APS DISTRICT HIGH SCHOOL SCIENCE CURRICULUM FRAMEWORK

Course Title: Pre-Engineering Electronics **Course Number:** 44116

Department: Science **ADS Number:** 17814944

Prerequisites: Successful completion of Algebra I

Length of Course: One Year **Credit/PRI Area:** .50 per Sem/ Elective **Grade Level(s):** 11-12

Important Notes:

This course meets either an electric or practical arts elective. It does not meet the three laboratory science requirements.

COURSE DESCRIPTION: This laboratory course* is designed to teach the student DC, AC, and digital circuit principles, functions of electronic devices, electronic assembly, and fabrication methods. He/She practices technical skills (e.g., reading a circuit diagram, soldering, recognizing and utilizing electronic components) and investigates how electronic circuits and devices function as well as how to design circuits to perform a task. The student analyzes circuit schematics mathematically and designs, possibly with a computer drawing program, a circuit that performs a function. The student understands that electronics incorporate chemistry, physics, and technology concepts into electronic design solutions. A final project (e.g., measuring the speed of a projectile, incorporating robotics-based sensors, regulating the pH of a solution, responding to motion, light, sound, or temperature changes) is required. The student increases his/her literacy proficiency by reading text from a variety of sources, completing various written assignments, and presenting projects, all skills necessary for a career in electronics, technology, or electrical engineering as well as any other science or technology field. Scientific thinking and practice (e.g., extensive laboratory activities, critical thinking, and problem solving), science and society, mathematics, and literacy are integrated throughout the course.

* Lab Courses: A minimum of 250 minutes per week of directed class activity for 36 weeks, 40% of which must be lab oriented, for a total of 150 clock hours (90 hours of class plus 60 hours of lab) shall be required for one (1) unit of credit, excluding passing period. [APS Procedural Directives, Section I – Instruction, Basis for offering credit].

References in parentheses following a performance standard refer to and are aligned with New Mexico Science Standards (NM), New Mexico Career Readiness Standards (CR), and the Albuquerque Public Schools Language Arts Standards (APS-LA).

STRATEGIES:
The "Illustrations" column provides exemplars of the performance standards, strategies, and the best practices suggested by the high school science teachers in the Albuquerque Public Schools.

ASSESSMENTS:
Assessments include authentic and performance-based assessment, cooperative learning, teacher observations, role playing, checklists, rubrics, tests and exams, formal and informal writing, oral presentations, group discussions, multimedia presentations, projects and demonstrations. The "Illustrations" column also incorporates a variety of assessments.

SUGGESTED TEXTBOOKS AND INSTRUCTIONAL MATERIALS:

- Any electronics textbook on the NM State approved list.
- *The Art of Electronics* - Horowitz & Hill - Cambridge University Press - (1989)
- *Foundations of Electronics: Circuits and Devices* – Meade - Delmar Publishers, Inc. - (1994)

SUGGESTED TITLES/AUTHORS WEB SITES:

- *Mobile Robots: Inspiration to Implementation*, Jones, Seiger, and Flynn (1991), , A K Peters, Ltd.
- *The ARRL Handbook for Radio Communications* (2004), The American Radio Relay League, Inc.
- http://www.eric.ed.gov/ ERIC (Educational Resources Information Center) is a national information system funded by the U.S. Department of Education's Institute of Education Sciences to provide access to education literature and resources.
- http://164.64.166.11/cilt/standards An online tool provided by NM State Department of Education to plan and map instructional strategies based on NM standards.
- http://164.64.166.11:8080/http/cilt2/login This tool helps organize units and lessons, keeps track of which standards you have addressed, and shares best practices.
- http://manzano.aps.edu/technology/ Steve Schum's web page at Manzano High School for extensive curriculum resources including "Engineering with Java Programming."
- http://www.aps.edu/aps/wmhs/atca/academies.html West Mesa's Academies for Photonics and AdvancedTechnologies.
- CETA at http://engineering-ed.org CETA is California Engineering & Technology Alliance Engineering/Technology Curriculum for High Schools.
- Futurama @ java.sun.com This web site is about JAVA programming.
- http://www.nmroborave.com/ The New Mexico ROBO RAVE (Robots Are Very Educational) is a state robot competition.
- http://www.werc.net/contest/ An environmental design contest including developing new technology to solve a real-world problem
- http://parallax.com Digital circuit board kits, online activity manuals, software
- http://robotics.nasa.gov/ NASA Robotics Education Project. Includes a link to the "Cool Robot of the Week" with archives of past robots.

