Introduction to Network Cabling (C-Tech)

Instructor Information
Instructor:
Instructor Email:
Instructor Website:
Room:
Period:
Grade Level: 9th – 12th Grade
Course Prerequisites: Computer Applications and/or Introduction to Information Technology

Course Description
This class is designed to prepare students to become more knowledgeable about the telecommunication and copper wiring field. Through the use of C-Tech’s course and equipment, students will develop the skills needed to prepare themselves for the future.

C-Tech Prep is a telecommunications and networking course split into three tiers: an introduction to telecommunications, copper-based systems, and fiber optic cabling.

Introduction to Telecommunications
Students complete a series of investigative activities, through which hands-on skills are developed and practiced, and Technology Learning Activities, in which students are presented with real-life telecommunications problems to solve.

Students will have an exciting insight into Telecommunications…past..present..and…future. They will have a basic understanding of copper and fiber optic-based cabling systems. Students will perform continuity testing on Fiber Optic, as well as Category 5 Cables.

Introduction to Networking Cabling Copper-Based Systems, prepares the student with the understanding of networking wiring and cabling opens a door to the future. Students completing this program will be prepared for entry-level jobs leading to tomorrow’s careers. Preparing students with knowledge and skills is just part of the process.

Introduction to Network Cabling – Fiber Optic-Based System, Tier 3 of C-Tech Prep, provides students with a theoretical and hands-on knowledge of Fiber Optics. C-Tech has designed this 30-hour course (average time of completion) with input from industry professionals and educators. Students will develop the skills and theory sought by employers of entry-level technicians.

Instructional Philosophy
Introduction to Network Cabling will be delivered in a lecture lab format. The course will use the book and lab materials provided by C-Tech. This is a certification course and all assignments and assessments are created by C-Tech. The grading and answer keys are also provided by C-Tech and will be followed in this course. During Tier 1 it will be more lecture and discussion labs and Tier 2 and Tier 3 the class will be mainly hands-on cabling labs.

South Dakota 9-12 Educational Technology Content Standards
Introduction to Network Cabling course is designed as an elective course available to students in the 9th through the 12th grade. It is important that the course not only address the Course Standards, but also the South Dakota Educational Technology Standards. This course is should meet at least the proficient level of the South Dakota Educational Technology Standards.
South Dakota 9-12 Educational Technology Content Standards

Students understand the history and progression of technology in relation to the development and design of future technology

9-12.NC.1.1 Compare and contrast how societal changes mirror innovations and emerging technologies.

9-12.NC.1.2 Predict how the evolution of technology will influence the design and development of future technology.

Students analyze the parts of a technological system in terms of input, process, output, feedback.

9-12.NC.2.1 Analyze technology systems to make informed choices

Students analyze the relationships and the connections between technologies in different fields of study and how they apply to communities.

9-12.NC.3.1 Analyze intended and unintended impacts of a system

9-12.NC.3.2 Integrate technology into school, home and community

9-12.NC.3.3 Evaluate technologies that increase educational and workplace opportunities

Students understand the purpose and demonstrate the use of the design process in problem solving.

9-12.NC.4.1 Compare and contrast other problem-solving and decision-making methods

9-12.NC.4.2 Formulate a technological solution using data-driven decision-making.

Students understand the safe, ethical, legal, and societal issues related to technology.

9-12.SI.1.1 Evaluate the need for acceptable use policies

9-12.SI.1.2 Compile a list of immediate and long-range effects of ethical and unethical uses of technology on individuals and society.

Students investigate the advantages and disadvantages of technology.

9-12.SI.2.1 Analyze advantages and disadvantages of widespread use and reliance on technology in the workplace and in society as a whole.

9-12.SI.2.2 Compare and contrast society’s influence on technology and technology’s influence on society.

Students recognize and demonstrate skills in operating technological systems.

9-12.CT1.1 Incorporate knowledge and enhanced usage skills to create a product.

9-12.CT.1.2 Apply strategies for identifying and solving routine hardware and software issues.
Students use technology to enhance learning, extend capability, and promote creativity.

