

# **North Dakota Electronics Education**

## **Content Standards**

Approved and Adopted - February 2017



**North Dakota Department of Career and Technical Education**

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**Adapted from:**

-The Apprentice Telecommunications (APP) Basic Electronics Competency Requirements, *Electronics Technicians Association International*, 2013. <http://www.eta-i.org>

-Basic Electronics I (550) & (651), *Precision Exams*, 2016. A document created by national subject matter experts in collaboration with user groups at schools, focusing on identifying national standards, and, in the case of Electronics, aligning with SkillsUSA standards.

**This set of standards was approved and edited with the inclusion of all current Electronics teachers in the state over a period of three months, through a cooperative process and with meetings during professional development.**

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# **Career and Technical Education Standards Introduction**

## **Mission**

The mission of the State Board for Career and Technical Education (CTE) is to work with others to provide all North Dakota citizens with the technical skills, knowledge, and attitudes necessary for successful performance in a globally competitive workplace.

## **Vision**

The State Board for Career and Technical Education (CTE) is committed to providing career awareness, work readiness skills, occupational preparation, and retraining of workers throughout the state. Career and technical education will span all educational levels, providing youth with exploration opportunities and the foundation skills needed to enter the world of work while providing adults with skills needed to enter, re-enter, or advance in the workforce.

## **Goal**

North Dakota Career and Technical Education's goal is to create a competitive and knowledgeable work force. This is accomplished through a variety of educational program areas that are organized to prepare students for careers in their chosen fields, to take leadership roles, and balance their multiple roles in life. CTE programs prepare students with the knowledge and skills to make informed career choices, to integrate and apply academic concepts, to prepare for successful participation in a global society, and to engage in lifelong learning.

## **Standards Development Process**

Standards development is a multi-phase process. Existing and/or industry standards are the basis for the North Dakota Program Standards. A team of expert secondary and postsecondary teachers, business and industry representatives, and the state program supervisor draft the standards document. Once the document is finalized, the State Board for Career and Technical Education approves and adopts the standards.

Course Frameworks are also developed by the writing team. A framework includes a brief overview of the course content, topical units of study, and identifies the standards recommended for inclusion within the course. The frameworks are tailored to prepare young people for the opportunities in North Dakota. School Districts will use the frameworks as a guide for developing curriculum that reflects local needs.

# Key Principles of Career and Technical Education

## We believe that Career Technical Education:

**1. Draws its curricula, standards, and organizing principles from the workplace.**

The workplace provides the context, objectives, and organizing constructs for instruction and assessment. The workplace also defines the standards of performance necessary, including those required for academic, technical, and employability skills.

**2. Is a critical and integral component of the total educational system, offering career-oriented benefits for all students.**

CTE classes offer educational benefits to students pursuing careers requiring specific technical skills as well as providing a strong foundation for those pursuing a traditional four-year (or more) degree.

**3. Is a critical and integral component of the workforce development system, providing the essential foundation for a thriving economy.**

Preparation of a well-prepared, qualified workforce requires solid academics, good work ethics, and specific technical skills as well as the ability to communicate, work with others, solve problems, and use information. CTE contributes directly to this preparation by providing a curriculum tied to specific workplace requirements.

**4. Maintains high levels of excellence supported through identification of academic and workplace standards, measurement of performance (accountability), and high expectations for participant success.**

Career Technical Education is committed to continuous improvement, attention to industry certification, and the development of highly qualified teachers.

**5. Is robust and flexible enough to respond to the needs of the multiple educational environments, customers, and levels of specialization.**

CTE involves a large and complex delivery system that (1) integrates career exploration, (2) provides effective tools for organizing all curricula, (3) facilitates the teaching and use of technology, (4) is integrated into the total learning experience, (5) enhances the learning of academic subjects, (6) teaches broad occupational skills, (7) includes all aspects of the industry, (8) teaches how to balance family and work responsibilities, (9) provides job-specific training, (10) is offered at multiple levels of the educational continuum, and (11) is delivered through a variety of educational environments.