Approved by HSCA: 12/04

STRAND I: SCIENTIFIC THINKING AND PRACTICE
CONTENT STANDARD: The student understands the processes of scientific investigations and uses inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

BENCHMARKS: A. The student uses accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.
B. The student understands that scientific processes produce scientific knowledge that is continually evaluated, validated, revised, or rejected.
C. The student uses mathematical concepts, principles, and expressions to analyze data, develop models, understand patterns and relationships, evaluate findings, and draw conclusions.

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	1. Describes the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions (NM-I.I.I.1). 2. Designs and conducts scientific investigations that include (NM-I.I.I.2): • testable hypotheses, • controls and variables, • methods to collect, analyze, and interpret data, • results that address hypotheses being investigated, • predictions based on results, • re-evaluation of hypotheses and additional experimentation as necessary, and • error analysis.	**NOTE: Illustrations include suggested activities for attaining each performance standard. A check (√) refers to a key feature to look for while assessing student performance.** 1 – 7, 12 – 16. The student properly and safely designs, diagrams, and assembles an electronic circuit to perform a task (e.g., open/close a switch after a specified amount of time). He/She then changes some timing parameters (e.g., circuit components), observing and recording the effects. The student discusses and explains the results orally and/or in a written format. ✓ reasonable and testable electronic task ✓ identification of independent/dependent variables and controls ✓ experimental design ✓ proper safety technique ✓ selection and use of appropriate equipment ✓ explanation of circuit analysis ✓ accurate mathematical calculations ✓ organization of data ✓ analysis of data ✓ multiple trials to verify data ✓ defensible conclusion based on data ✓ critical thinking and insights ✓ use of technology ✓ effective communication skills ✓ writing conventions

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
	3. Uses appropriate technologies (e.g., computers, calculators, balances, microscopes) to collect, analyze, and communicate scientific data (NM-I.I.I.3). 4. Conveys results of investigations using scientific concepts, methodologies, and expressions, including the following: • scientific language and symbols, • diagrams, charts, and other data displays, • mathematical expressions and processes (e.g., mean, median, slope, proportionality), • clear, logical, and concise communication, and • reasoned arguments (NM-I.I.I.4). 5. Understands how scientific theories are used to explain and predict natural phenomena (e.g., plate tectonics, ocean currents, structure of atoms) (NM-I.I.I.5). 6. Understands how scientific processes produce valid, reliable results, including (NM-I.I.II.1): • consistency of explanations with data and observations, • openness to peer review, • full disclosure and examination of assumptions, • testability of hypotheses, and • repeatability of experiments and reproducibility of results. 7. Uses scientific reasoning and valid logic to recognize (NM-I.I.II.2): • faulty logic, • cause and effect, • the difference between observation and unsubstantiated inferences and conclusions, and • potential bias. 8. Understands how new data and observations can result in new scientific knowledge (NM-I.I.II.3). 9. Critically analyzes an accepted explanation by reviewing current scientific knowledge (NM-I.I.II.4).	3, 4. The student programs (e.g., Basic, JAVA) a microcontroller to perform a function in conjunction with a circuit (e.g., light up a string of LEDs in sequence, A/D conversion, mechanical control). ✓ appropriate programming steps ✓ effective program ✓ desired output attained 6, 7, 12 – 16. See Strand I (Scientific Thinking and Practice) Illustration #1 – 7, 12 – 16. 8 – 11. The student researches and reports on the history and development of a modern technology (e.g., weather satellite, wireless cell phone, DVD player, semiconductors, lasers, robots). The research includes the following: • global/local impact, • historical timeline, • scientific principles, • economic impact,