9-12.CT.2.1 Utilize a virtual learning environment as a strategy to build 21st century learning skills

9-12.CT.2.2 Investigate to apply expert systems, intelligent agents, and simulations in real-world situations

9-12.CT.2.3 Utilize online information resources routinely and efficiently to meet needs for collaboration, research, publication, communication, and productivity.

Students evaluate and select information tools based on the appropriateness to specific tasks.

9-12.CT.3.1 Select and apply technology tools for research, information analysis, problem solving, and decision making in content learning.

9-12.CT.3.2 Organize and manage personal/professional information using technology tools. (e.g., finances, schedules, addresses, purchases, correspondences).

Students understand the purpose of information technologies to communicate with a variety of collaborators.

9-12.CP.1.1 Collaborate with external peers, experts, and others by using technology to compile, synthesize, produce, and disseminate information, models, and other creative works.

Students exchange information and ideas for an identified purpose through Information technologies.

9-12.CP.2.1 Adapt delivery of communication based on available information technologies.

Students use technology to locate and acquire information.

9-12.IL.1.1 Design a research project using a variety of technologies to find information to solve real world problems.

Students determine the reliability and relevancy of information.

9-12.IL.2.1 Independently evaluates the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information services.

Course Standards

Students will understand the introductory concepts and some hands-on training required at the entry level of the telecommunications industry.

1.1 Students will identify basic telecommunication systems and physical layer components present in the field of telecommunications.

1.2 Students will understand the history and function of various telecommunication systems.

1.3 Students will be able to identify and analyze the characteristics of the cabling systems and terminations that constitute the physical layer.

1.4 Students will be able to identify general safety precautions.

1.5 Students will be able to indentify tools, construction techniques, and test equipment utilized in network cabling.

1.6 Students will be able to identify and record faulty system identifications.

1.7 Students will be able to identify positive and negative impacts of possible future technological developments

Students will understand the tool use and construction, characteristics of various industry standards, and troubleshooting and repair of a copper based system
2.1 Students will be able to identify the components of the advanced cable trainer and the data voice and electric test set.

2.2 Students will be able to identify and describe the characteristics, application, and configurations of various cables and terminations.

2.3 Students will be able to identify and explain the safety precautions, installation techniques, and tools used to install copper-based network cabling systems.

2.4 Students will be able to terminate twisted and test twisted pair cables.

2.5 Students will be able to identify, terminate, and test 2-pair STP cabling systems.

2.6 Students will be able to identify, describe, terminate, and test coaxial cable.

2.7 Students will be able to identify and explain the National Electric Code (N.E.C.) codes and American National Standard Institute Telecommunication Industry Association, Electronics Industry Alliance (ANSI/TIA/EIA) 568-A Standards.

Students will understand the tool use and construction techniques, characteristics of various industry standards, and trouble shooting and repair of a fiber optic system.

3.1 Students will be able to identify the tools and equipment used to terminate and test fiber optic cables.

3.2 Students will be able to define the basic characteristics of light, optical sources, detectors, and continuity and attenuation.

3.3 Students will be able to identify and describe the components used in a fiber optic system.

3.4 Students will be able to identify the step-by-step procedure for placing fiber optic cables in a building.

3.5 Students will be able to state the characteristics of continuity testing, testing with a power meter and light source, and the optical time domain reflectometer test.

3.6 Students will be able to demonstrate the ability to use the tools and follow step-by-step process used to attach a fiber connector to an optical fiber.
Major Projects and Assignments

(These projects may change at the discretion of the instruction during the course of the semester)

Introduction to Telecommunications Tier 1 (approx. 40 hours)

The Interactive Physical Layer – In this module students are introduced to the basic telecommunication systems and the physical layer components that are present in the field of communication. We will test a variety of connections and cables to see what type of troubleshooting needs to take place.

Telecommunications: From The Beginning – Here students will learn about various telecommunication systems. Students will examine how different telecommunication systems transmit information.

Transmission Media and Physical Layer Components – Students will learn about different 2 and 4 pair cabling systems and how they are terminated. Students will be introduced to pair to pin configurations in cabling systems.

Safety Precautions – In this module students will understand the need for safety precautions when working with tools, cables, and in the work place.

