to engage learners who might have trouble with more traditional instructional methods.
These methods include but are not limited to: web quests, video/audio clips, flash animations and instructional web tutorials.

College and Workplace Readiness

The Electronics program is designed to give students interested in engineering or technology based occupation, the skills and knowledge necessary to work within an electronics environment. The majority of the content can easily translate to a first year college level electronics course and might even count towards college credit at select schools and trade programs.

Electronics I - Unit 04

Components and Schematic Symbols

Enduring Understandings:
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.

Essential Questions:
How do electrical products operate?
How are electrical components classified?
What are schematic symbols and how are they used to build electrical circuits?

Unit Goals:
Students will be able to identify and utilize a variety of electrical components in circuits.
Students will be able to properly build circuits using schematic symbols.
Students will be able to classify electrical components based on their uses and operation.

Recommended Duration: 4 weeks

Guiding/Topical Questions	Content/Themes/Skills	Resources and Materials	Suggested Strategies	Suggested Assessments
What are resistors and how are they used to control electrical current?	Define what resistors are and how their value can be calculated using the resistor color code Be able to construct circuits using both fixed resistors as well as variable resistors/potentiometers Explain how resistors are used to create a load in a circuit by limiting current flow	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Online Resources	Introductory lesson on resistors and how they operate Lab demonstration of current control using resistors in both series and parallel Discussion of the benefits of variable resistors vs. fixed resistors Worksheet on the resistor color code and properly identifying the Ohm value of a resistor	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examination

What are semi-conductors, and how do they help to create integrated circuits?	Define the following components and explain their operation: Diodes, transistors and integrated circuits Explain what the P-N junction is and how it must be used to create all types of semi-conductors Build circuits using transistors as a switch and amplifier Create a circuit using at least one type of integrated circuit (LM555, LM741, etc.)	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Online Resources	Video clips that explain the evolution of the semi-conductor throughout history Lesson on P-type and N-type material and how they can be grouped in different patterns to form semi-conductors Lesson and article on the development of the transistor by Bell Labs in Holmdel, NJ Lab activities where the students will build circuits using a variety of semi-conductors "Tone Generator" circuit using the LM555 timer "Temperature sensor" circuit using the LM741	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examination
What are capacitors and how are they used in timing and the storage of electrical charge?	Explain what the RC time constant is and how it affects the charging of capacitors. Utilize capacitors in a timing circuit to change the frequency of a signal. Utilize capacitors in a storage circuit to control the flow of electrical current. Describe the differences between ceramic and electrolytic capacitors	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Online Resource	"*Myth busters*" episode on capacitors and laden jars as an introduction into storing electrical charge Lab activity which involves using capacitors in parallel to calculate how long and LED can stay on without a power source Lesson on the RC-time constant and quiz which covers the content Circuits which involve timing control using a capacitor (Tone Generator Project)	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and Peer assessments Midterm/final examination

What are the major electrical schematic symbols and how are they used to both design and build circuits?	Properly identify and define the major schematic symbols used by electrical engineers and other professionals in the electrical industry Read schematics and build the corresponding circuits using only the symbols Utilize online simulation software which can test the operation of circuits by drawing their schematic symbols	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentation Internet Online Resources	Lesson on the fundamental schematic symbol families Schematic symbol worksheets and identify and define activities Circuit building activities which involve reading schematics and replicating a working circuit using real life components Circuit simulation using computer software to test the knowledge of schematic symbols Quizzes on proper symbol identification	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and Peer assessments Midterm/final examination

SCI.9-12.5.7.12 A.5	Know that there are strong forces that hold the nucleus of an atom together and that significant amounts of energy can be released in nuclear reactions (fission, fusion, and nuclear decay) when these binding forces are disrupted.
SOC.9-12.6.1.12 A.1	Analyze how historical events shape the modern world.
SOC.9-12.6.2.12 E.9	Discuss the impact of technology, migration, the economy, politics, and urbanization on culture.
SOC.9-12.6.6.12 E.8	Delineate and evaluate the environmental impact of technological change in human history (e.g., printing press, electricity and electronics, automobiles, computer, and medical technology).
TEC.9-12.8.2.12.A	Nature of Technology: Creativity and Innovation
TEC.9-12.8.2.12.C.3	Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
TEC.9-12.8.2.12.F.1	Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.