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
	10. Examines investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe) (NM-I.I.II.5). 11. Examines the scientific processes and logic used in investigations of past events (e.g., using data from crime scenes, fossils), investigations that can be planned in advance but are only done once (e.g., expensive or time-consuming experiments such as medical clinical trials), and investigations of phenomena that can be repeated easily and frequently (NM-I.I.II.6). 12. Creates multiple displays of data to analyze and explain the relationships in scientific investigations (NM-I.I.III.1). 13. Uses mathematical models to describe, explain, and predict natural phenomena (NM-I.I.III.2). 14. Uses technologies (e.g., calculators, computer spreadsheets and databases, graphing software, simulations, modeling) to quantify relationships in scientific hypotheses (NM-I.I.III.3). 15. Identifies and applies measurement techniques and considers possible effects of measurement errors (NM-I.I.III.4). 16. Uses mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis) (NM-I.I.III.5).	• hazards, and • electrical design. The student uses technology (e.g., PowerPoint, slide show, workable model) to present findings. ✓ clear communication ✓ writing conventions ✓ effective presentation ✓ all components present ✓ thorough research 13 – 16. See Strand II (Content of Physical Science) Illustration #20, 21.

STRAND II: THE CONTENT OF PHYSICAL SCIENCE
CONTENT STANDARD: The student understands the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

BENCHMARKS: A. The student understands the properties underlying structure and reactions of matter.
B. The student understands the transformation and transmission of energy and how energy and matter interact.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	Properties of Matter 1. Classifies matter in a variety of ways (e.g., element, compound, mixture, solid, liquid, gas, acidic, basic, neutral) (NM-II.I.I.1).	1, 2. The student observes, determines, and classifies the various circuit components and (e.g., resistors, capacitors, processors, wiring, circuit boards) materials, and identifies properties (e.g., density, opacity, hardness, resistance, heat and electrical conductivity) of each. ✓ metallic/nonmetallic ✓ accurate identification and classification of components ✓ identification of properties
	2. Identifies, measures, and uses a variety of physical and chemical properties (e.g., electrical conductivity, density, viscosity, chemical reactivity, pH, melting point) (NM-II.I.I.2). **Structure of Matter** 3. Understands that matter is made of atoms and that atoms are made of subatomic particles (NM-II.I.I.5). 4. Understands atomic structure, including the following: • most space occupied by electrons, • nucleus made of protons and neutrons, and • atom held together by proton-electron electrical forces (NM- II.I.I.6). 4. Explains how electrons determine the properties of substances by (NM-II.I.I.7): • interactions between atoms through transferring or sharing valence electrons, • ionic and covalent bonds, and • the ability of carbon to form a diverse array of organic structures. .	2 – 7. The student investigates the electrical conductivity/resistivity of several materials (e.g., aluminum, copper, gold, carbon, glass, ceramic, plastic, paper) and relates it to the atomic, crystalline, molecular, and macroscopic structures. He/She predicts elements' conductivity based on placement on the periodic chart. ✓ proper use of equipment ✓ safety procedures ✓ atomic structure ✓ mobility of electrons ✓ ionic/covalent bonding ✓ crystalline/molecular structure ✓ accurate measurement of conductivity/resistivity ✓ accurate prediction of conductivity of elements ✓ clearly written description of observed properties with chemical ✓ structure and placement on periodic chart