Tools, Construction Techniques, and Test Equipment Utilized in Network Cabling – In this module students will be introduced to tools to be used with coaxial cable, telephone cable, and RJ-11. In this module students will correctly strip and terminate 2-pair telephone cable with RJ-11 connectors and Coaxial Cable with a screw-on F-Type connector.

Testing and Troubleshooting the Physical Layer – In this module students will understand how to recognize and troubleshoot a variety of problems as well as how to perform preventative maintenance. We will perform operational checks, end-to-end signal testing, and fiber optic testing.

Telecommunications: A Glimpse into the Future – Students will explore the idea of smart homes and wireless technologies. Students will be asked to look into the future and plan on what changes in telecommunications will take place.

Introduction to Network Cabling Copper Based Systems Tier 2 (approx. 45 hours)

- The ACT with DAVE Training Aid
- Twisted Pair Cabling Systems
- Safety Precautions, Installation Techniques and Tools
- 4-Pair Cabling Systems
- 2-Pair Cabling Systems
- Coaxial Cabling
- National Codes and Standards

Introduction to Network Cabling Fiber Optic Based Systems Tier 3 (approx. 20 hours)

- Fiber Optic Termination Kit
- Fiber Optics Concepts
- Fiber Optic System Components
- Placing Fiber Optic Cables
- Testing Fiber Optic Connectors
- Installing Fiber Optic Connectors
**Tests and Quizzes:** Quizzes and tests are given periodically throughout each of the lessons and usually at the end of each lesson. The quizzes and tests are provided by C-Tech and are required to be given in order for certification. Quizzes and Tests will be in the format of written and hands-on. At the end of Tier 2 there is a final hands-on and written exam.

**Assessment Plan**
All assignments are designed to show whether students have met the standards for the course. Any unit test, project, lab report, or presentation assessed as “poor quality” will be expected to be REDONE for higher credit.

**Distribution of Grading Components**
Grades are determined by dividing the points earned by the total number of points available in the grading period. Each major project and assignment commands an approximate percentage of the total points for the grading period as follows:

<table>
<thead>
<tr>
<th>Daily Activities</th>
<th>30%</th>
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</thead>
<tbody>
<tr>
<td>Quizzes</td>
<td>20%</td>
</tr>
<tr>
<td>Tests</td>
<td>50%</td>
</tr>
</tbody>
</table>

*Distribution of component percentages is subject to change.*

**Description of Grading and Quality Work**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Scale</th>
<th>Description of Work</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>94-100%</td>
<td>Consistently demonstrates an exceptional level of quality and effort. Having all work in on time and completed to exceed expectations. Mastery in evaluating, synthesizing, and applying the knowledge and skills of information technology.</td>
</tr>
<tr>
<td>B</td>
<td>87-93.9%</td>
<td>Consistently demonstrates proficient knowledge with a good effort and quality of work. All assignments are complete and on time. Demonstrates the ability to evaluate, analyze, synthesize and apply the principles of information technology.</td>
</tr>
<tr>
<td>C</td>
<td>78-86.9%</td>
<td>Demonstrates proficient knowledge and the ability to apply information technology. Work shows average effort. A few assignments may be missed or late.</td>
</tr>
<tr>
<td>D</td>
<td>68-77.9%</td>
<td>Work shows minimal effort and some assignments are late. Demonstrates a basic understanding of recalling or comprehending information technology.</td>
</tr>
<tr>
<td>F</td>
<td>Below 67.9%</td>
<td>Understanding is below basic in relation to information technology. Work is of poor quality and does not meet standards or expectations.</td>
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**Extra Help**

**Course Resources**
Cabling

Rationale Statement:
The cabling course is based off the C-Tech cabling courses. The C-Tech cabling courses consist of three tiers. The tiers include introduction to telecommunications, introduction to network cabling for copper based systems, and introduction to network cabling for fiber optic systems.

In the introduction to telecommunications students begin to explore the open standards interconnection model for communication networks. This consists of the physical layer of telecommunications. Students learn about the basics and the history of data, voice, and video systems. This tier will help them as they enter into the copper based systems.