Differentiation

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Technology

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College and Workplace Readiness

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Electronics I - Unit 05

Basic Circuits

Enduring Understandings:
All electrical circuits must be comprised of a power source, a load and a path for electricity to flow.

Essential Questions:
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?

Unit Goals:
Students will be able to construct basic electrical circuits using a solder-less breadboard.

Students will be able to utilize a variety of loads in an electrical circuit.

Students will be able to utilize a variety of power sources in an electrical circuit.

Students will be able to explain how the flow of electrical current can be manipulated by the designer of a circuit.

Recommended Duration: 4 weeks

Guiding/Topical Questions	Content/Themes/Skills	Resources and Materials	Suggested Strategies	Suggested Assessments
When building an electrical circuit, what are the three basic parts which are needed to create a complete circuit?	Define the following: power source, path and load Be able to identify what causes short circuits and how to avoid them Create simple circuits using schematic symbols and test their function using a variety of methods Troubleshoot non-working circuits using systematic steps and methods	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentations Internet Online Resource	Introductory lesson on the basics of electrical circuits Demonstration on continuity of a circuit and how short circuits form Lab activities which cover how to create and control basic circuits Troubleshooting activities of non-working circuits	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examination
What is an electrical load and why must all circuits have one?	Identify and describe a variety of electrical loads Build a circuit which utilizes each of the following loads: light, sound, mechanics and electro-magnetism	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentations Internet Online Resources	Lesson on types of electrical loads and how each can play a different role in electrical products Discussion of loads and their relative resistances both in series and parallel Circuit simulation using computer software Circuit building activities with a variety of electrical loads	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examination

How do electrical circuit designs utilize a variety of electrical components to manipulate electrical current flow?	Explain the role of electrical components in a circuit on that circuits function Build a variety of circuits which use the following components: resistors, capacitors, diodes, transistors, integrated circuits, switches, motors and electromagnets	Classroom supplies for technological learning activities (TLA) Current textbook and resource binder Multimedia/interactive white board presentations Internet Online Resources	Lesson on each of the following circuits: *basic control with switches* *voltage dividers* *current dividers* *bridge rectifiers* *motor control with relay* Construction of each of the following circuits on a solder-less breadboard and if time permits a printed circuit board (PCB): *basic control with switches* *voltage dividers* *current dividers* *bridge rectifiers* *motor control with relay*	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examination

SCI.9-12.5.7.12 A.5	Know that there are strong forces that hold the nucleus of an atom together and that significant amounts of energy can be released in nuclear reactions (fission, fusion, and nuclear decay) when these binding forces are disrupted.
SOC.9-12.6.2.12 E.9	Discuss the impact of technology, migration, the economy, politics, and urbanization on culture.
TEC.9-12.8.2.12.C.3	Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
TEC.9-12.8.2.12.F.1	Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.

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Electronics I - Unit 06

Electrical Laws, Notations and Theories

Enduring Understandings:
All electrical circuits must be comprised of a power source, a load and a path for electricity to flow.

With the proper equation, every aspect of an electrical circuit can be calculated mathematically.

Essential Questions:
What is the relationship between voltage, current and resistance?

Unit Goals:
Students will become familiar with electrical notations and prefixes.

Students will become familiar with Ohm's Law and its applications.

Students will become familiar with Kirchhoff’s laws and their applications.