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<b>Standard 1</b>	<b>SAFE PRACTICES</b>	
<b>Topic 1.1</b>	<b>Understand electrical hazards</b>	
<b>Student Competencies</b>		
	1.1.1	Identify typical electric shock hazards in industry.
	1.1.2	Identify the effects of electric current on a human body.
	1.1.3	Identify the effects of electrostatic discharge on the human body and on devices.
	1.1.4	Identify various types of safety devices used with electricity.
<b>Topic 1.2</b>	<b>Use safe work practices.</b>	
<b>Student Competencies</b>		
	1.2.1	Recognize general safety precautions to observe when working with electricity in the workplace.
	1.2.2	Describe correct safety procedures for hand and power tools.
	1.2.3	Locate and describe the use of shop safety equipment.

Standard 2	<b>BASIC ELECTRONIC THEORY</b>	
<b>Topic 2.1</b>	<b>Describe basic principles of electrical theory.</b>	
	<b>Student Competencies</b>	
	2.1.1	Identify and locate parts of the atomic structure of matter.
	2.1.2	Use and apply electrical charge, voltage, current, resistance, power, capacitance, inductance, and the units of measurement correctly.
	2.1.3	Describe the factors that affect the movement of electrical charges.
	2.1.4	Describe the difference between AC and DC power.
<b>Topic 2.2</b>	<b>Verify Ohm's Law and Watt's Law.</b>	
	<b>Student Competencies</b>	
	2.2.1	Use basic mathematics to solve Ohm's Law problems.
	2.2.2	Graph the relationships between resistance, current, and voltage in circuits.
	2.2.3	Use basic mathematics to solve Watt's Law problems.
	2.2.4	Graph the relationships between voltage, current, and power in circuits.
	2.2.5	Describe the effect on power requirements of changing voltage, current, or resistance.
<b>Topic 2.3</b>	<b>Understand simple series resistive circuits.</b>	
	<b>Student Competencies</b>	
	2.3.1	State and use Kirchoff's voltage law and the voltage divider formula.
	2.3.2	Construct, measure, and analyze simple series resistive circuits.
	2.3.3	Use a VIRP table to predict the voltage, current, resistance, and power in all parts of a series circuit from a schematic diagram.
<b>Topic 2.4</b>	<b>Understand simple parallel resistive circuits.</b>	
	<b>Student Competencies</b>	
	2.4.1	State and use Kirchoff's current law and the current divider formula.
	2.4.2	Construct, measure, and analyze simple parallel resistive circuits.
	2.4.3	Use a VIRP table to predict the voltage, current, resistance, and power in all parts of a parallel circuit from a schematic diagram.



<b>Standard 3</b>	<b>TEST EQUIPMENT AND BASIC HAND TOOLS</b>	
<b>Topic 3.1</b>	<b>Understand the proper configuration, use, handling, and storage of the following:</b>	
	<b>Student Competencies</b>	
	3.1.1	Voltmeter
	3.1.2	Ammeter
	3.1.3	Ohm meter
	3.1.4	Bench power supply
	3.1.5	Oscilloscope
	3.1.6	Basic hand tools
	3.1.7	Small power tools
	3.1.8	Logic Analyzer
	3.1.9	Function Generator