In the introduction to network cabling for copper based systems, students learn the knowledge and skills needed to become certified entry-level technicians. This tier does allow the students to become certified in copper through C-Tech. In this tier students learn about the proper tool use, construction techniques, industry standards, and troubleshooting and repair.

In the introduction to network cabling for fiber optic based systems, students are provided with the theoretical and hands-on knowledge of Fiber Optics. This tier also allows the students to become certified in fiber optic installation.

Course Description:
Depending on the length of the course will depend on what tiers a course may complete. Generally the course will cover the introduction to telecommunications and copper. However these components could be used in other courses, or as a yearlong course and get through all three tiers. Depending on how you go about the outline of the course will dictate your description.
C-Tech Course Description can be found at the [http://c-techtraining.com](http://c-techtraining.com)

Tier 1 – Introduction to Telecommunication
Indicator #1: Students will understand the introductory concepts and some hands-on training required at the entry level of the telecommunications industry. [http://c-techtraining.com/programs-telecom.htm](http://c-techtraining.com/programs-telecom.htm)

Tier 2 – Introduction to Network Cabling – Copper Based System
Indicator #2: Students will understand the tool use and construction, characteristics of various industry standards, and troubleshooting and repair of a copper based system [http://c-techtraining.com/programs-copper.htm](http://c-techtraining.com/programs-copper.htm)

Tier 3 – Introduction to Network Cabling – Fiber Optic Systems
Indicator #3: Students will understand the tool use and construction techniques, characteristics of various industry standards, and trouble shooting and repair of a fiber optic system. [http://c-techtraining.com/programs-fiber.htm](http://c-techtraining.com/programs-fiber.htm)

Grade Level: 9 – 12

Topics Covered:
- History and basics of telecommunications
- Tools and construction techniques in terminating cables
- Copper based systems for networking
- Safety precautions
- Fiber optic systems for networking
- Testing and troubleshooting of physical layer
- Physical layer of the OSI model
Indicator #1: Students will understand the introductory concepts and some hands-on training required at the entry level of the telecommunications industry.

<table>
<thead>
<tr>
<th>Bloom’s Taxonomy Level</th>
<th>Standard and Examples</th>
</tr>
</thead>
</table>
| Remembering            | **1.1 Students will identify basic telecommunication systems and physical layer components present in the field of telecommunications.**  
For example, to meet this standard students may:  
- Identify physical layer components in various telecommunication systems.  
- Trace the signal flow of a telecommunication system.  
- Demonstrate knowledge of testing equipment and how to use it to determine continuity. |
| Understanding          | **1.2 Students will understand the history and function of various telecommunication systems.**  
For example, to meet this standard students may:  
- Define the communication and telecommunication process.  
- Identify key developments in the history of telecommunications.  
- Identify cabling systems used for the distribution of data, voice, and video.  
- Identify diagrams showing the telecommunications process. |
| Remembering            | **1.3 Students will be able to identify and analyze the characteristics of the cabling systems and terminations that constitute the physical layer.**  
For example, to meet this standard students may:  
- Define the level or category associated with the different types of twisted pair cabling systems.  
- Define techniques to eliminate noise reduction and cross talk.  
- Identify 2-pair and 4-pair cabling characteristics and identification.  
- Define the characteristics of twisted pair modular connecting systems.  
- Demonstrate and identify pair to pin configuration using the EIA/TIA 570 standard.  
- Define the characteristics of coaxial cable systems to include BNC and F-Type connections.  
- Define characteristics of Fiber Optic cable systems and the ST connector. |
| Remembering            | **1.4 Students will be able to identify general safety precautions.**  
For example, to meet this standard students may:  
- Identify safety precautions that insure personal protection.  
- Define key points concerning safety on a job site.  
- Define safety in dealing with electrical equipment.  
- Indentify and explain common safety procedures when working with hazardous materials.  
- Indentify and explain the safety procedures and precautions that should be followed for fire prevention and safety. |
| Applying | 1.5 Students will be able to indentify tools, construction techniques, and test equipment utilized in network cabling.  
For example, to meet this standard students may:  
• Identify stripping and crimping tools use in network cabling.  
• Terminate 2-pair telephone and F-type coax cable.  
• Check for cable continuity using testing equipment. |
|----------|-------------------------------------------------------------------------------------------------|
| Applying | 1.6 Students will be able to identify and record faulty system identifications.  
For example, to meet this standard students may:  
• Define the terms testing, troubleshooting, and preventative maintenance.  
• Perform end-to-end signal testing.  
• Perform selective testing on individual systems  
• Identify the basic characteristics of basic troubleshooting techniques.  
• Demonstrate the use of patch cords, adapters, and bridging clips to simulate or correct malfunctions. |
| Remembering | 1.7 Students will be able to identify positive and negative impacts of possible future technological developments  
For example, to meet this standard students may:  
• Identify wiring infrastructure, personal computer, and smart devices in a smart home.  
• Identify future developments of wireless systems, cellular systems, and consumer electronics. |
### Indicator #2: Students will understand the tool use and construction, characteristics of various industry standards, and troubleshooting and repair of a copper based system