	6. Makes predictions about elements using the periodic table (e.g., number of valence electrons, metallic character, reactivity, conductivity, type of bond between elements) (NM-II.I.I.8). 7. Understands how the type and arrangement of atoms and their bonds determine macroscopic properties (e.g., boiling point, electrical conductivity, hardness of minerals) (NM-II.I.I.9). **Chemical Reactions** 8. Understands types of chemical reactions (e.g., synthesis, decomposition, combustion, redox, neutralization) and identifies them as exothermic or endothermic (NM-II.I.I.13). 9. Describes how the rate of chemical reactions depends on many factors that include temperature, concentration, and the presence of catalysts (NM-II.I.I.15). **Energy Transformation and Transfer** 10. Identifies different forms of energy, including kinetic, gravitational (i.e., potential), chemical, thermal, nuclear, and electromagnetic (NM-II.I.II.1). 11. Explains how thermal energy (i.e., heat) consists of the random motion and vibrations of atoms and molecules and is measured by temperature (NM-II.I.II.2). 12. Understands that energy can change from one form to another (e.g., changes in kinetic and potential energy in a gravitational field, heats of reaction, hydroelectric dams) and knows that energy is conserved in these changes (NM-II.I.II.3). 13. Understands that the ability of energy to do something useful (work) tends to decrease (and never increases) as energy is converted from one form to another (NM-II.I.II.5).	7. See Strand II (Content of Physical Science) Illustration #2 – 7. 8, 9. The student researches and describes the process involved in etching a circuit board, including an overview of the chemical reactions that take place. He/She discusses hazardous byproducts and their disposal. ✓ accurate description of steps ✓ correct identification of reactions, reaction types, and endo- or ✓ exothermic ✓ clear explanation of factors that might change rate of reactions ✓ description of by product hazards and proper disposal methods 10 – 13, 18. The student researches then diagrams and describes the energy changes and transfers from an electrical energy source (e.g., nuclear, hydroelectric, fossil fuel) through a power plant from mechanical (e.g., gravity pulls water down, turns turbines) to electrical (e.g., magnets, coils), and then through a circuit (e.g., electrical to mechanical for a switch, fan, electrical to thermal in a resistor). Temperature is a measure of thermal energy and describes how energy is conserved yet available energy decreases. ✓ recognition of limits of these energy transfer technologies ✓ accurate diagram of energy flow chart showing forms of energy ✓ accurate identification of energy transformations ✓ clear communication of relationship between temperature and thermal energy

	Interactions of Energy and Matter 14. Understands that electromagnetic waves carry energy that can be transferred when they interact with matter (NM-II.I.II.7). 15. Describes the characteristics of electromagnetic waves (e.g., visible light, radio, microwave, X-ray, ultraviolet, gamma) and other waves (e.g., sound, seismic waves, water waves) (NM-II.I.II.8). 16. Knows that each kind of atom or molecule can gain or lose energy only in discrete amounts (NM-II.I.II.9). **Forces** 17. Knows that materials containing equal amounts of positive and negative charges are electrically neutral, but a small excess or deficit of negative charges produces significant electrical forces (NM-II.I.III.3). 18. Explains how electric currents cause magnetism and how changing magnetic fields produce electricity (e.g., electric motors, generators) (NM-II.I.III.5). 19. Represents the magnitude and direction of forces by vector diagrams (NM-II.I.III.6). 20. Knows that when one object exerts a force on a second object, the second object exerts a force of equal magnitude and in the opposite direction on the first object (i.e., Newton's Third Law) (NM-II.I.III.7). **Motion** 21. Applies Newton's Laws to describe and analyze the behavior of moving objects, including (NM-II.I.III.8): • displacement, velocity, and acceleration of a moving object, and • Newton's Second Law, $F = ma$.	14, 15. After designing and assembling a simple circuit with a photovoltaic cell as the detector, the student identifies and describes the properties and roles of each component and determines the voltage. ✓ proper use of safety equipment ✓ workable circuit ✓ accurate identification ✓ troubleshooting skills 14 - 16. The student creates a diagram and explains how a fluorescent light bulb works, including electron transitions at the atomic level. ✓ accurate diagram ✓ clear communication ✓ light output related to electron energy level transitions 17. The student describes the process of how he/she gets a static shock when touching a doorknob, relating this to static buildup in any circuit. He/She explains ways to prevent a static charge buildup. ✓ clear, accurate description of process ✓ identification of regions of excess electrons ✓ accurate description of how to ground out a circuit 18. See Strand II (Content of Physical Science) Illustration #10 – 13, 18. 19. The student creates force diagrams of the interaction between like and unlike charges [i.e., protons and electrons; e.g., (+)→ ←(-)]. ✓ accurate diagram 20, 21. With a partner the student places a powered vehicle (e.g., wind-up toy, robot) on a horizontal, flat surface, rolling the vehicle across this surface and then up an inclined plane. Using a stopwatch, the student determines the time and distance for each of the two regions (i.e., flat, inclined plane) and computes speeds and accelerations for each region. He/She repeats the scenario three times, takes the average, and describes forces that cause the vehicle to move and to slow down. ✓ safe procedures ✓ accurate measurements of time and distance ✓ analysis of sources of error ✓ accurate computations of speed and acceleration (i.e., equations of motion) ✓ description of forces