Recommended Duration: 4 weeks

Guiding/Topical Questions	Content/Themes/Skills	Resources and Materials	Suggested Strategies	Suggested Assessments
How can Ohm's Law be used to find, current, voltage and resistance?	Be able to identify various schematic symbols and other notations Draw basic circuits using schematic diagrams Build basic circuits using a schematic diagram Be familiar with Ohm's Law. Calculate voltage, current, or resistance when two of the values are present	Ohm's Law Information Ohm's Law Calculator Ohm's Law Activities Online Lessons - Ohm's Law:	Create a poster comparing schematic symbols with actual components and circuits Keep an "Engineer's Notebook" with hand drawn circuits and notations Provide a schematic diagram and have students build and test the circuit Have students research circuits to build. Draw schematics, make spreadsheets calculating cost of components, build and test circuits, report on operation of circuit Design an electronic circuit to accomplish a specific task. (For example, turn on a fan when it gets too hot, turn on a light when it gets dark)	Written tests and quizzes Worksheets Project assessments Notebook assessments Safety quizzes Midterm/final examinations
What prefixes are used to describe various electronic values?	Convert one value to another List all the prefixes and their associated values	Online Calculator	Introduce students to notations and prefixes Have students use the online calculator to convert from one value to another Use worksheets to reinforce concepts	Worksheets Project assessments Midterm/final examinations
How can Kirchhoff's Laws be used to calculate voltage and current?	Explain Kirchhoff's Laws for voltage and current. Be familiar with Kirchhoff's First and Second Laws. Explain the conservation of current and voltage. Use a multimeter to test circuits for voltage, current, resistance.	Online Lessons - Kirchhoff's Laws	Provide students with sample problems so they may have an opportunity to use Kirchhoff's Laws Use the online resources during lectures or demonstrations Give students a schematic and have them build the circuit Use a multimeter to analyze various points in the circuit to test Kirchhoff's Laws	Worksheets Project assessments Notebook assessments Safety quizzes

MA.12.4.5 A.1	Learn mathematics through problem solving, inquiry, and discovery.
MA.12.4.5 C.4	Apply mathematics in practical situations and in other disciplines.
MA.12.4.5 C.6	Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
MA.12.4.5 E.2	Select, apply, and translate among mathematical representations to solve problems.
MA.12.4.5 F.1	Use technology to gather, analyze, and communicate mathematical information.
MA.12.4.5 F.3	Use graphing calculators and computer software to investigate properties of functions and their graphs.
MA.12.4.5 F.4	Use calculators as problem-solving tools (e.g., to explore patterns, to validate solutions).
MA.12.4.5 F.6	Use computer-based laboratory technology for mathematical applications in the sciences (cf. science standards).
TEC.9-12.8.2.12.A	Nature of Technology: Creativity and Innovation
TEC.9-12.8.2.12.F.1	Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.

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Electronics I - Unit 07

Magnetism

Enduring Understandings:
Electrical circuits and magnetism have an interdependent relationship which can be harnessed and later utilized to do work.

Essential Questions:
How are alternating current and direct current different?

What role does magnetism have in the creation of electrical power?

How is magnetism utilized to create motion?

Unit Goals:
Students will be able to describe the operation of various devices that use magnetism to accomplish work such as solenoids, motors, and relays.

Students will be able to incorporate one or more of these devices into a finished prototype or prototypes.

Students will be able to describe the difference between alternating and direct current.

Students will be able to explain how electrical energy can be produced using magnetism.

Recommended Duration: 4 weeks

Guiding/Topical Questions	Content/Themes/Skills	Resources and Materials	Suggested Strategies	Suggested Assessments
How are magnets and electromagnets related?	Be able to explain the difference between permanent magnets and electromagnets	Permanent magnets, 18-22 gauge wire, DC power source (bench top supply or battery pack), metal rod (bolt or nail), various metallic and nonmetallic objects, iron filings	Research the operation of permanent magnets Test various objects for magnetic properties using a permanent magnet Build an electromagnet Using iron filings and a piece of paper, demonstrate the magnetic lines of force	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Safety quizzes Self and peer assessments Midterm/final examination
How can magnetism be harnessed to do work?	Identify the parts in a DC motor Compare and contrast a DC motor with a DC generator	DC motors, cordless drill, multimeter, alligator clips, bench vise or clamp	Reverse engineer a DC motor Draw and label all parts Explain the operation of a DC motor Using a cordless drill, turn the shaft of a DC motor and test for voltage Using a commercially available kit or discrete parts, construct a DC motor and test its operation	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Safety quizzes Self and peer assessments Midterm/final examination

What types of devices use magnetism in their operation?	Be familiar with different technological products and devices that use magnetism	Textbooks Websites	Discussion of products that use magnets and magnetism Reverse engineer a product and explain how magnets are utilized	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Safety quizzes Self and peer assessments Midterm/Final Exam

TEC.9-12.8.1.12.A.1	Construct a spreadsheet, enter data, and use mathematical or logical functions to manipulate data, generate charts and graphs, and interpret the results.
TEC.9-12.8.1.12.A.3	Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
TEC.9-12.8.1.12.A.4	Create a personalized digital portfolio that contains a résumé, exemplary projects, and activities, which together reflect personal and academic interests, achievements, and career aspirations.
TEC.9-12.8.1.12.C.1	Develop an innovative solution to a complex, local or global problem or issue in collaboration with peers and experts, and present ideas for feedback in an online community.
TEC.9-12.8.2.12.C.3	Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
TEC.9-12.8.2.12.D.1	Reverse-engineer a product to assist in designing a more eco-friendly version, using an analysis of trends and data about renewable and sustainable materials to guide your work.
TEC.9-12.8.2.12.F.2	Explain how material science impacts the quality of products.