Standard 4	<b>USE, TEST, AND SELECT ELECTRONIC COMPONENTS</b>	
<b>Topic 4.1</b>	<b>Identify the following components and draw their schematic symbols:</b>	
	<b>Student Competencies</b>	
	4.1.1	Resistor
	4.1.2	Potentiometer
	4.1.3	Light emitting diode
	4.1.4	Transistor
	4.1.5	Incandescent light bulb
	4.1.6	Battery
	4.1.7	Capacitor
	4.1.8	Variable Capacitor
	4.1.9	Normally-closed switch
	4.1.10	Relay switch
	4.1.11	Induction coil
	4.1.12	Antennae
	4.1.13	Transformer
	4.1.14	Diode
	4.1.15	Microphone
	4.1.16	Terminal post
	4.1.17	Ammeter
	4.1.18	Volt meter
	4.1.19	Single-pole single-throw-switch
	4.1.20	Normally-open switch
	4.1.21	Single Pole-double-throw-switch
	4.1.22	Earth ground
	4.1.23	Speaker
	4.1.24	Ohm meter
	4.1.25	Chassis ground
<b>Topic 4.2</b>	<b>Describe the function of each of the above mentioned components.</b>	
<b>Topic 4.3</b>	<b>Describe the operation of each of the above mentioned components in a series or a parallel circuit.</b>	
<b>Topic 4.4</b>	<b>Determine the values for electronic components from their markings and physical characteristics.</b>	
<b>Topic 4.5</b>	<b>Describe the procedures for testing each of the above mentioned components.</b>	

<b>Standard 5</b>	<b>UNDERSTAND AND DEMONSTRATE INDUCTION</b>	
<b>Topic 5.1</b>	<b>Describe principles of magnetism and electromagnetism.</b>	
	<b>Student Competencies</b>	
	5.1.1	List the principles of magnetic fields.
	5.1.2	List the principles of electromagnetic fields.
	5.1.3	Describe the operation and application of magnetic devices.
	5.1.4	Describe the principles of electromagnetic induction.
<b>Topic 5.2</b>	<b>Understand and demonstrate how to use transformers.</b>	
	<b>Student Competencies</b>	
	5.2.1	Demonstrate how transformers step up and step down voltage as a factor of turn ratios, and Ohm's and Watt's Laws.
	5.2.2	Demonstrate the function of alternating current in transformers.
	5.2.3	Demonstrate the procedure for constructing, testing, and troubleshooting transformer circuits.

<b>Standard 6</b>	<b>UNDERSTAND AND DEMONSTRATE CAPACITANCE</b>	
<b>Topic 6.1</b>	<b>Describe principles of capacitance in DC and AC circuits</b>	
	<b>Student Competencies</b>	
	6.1.1	Identify terms associated with capacitance in DC and AC circuits.
	6.1.2	Identify wave shapes created by charging and discharging capacitors
	6.1.3	Describe, use, and apply formulas used for computing RC circuits
	6.1.4	List, use, and apply formulas using the universal time constant chart.
<b>Topic 6.2</b>	<b>Understand and demonstrate how to use capacitors in DC and AC circuits.</b>	
	<b>Student Competencies</b>	
	6.2.1	Use capacitors to create a RC circuit
	6.2.2	Demonstrate how capacitors affect current and voltage in a DC and AC circuits.
	6.2.3	Demonstrate the procedure for constructing, testing, and troubleshooting capacitive circuits.

<b>Standard 7</b>	<b>SOLDERING TECHNIQUES</b>	
<b>Topic 7.1</b>	<b>Understand and demonstrate correct soldering and desoldering.</b>	
	<b>Student Competencies</b>	
	7.1.1	Explain the principles of soldering and desoldering.
	7.1.2	Describe appropriate soldering techniques such as tinning, physical connections, temperature selection, and cleaning.
	7.1.3	Describe the precautions to prevent electrostatic discharge (ESD) during soldering.
	7.1.4	Solder and desolder ICs, wires, and discrete components on a PC board.
	7.1.5	Show appropriate use of heat sinks on solid state components.