	NOTE: The following content standards were written for this course.	
	Electricity and Electronics	
	22. Identifies, measures, and tests electric circuit components (e.g., resistors, capacitors, inductors, transistors, LEDs, amplifiers, oscillators, integrated circuits, regulated power supplies, motors).	22. Given a schematic circuit diagram, the student identifies the components, verifies them by measurements (e.g., finds the actual resistance of a resistor with a meter), constructs a circuit, and tests its operation. ✓ correct identification of components ✓ accurate measurements ✓ selection of proper equipment and appropriate lab safety ✓ working circuit verified with appropriate tests -ALSO- See Strand II (Content of Physical Science) Illustration #1, 2 and Illustration #2 – 7. 22 – 24, 27, 29, 30. See Strand II (Content of Physical Science) Illustration #14, 15.
	23. Understands circuit schematic diagrams including the following: • proper symbols, • current flow, and • component values	23. Given a circuit diagram, the student identifies each component (e.g., resistors, capacitors, op amps, logic gates) and their properties or values (e.g., resistance values, power ratings) when appropriate and determines the function of the circuit. ✓ correct identification of components ✓ accurate properties/values ✓ determination of circuit function
	24. Applies circuit principals (e.g., Ohm's Law, Kirchhoff's Law, power formulas) for schematic diagrams and calculations.	24. The student analyzes a series-parallel DC circuit diagram and determines total current, current through each arm, voltages at various points with respect to ground or between two points, and the power requirements for the components. ✓ appropriate application of Ohm's and Kirchhoff's Laws ✓ accurate calculations ✓ correct choice of power requirements - ALSO- See Strand I (Scientific Practice and Thinking) Illustration #1 – 7, #12 – 16.

	25. Explains how electronic components function in AC and/or DC circuits.	25. The student describes the voltage biases necessary and current flows through transistors and explains their operation on the atomic level (i.e., p-type and n-type materials) in a DC circuit. ✓ accurate description of necessary voltage biases ✓ correct identification of current flow directions ✓ clear description of transistor properties and operation on the atomic level
	26. Understands how motors and generators work in a circuit.	26. The student constructs a simple motor (e.g., with a battery, magnet, coil, and holder), explains its operation, and predicts how a generator would work. ✓ working motor ✓ clear explanation of electromagnetic properties leading to motor's operation ✓ clear application to operation of generator -ALSO- See Strand II (Content of Physical Science) Illustration #10 – 13, 18.
	27. Analyzes a circuit diagram and its input/output signals (e.g., power, voltage, current, resistance).	27. Given a digital logic circuit diagram (e.g., counter, R latch, J-K flip-flop), the student predicts the output signal(s) (e.g., high or low) based on the input signal(s). ✓ correct signal progression at each point in the circuit ✓ correct output signal(s)
	28. Understands logic symbols and truth tables for digital logic circuits.	28. Given a diagram with a string of logic gates, the student constructs a truth table for the input/output signals. ✓ accurate truth table
	29. Understands the usefulness of sensors (e.g., motion, light, temperature, carbon monoxide, pH, radiation, noise).	29. The student, as part of a small group, constructs a circuit and simple robot that detects motion and moves toward the motion. ✓ efficient and neatly laid-out circuit ✓ efficient use of detectors and motors ✓ working robot -ALSO- See Strand I (Scientific Thinking and Practice) Illustration #3, 4. -ALSO- See Strand II (Content of Physical Science) Illustration #14, 15.

	30. Employs scientific trouble shooting methods in circuits.	30. The student uses efficient troubleshooting techniques to find a fault in a circuit. ✓ portions of circuit divided/isolated ✓ components tested/checked ✓ repetition of process ✓ understanding that faults cause voltage/resistance changes

STRAND III: SCIENCE AND SOCIETY
CONTENT STANDARD: The student understands how scientific discoveries, inventions, practices, and knowledge influence and are influenced by individuals and societies.