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Electronics I - Unit 08

Electrical Timing, Control and Calibration

Enduring Understandings:
Electrical signals can be manipulated and changed to perform a number of useful tasks in our daily lives.

Essential Questions:
What are some different types of circuits which change electrical signals?

Unit Goals:
Students will become familiar with 555 timers in monostable and astable modes.
Students will become familiar with using a microcontroller.

Recommended Duration: 4 weeks

Guiding/Topical Questions	Content/Themes/Skills	Resources and Materials	Suggested Strategies	Suggested Assessments
What is the difference between monostable and astable modes?	Student will be able to follow a schematic diagram and assemble a 555 timer circuit in monostable and astable modes Student will be able to access the data sheet for 555 timers and other components Student will be able to describe the difference between astable and monostable	555 timers, breadboards, LEDs, wire, resistors and capacitors, power supply, multimeter 555 timer in astable mode 555 monostable timer calculator Animated gif of 555 timer	Lecture on 555 timer using animated gif Build and demonstrate the 555 timer in astable and monostable modes Locate the data sheet for the 555 Have students answer questions about pin diagrams, max voltage, max current, etc Using schematic diagrams have students build and demonstrate a 555 timer in both monostable and astable	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examinations

What can a 555 timer do?	Students will build a circuit to demonstrate an alternate use for the 555 timer.	555 timer circuits	Lecture Build various 555 timer circuits and demonstrate their operation. Have students identify a problem that can be solved using the 555 timer. Build, test, and demonstrate the circuit to the class.	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examinations
What is a microcontroller?	Students will be able to explain what a microcontroller is. Students will be able to write a program that will control inputs and outputs on a microcontroller.	PIC Microcontroller or Basic Stamp Various electronic components, tools, multimeter, power supply Basic Stamp Tutorials	Demonstrate how to set up a microcontroller for programming and basic operation. Demonstrate the operation of LEDs, relays, and motors using the microcontroller If resources are available, students may work in teams to create circuits, write and download code, and test circuits using a microcontroller	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and Peer assessments Midterm/final examinations

TEC.9-12.8.2.12.B.3	Analyze the full costs, benefits, trade-offs, and risks related to the use of technologies in a potential career path.
TEC.9-12.8.2.12.C.3	Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
TEC.9-12.8.2.12.F.1	Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.

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Electronics I - Unit 09

Rectification, Modulation and Amplification

Enduring Understandings:
Electrical signals can be manipulated and changed to perform a number of useful tasks in our daily lives.

Essential Questions:
What are some different types of circuits which change electrical signals?

Unit Goals:
Students will be able to describe the operation of rectifiers, modulators and amplifiers.
Students will be able to explain how these important devices are used in everyday devices.
Students will construct rectifiers, modulators and amplifiers using schematic diagrams.

Recommended Duration: 4 weeks

Guiding/Topical Questions	Content/Themes/Skills	Resources and Materials	Suggested Strategies	Suggested Assessments
What are rectifiers?	Operation of various diodes Operation of half-wave and full-wave rectifiers Schematics of half-wave and full-wave rectifiers	Diodes Rectifiers	Build a rectifier Demonstrate the shape of the wave generated using an oscilloscope	Written tests and quizzes Worksheets Project assessments Notebook assessments Safety quizzes Midterm/final examinations

What are amplifiers?	Operation of LM386 amplifier Build and test an amplifier using the LM386	LM386, Data sheet, breadboards, power supply, multimeter, various tools and components, speaker, wire Various audio circuits using the LM386 Audio amplifier circuit - MIT	Lecture on operation of amplifiers Demonstrate by building an amplifier using an LM386 Have students build and operate an amplifier using an LM386	Written tests and quizzes Worksheets Project assessments Notebook assessments Safety quizzes Midterm/final examinations

TEC.9-12.8.2.12.B.3	Analyze the full costs, benefits, trade-offs, and risks related to the use of technologies in a potential career path.
TEC.9-12.8.2.12.C.3	Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
TEC.9-12.8.2.12.F.1	Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.