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</table>
| **Remembering** 2.1 | **Students will be able to identify the components of the advanced cable trainer and the data voice and electric test set.** For example, to meet this standard students may:  
  - Indentify all the components of the advanced cable trainer (ACT).  
  - Indentify all aspects of the wiring configuration banner board.  
  - Indentify all components of the data voice and electric test set (DAVE-3) units.  
  - Correctly identify all cables and test adapters.  
  - Identify the tools used in cable construction. |
| **Remembering** 2.2 | **Students will be able to identify and describe the characteristics, application, and configurations of various cables and terminations.** For example, to meet this standard students may:  
  - Identify the characteristics and application of Twisted Pair Cables.  
  - Identify the characteristics and application of 4-Pair UTP Cables.  
  - Identify the three types of configurations for terminating twisted pair on modular patch cords, plugs, and outlets.  
  - Identify configuration and application of 66-type terminal block.  
  - Identify configuration and application of 110-type terminal block.  
  - Identify configuration and application of a modular patch panel.  
  - Identify configuration and application of shielded 4-pair cable.  
  - Identify the characteristics and applications of 25-pair UTP cables. |
| **Remembering** 2.3 | **Students will be able to identify and explain the safety precautions, installation techniques, and tools used to install copper-based network cabling systems.** For example, to meet this standard students may:  
  - Identify and explain the safety procedures and precautions that should be followed for personal protection, at the work site, to prevent electrical hazards, working with hazardous materials, working with tools and equipment, and for fire prevention and safety.  
  - Identify the minimum distance required between network cables and power sources.  
  - Indentify types and location for cable supports.  
  - Identify and describe the step-by-step process used to install cable in buildings. |
| Applying | 2.4 Students will be able to terminate twisted and test twisted pair cables.  
For example, to meet this standard students may:  
- Terminate an unshielded twisted pair cable to an 8P8C plug 568B.  
- Terminated a screened twisted pair cable to an 8P8C plug 568B.  
- Identify and troubleshoot shorts, opens, transposals, reversals, and pair to pin configurations.  
- Terminate and test 4-pair UTP cable to 66 and 100 connection blocks and modular jacks. |
| Applying | 2.5 Students will be able to identify, terminate, and test 2-pair STP cabling systems.  
For example, to meet this standard students may:  
- Identify the application, configuration, construction and color code for 2-Pair STP cable.  
- Terminate an IBM 2-Pair cable with the 4-position UDC  
- Test an IBM cabling system and 2-Pair STP circuit |
| Applying | 2.6 Students will be able to identify, describe, terminate, and test coaxial cable.  
For example, to meet this standard students may:  
- Identify the characteristics, type, and applications of coaxial cable.  
- Identify characteristics, type and application of coaxial connectors.  
- Identify tools for installing connectors on coaxial cable.  
- Terminate an test coaxial cable systems |
| Remembering | 2.7 Students will be able to identify and explain the National Electric Code (N.E.C.) codes and American National Standard Institute Telecommunication Industry Association, Electronics Industry Alliance (ANSI/TIA/EIA) 568-A Standards.  
For example, to meet this standard students may:  
- Identify the purpose and application of the N.E.C. codes as they pertain to network cabling.  
- Identify N.E.C. electrical code limited energy articles.  
- Identify the major elements of the ANSI/TIA/EIA 568-A Standard.  
- Identify and explain the standards as applied to horizontal, new installation, and backbone cabling.  
- Identify and explain the 568-A standard for buildings, UTP, and ScTP cables. |
Indicator #3: Students will understand the tool use and construction techniques, characteristics of various industry standards, and trouble shooting and repair of a fiber optic system.