BENCHMARK: The student examines and analyzes how scientific discoveries and their applications affect the world and explains how societies influence scientific investigations and applications.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	Science and Technology	
	1. Knows how science enables technology but also constrains it, and recognizes the difference between real technology and science fiction (e.g., rockets vs. antigravity machines, nuclear reactors vs. perpetual motion machines, medical X-rays vs. Star-Trek tricorders) (NM-III.I.I.1).	1 – 14. See Strand I (Scientific Thinking and Practice) Illustration #8 – 11. -ALSO- 1, 4, 11. See Strand II (Content of Physical Science) Illustration #10 – 13, 18.
	2. Understands how advances in technology (e.g., microscopes and cellular structure, telescopes and understanding of the universe) enable further advances in science (NM-III.I.I.2).	2 – 4, 6, 9, 10, 13, 14. See Strand II (Content of Physical Science) Illustration #8, 9.
	3. Evaluates the influences of technology on society (e.g., communications, petroleum, transportation, nuclear energy, computers, medicine, genetic engineering) including both desired and undesired effects, and including some historical examples (e.g., the wheel, the plow, the printing press, the lightning rod) (NM-III.I.I.3).	
	4. Understands the scientific foundations of common technologies (e.g., kitchen appliances, radio, television, aircraft, rockets, computers, medical X-rays, selective breeding, fertilizers and pesticides, agricultural equipment) (NM-III.I.I.4).	4. See Strand II (Content of Physical Science) Illustration #14, 15 and Illustration #14 – 16, and Illustration #26.
	5. Analyzes the impact of digital technologies on the availability, creation, and dissemination of information (NM-III.I.I.6).	4, 5. See Strand I (Scientific Thinking and Practice) Illustration #3, 4.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	Science and Society	
	6. Describes how scientific knowledge helps decision makers with local, national, and global challenges [e.g., Waste Isolation Pilot Project (WIPP), mining, drought, population growth, alternative energy, climate change] (NM-III.I.I.9).	6, 9, 14. See Strand II (Content of Physical Science) Illustration #8, 9.
	7. Describes major historical changes in scientific perspectives (e.g., atomic theory, germs, cosmology, relativity, plate tectonics, evolution) and the experimental observations that triggered them (NM-III.I.I.10).	7 – 14. See Strand I (Scientific Thinking and Practice) Illustration #8 – 11.
	8. Knows that societal factors (e.g., government funding, laws and regulations about human cloning and genetically modified organisms, gender and ethnic bias, AIDS research, alternative-energy research) can promote or constrain scientific discovery (NM-III.I.I.11).	
	9. Explains how societies can change ecosystems and how these changes can be reversible or irreversible (NM-III.I.I.11).	9. See Strand II (Content of Physical Science) Illustration #8, 9.
	10. Describes how environmental, economic, and political interests impact resource management and use in New Mexico (NM-III.I.I.13).	10. See Strand II (Content of Physical Science) Illustration #14 – 16.
	Science and the Individual	
	11. Identifies how science has produced knowledge that is relevant to individual health and material prosperity (NM-III.I.I.15).	
	12. Identifies important questions that science cannot answer (e.g., questions that are beyond today's science, decisions that science can only help to make, questions that are inherently outside of the realm of science) (NM-III.I.I.17).	
	13. Understands that scientists have characteristics in common with other individuals (e.g., employment and career needs, curiosity, desire to perform public service, greed, preconceptions and biases, temptation to be unethical, core values including honesty and openness) (NM-III.I.I.18).	
	14. Knows that science plays a role in many different kinds of careers and activities (e.g., public service, volunteers, public office holders, researchers, teachers, doctors, nurses, technicians, farmers, ranchers) (NM-III.I.I.19).	14. See Strand II (Content of Physical Science) Illustration #8, 9.

STRAND IV: CAREER READINESS
CONTENT STANDARD: The student develops skills necessary for responsible and ethical workplace behaviors, for effective teamwork, for attainment of project goals, and for marketable skills for future careers.