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Electronics I - Unit 10

Robotics

Enduring Understandings:
Electrical signals can be manipulated and changed to perform a number of useful tasks in our daily lives.

Essential Questions:
What are some different types of circuits which change electrical signals?
How do electrical circuits gather data from the environment they are placed in?

Unit Goals:
Identify the parts of a "robotic" system.
Design and construct a small mobile robot.

Recommended Duration: 4 weeks

Guiding/Topical Questions	Content/Themes/Skills	Resources and Materials	Suggested Strategies	Suggested Assessments
What is robotics?	Shapes of robots; mobile platforms, walkers, industrial robotic arms Parts of robots; power sources, motors, sensors, controllers, structural system	he Electronics Teacher: Sensors: Methods of Movement: Stepper Motors Various electronic components such as light sensors, dc motors, stepper motors, Basic Stamp or other suitable microcontroller, etc.	Students should be allowed to experiment as much as possible with different components that can be used to create a robot Students should have an understanding of how these components operate Students should be encouraged to combine these components into systems and document their interaction with one another	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examinations

What can robots do?	Describe the difference between autonomous, tethered, and programmable robots	How Stuff Works	Research and present on various robotic systems Research the costs involved in building a robot. Use a spreadsheet to keep track of costs and parts	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examinations
How are robots designed and built?	Describe what a voltage divider is and its applications in robotics Describe the different configurations of robots Design and construct the controls and sensors for a robotic platform	Society of Robots Voltage Divider	Build a voltage divider using photo resistors that will turn on a LED when it is dark out or light out Construct Mousy the Junkbot	Written tests and quizzes Worksheets Project assessments Article summaries Notebook assessments Responses to discussion questions Journal assessments Threaded discussion groups Self and peer assessments Midterm/final examinations

Electronics I - Unit 11

Careers in Electronics

Enduring Understandings:

Career Education provides the knowledge, skill and attitude essential to meet a lifetime of career challenges in a competitive global society by recognizing and drawing upon the strengths and interest of each student.

Essential Questions:

What are examples of the employment/career opportunities open to the field of advanced electronics?
What types of training/certification are needed for a career in advanced electronics?
Where can training for a career in advanced electronics be obtained?

Unit Goals:

Identify different careers related to electronics.
List some of the skills required for various electronics careers.
Be familiar with educational requirements regarding various career choices.

Recommended Duration: 2 weeks

Guiding/Topical Questions	**Content/Themes/Skills**	**Resources and Materials**	**Suggested Strategies**	**Suggested Assessments**
What kinds of jobs exist that requires knowledge of and skills with electronics? Where can one find information about jobs in electronics?	Electronic devices require different levels of expertise in their design and construction Identify the different attributes of a career one might consider	US Bureau of Labor Statistics: Discover Engineering All Engineering Schools	Identify an electronic device. Break the class down into different job categories such as product designer, engineer, technician, quality control. Have the students' research what each area is responsible and then present on the various careers and how they relate to the particular electronic device Research various jobs. Create posters. Place around the room Career Research Assignment: Students will identify a career in electronics and research salary, job conditions, educational requirements, etc. Present a report/presentation to the class	How will the teacher uncover evidence of student learning? Remember, the assessments should, in total, allow the students to answer all of the essential questions of the unit

WORK.9-12.9.1.12 A.2 Evaluate academic and career skills needed in various career clusters.
WORK.9-12.9.1.12 A.3 Analyze factors that can impact an individual's career.

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TEC.9-12.8.2.12.B.2	Design and create a prototype for solving a global problem, documenting how the proposed design features affect the feasibility of the prototype through the use of engineering, drawing, and other technical methods of illustration.
TEC.9-12.8.2.12.B.3	Analyze the full costs, benefits, trade-offs, and risks related to the use of technologies in a potential career path.
TEC.9-12.8.2.12.C.3	Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
TEC.9-12.8.2.12.E.1	Use the design process to devise a technological product or system that addresses a global issue, and provide documentation through drawings, data, and materials, taking the relevant cultural perspectives into account throughout the design and development process.
TEC.9-12.8.2.12.F.1	Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.

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