<b>Standard 8</b>	<b>DIGITAL SYSTEMS AND APPLICATIONS</b>	
<b>Topic 8.1</b>	<b>Digital Concepts and Circuitry</b>	
	<b>Student Competencies</b>	
	8.1.1	Describe ASCII code.
	8.1.2	Identify each basic digital gate.
	8.1.3	Construct truth tables for common gates.
	8.1.4	Demonstrate how counters operate.
	8.1.5	Demonstrate how flip-flops work and list common types.
	8.1.6	Explain the purpose of a digital bus and show how it is connected to various sections of a product.
	8.1.7	List types of display circuitry and describe how numbers and letters are activated digitally.
	8.1.8	Show how pulsers are used for digital signal tracing and how logic probes are used to verify states in digital equipment.
	8.1.9	Describe digital clock usage and circuitry.
	8.1.10	Describe how microprocessors function and identify the basic components and pinouts.

<b>Topic 8.2</b>	<b>Computer Electronics</b>	
	<b>Student Competencies</b>	
	8.2.1	Describe the major sections of a computer.
	8.2.2	Demonstrate how the computer block diagram and flow charts are utilized.
	8.2.3	Describe different types of computer memory and how storage is accomplished.
	8.2.4	Define the word peripheral and list various types.
<b>Topic 8.3</b>	<b>Digital Systems and Applications</b>	
	<b>Student Competencies</b>	
	8.3.1	Demonstrate knowledge of basic computer operation.
	8.3.2	List ways to backup data and the importance of doing so.
	8.3.3	Explain the causes of line surges and viruses and protection procedures against each.
	8.3.4	Explain major components of the Internet, how it is accessed and common applications.
	8.3.5	Demonstrate how to download a service or application, data or programs.
	8.3.6	Explain how to use the Internet to locate parts and service literature.

# Career Ready Practices

## **1. Act as a Responsible and Contributing Citizen and Employee**

Career-ready individuals understand the obligations and responsibilities of being a member of a community and demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them, think about the near-term and long-term consequences of their actions, and seek to act in ways that contribute to the betterment of their teams, families, community, and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.

## **2. Apply Appropriate Academic and Technical Skills**

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications and make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.

## **3. Attend to Personal Health and Financial Well-Being**

Career-ready individuals understand the relationship between personal health, workplace performance, and personal well-being; they act on that understanding to regularly practice health diet, exercise and mental health activities. Career-ready individuals also take regular action to contribute to their personal financial well-being, understanding that personal financial security provides the peace of mind required to contribute more fully to their own career success.

## **4. Communicate Clearly, Effectively, and with Reason**

Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice and organization and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

## **5. Consider the environmental, social, and economic impacts of decisions**

Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organizations and the environment. They are aware of and utilize new technologies, understandings, procedures, materials and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and profitability of the organization.

## **6. Demonstrate creativity and innovation**

Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

## **7. Employ valid and reliable research strategies**

Career-ready individuals are discerning in accepting and using new information to make decisions, change practices, or inform strategies. They use a reliable research process to search for new information and evaluate the validity of sources when considering the use and adoption of external information or practices. They use an informed process to test new ideas, information, and practices in their workplace situation.

## **8. Utilize critical thinking to make sense of problems and persevere in solving them**

Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur, quickly take action to address the problem, thoughtfully investigate the root cause of the problem prior to introducing solutions, and carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

## **9. Model integrity, ethical leadership, and effective management**

Career-ready individuals consistently act in ways that align to personal and community-held ideals and principles while employing strategies to positively influence others in the workplace. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the direction and actions of a team or organization, and they apply insights into human behavior to change others' actions, attitudes, and/or beliefs. They recognize the near-term and long-term effects that management's actions and attitudes can have on productivity, morale, and organizational culture.

## **10. Plan education and career path aligned to personal goals**

Career-ready individuals take personal ownership of their own educational and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience, and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the educational and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals.

## **11. Use technology to enhance productivity**

Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology, being proficient with ubiquitous technology applications. They understand the inherent risks, personal and organizational, of technology applications, and they take actions to prevent or mitigate these risks.

## **12. Work productively in teams while using cultural/global competence**

Career-ready individuals positively contribute to every team whether formal or informal. They apply an awareness of cultural differences to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.