BENCHMARKS: A. The student develops effective interpersonal leadership and team skills.
B. The student effectively produces a quality product.
C. The student develops and demonstrates the technological knowledge and skills required for future careers.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	Personal Skills 1. Integrates positive behavior, conduct, and social manners (e.g., Character Counts pillars) (CR-4A). 2. Analyzes and applies appropriate safety standards (CR-4E). 3. Works cooperatively with others from diverse backgrounds to accomplish goals (CR-4B, 5C). 4. Identifies and utilizes individual interests, aptitudes, and skills with the group to accomplish goals (CR-2B, 5A). 5. Demonstrates leadership within a group through effective communication, ability to motivate team members, and effective delegation of responsi-bililties (CR-5D). **Production of Quality Product** 6. Identifies goals, required resources, prioritizes activities, and evaluates progress toward achievement of goals within a specified timeline (CR-2A). 7. Prepares a budget, records costs, and makes adjustments within a specific maximum amount (CR-2C). 8. Reassesses individual and group skills and makes adjustments in the delegation of responsibilities for efficient progress toward attainable goals (CR-2B).	1 – 12. As part of a group the student chooses a final project, plans a timeline, formulates goals, produces a budget and tracks costs, designs, acquires materials, assembles, tests, and presents the project both orally and in written form. The project incorporates the following concepts: • DC/AC circuitry, • digital circuitry, • sensors, • motors, • microcontrollers, and • usefulness. ✓ positive behavior and conduct ✓ safety practices ✓ cooperation ✓ delegation of responsibilities ✓ skills assessments ✓ leadership qualities ✓ goal setting with reevaluation if necessary ✓ budgeting and cost accounts ✓ effort and perseverance ✓ demonstration of electronics' knowledge ✓ usefulness of product ✓ clearly written presentation ✓ effective oral presentation ✓ effective visuals

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	9. Demonstrates a high level of effort, patience, and perseverance toward goal attainment (CR-4C). **Technological Knowledge and Skills** 10. Demonstrates marketable skills for entry into a post-secondary education training program leading to career fields of interest (CR-1E, 3D). 11. Explains how technology is used in electronic technology, electrical engineering, or other science and engineering fields (CR-3A). 12. Demonstrates knowledge of advanced technological systems/computer operations to design, develop, and maintain engineering products (CR-3B, C).	

STRAND V: LITERACY
CONTENT STANDARD: The student communicates electronic principles through reading, writing, and speaking opportunities.

BENCHMARK: The student demonstrates proficiency in reading comprehension, specialized vocabulary, and a variety of writing and speaking requirements.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Develops and demonstrates proficiency with the following strategies to approach reading for information across content areas (APS – LA I.1): • scans reading selection to determine whether a text contains relevant information, • uses the headings and subheadings of the material to make predictions and to validate comprehension of text, • reads and rereads to decode meaning, and • reviews and summarizes essential elements of text for overview.	1 – 7. See Strand I (Scientific Thinking and Practice) Illustration #8 – 11. -ALSO- See Strand II (Content of Physical Science) Illustration #8, 9 and Illustration #10 – 13, 18.
	2. Uses textual evidence to develop and support an interpretation of a scientific process or concept (APS – LA II.2).	
	3. Develops increased competence in using the writing process to create a final product (APS – LA III.1).	3, 4, 6. 7. See Strand IV (Career Readiness) Illustration #1 – 12.
	4. Develops increased competence in using elements of effective writing (APS – LA III.2).	3, 4, 7. See Strand II (Content of Physical Science) Illustration #14, 15 and Illustration #14 – 16 and Illustration #17.
	5. Supports an informed opinion (APS – LA III.6): • uses appropriate language, reasoning, and organizational structure for the audience and purpose, • provides relevant and convincing reasons, uses various types of evidence, and • demonstrates an awareness of possible questions, concerns, or counterarguments.	
	6. Responds to a variety of written, electronic, and other media (APS – LA III.7).	
	7. Develops increased competence with speaking and language conventions (APS – LA IV.3).	