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<tr>
<td><strong>Remembering</strong></td>
<td>3.1 Students will be able to identify the tools and equipment used to terminate and test fiber optic cables. For example, to meet this standard students may:</td>
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<td>- Identify the tools and equipment found in the fiber optic termination kit.</td>
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<td>- Identify the contents of the Student Consumable Kit.</td>
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<td>- Demonstrate the ability to observe a connectorized fiber optic cable.</td>
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<td>- Demonstrate the ability to prepare and use the heat strip tool.</td>
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<td>- Use the buffer tube stripper to strip fiber optic cable.</td>
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<td>- Demonstrate the ability to use the SPOT tester to check a fiber optic cable.</td>
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<td><strong>Remembering</strong></td>
<td>3.2 Students will be able to define the basic characteristics of light, optical sources, detectors, and continuity and attenuation. For example, to meet this standard students may:</td>
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<td>- Define the key characteristics and the relationships between the different characteristics of light.</td>
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<td>- Identify the three main elements of a fiber optic system.</td>
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<td>- Define advantages and disadvantages of fiber optic cabling systems.</td>
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<td>- Identify the primary light sources used in fiber optic systems and their key attributes.</td>
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<td>- Identify the structure and types of fiber optic cables</td>
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<td>- Identify the characteristics of various fiber optic cable systems.</td>
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<td>- Define continuity and indentify how to configure test equipment.</td>
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<td>- Define attenuation and identify the causes of attenuation in fiber optic cables.</td>
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<td></td>
<td>- Identify the test equipment used in fiber cabling and define how to configure fiber cables for attenuation measurement.</td>
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<tr>
<td><strong>Remembering</strong></td>
<td>3.3 Students will be able to identify and describe the components used in a fiber optic system. For example, to meet this standard students may:</td>
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<td>- Identify the characteristics and construction and compare loose core and tight core fiber optic cable.</td>
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<td>- Identify and describe three types of fiber optic splices and closures.</td>
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<td></td>
<td>- Identify the characteristics of fiber optic cabinets and closure.</td>
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<td></td>
<td>- Identify fiber optic connectors and identify the characteristics and use of a fiber optic connector.</td>
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</table>
| Remembering | 3.4 Students will be able to identify the step-by-step procedure for placing fiber optic cables in a building.  
For example, to meet this standard students may:  
- Identify the twelve-step sequence for placing a fiber optic cable in a building.  
- Identify the steps to place a pulling string in a pathway.  
- Identify the steps required to attach a pulling string to fiber cable.  
- Identify the safety precautions and procedures that must be followed when placing fiber optic cable. |
| --- | --- |
| Application | 3.5 Students will be able to state the characteristics of continuity testing, testing with a power meter and light source, and the optical time domain reflectometer test.  
For example, to meet this standard students may:  
- Identify the differences between a continuity test, and attenuation test, and an OTDR test.  
- Perform a continuity test on a fiber optic patch cord utilizing the SPOT tester.  
- Perform both a subtraction and a zero set attenuation test utilizing a power meter and light source. |
| Applying | 3.6 Students will be able to demonstrate the ability to use the tools and follow step-by-step process used to attach a fiber connector to an optical fiber.  
For example, to meet this standard students may:  
- Identify the step-by-step process of installing fiber optic connectors for both the epoxy method and the crimp-on method.  
- Identify and describe the safety procedures that must be followed when installing a fiber optic cable.  
- Terminate a fiber optic building cable using ST II+ connectors.  
- Terminate a fiber optic patch cord using ST II+ connectors.  
- Perform a continuity check and measure attenuation using the zero-set method. |