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| **TEXAS CTE LESSON PLAN**  [www.txcte.org](http://www.txcte.org) | |
| **Lesson Identification and TEKS Addressed** | |
| **Career Cluster** | Science, Technology, Engineering & Mathematics |
| **Course Name** | Principles of Applied Engineering |
| **Lesson/Unit Title** | Basic Electricity and Electronics: Module 1 - Basic Electricity |
| **TEKS Student Expectations** | **130.402. (c) Knowledge and Skills**  (8) The student understands the opportunities and careers in fields related to electrical and mechanical systems  (A) The student is expected to describe the applications of electrical and mechanical systems  (B) The student is expected to describe career opportunities in electrical and mechanical systems  (C) The student is expected to identify emerging trends in electrical and mechanical systems  (D) The student is expected to describe and apply basic electronic theory |
| **Basic Direct Teach Lesson**  (Includes Special Education Modifications/Accommodations and  one English Language Proficiency Standards (ELPS) Strategy) | |
| **Instructional Objectives** | The student can:   * Recall how charge creates electrical forces * Review basic atomic theory within a new framework for understanding electricity * Define the basic electrical quantities * Create the foundation for understanding transistors and digital electronics * Recall that sound is a pressure wave that can be produced by a vibrating speaker cone * Work problems involving Ohm’s Law |
| **Rationale** | After completing this lesson, the student will be able to demonstrate their understanding of basic electricity and electronic fundamentals through satisfactory performance on the Basic Electricity and Electronics Quiz. |
| **Duration of Lesson** | 2-3 45-minute periods |
| **Word Wall/Key Vocabulary**  *(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* | * **Volt** – is a potential difference between two points. * **Energy** - is the fundamental ability to do work. * **KW-Hr** - is a unit of energy. * **Electrical load** - is any resistive element connected to a power supply. * **Joule per second** - is a unit of power. * **Sound** - is the movement of air molecules. * **Current** – is the movement of electrons. * **Voltage** - is force created by the buildup of charge. * **Resistance** – is the opposition to current flow. * **Ohm** – is the unit of resistance.   **Coulomb** – is the unit of electrical charge. |
| **Materials/Specialized Equipment Needed** | Instructional Aids:   1. Basic Electricity and Electronics problem worksheet and key 2. Basic Electricity and Electronics terms and definitions handout 3. Basic Electricity and Electronics quiz 4. Basic Electricity and Electronics quiz key   Materials Needed:   1. CD-ROM disk 2. Paper 3. Pen or pencil   Equipment Needed:   1. Computer with access to Internet 2. Projector 3. CD player 4. Unshielded speaker |
| **Anticipatory Set**  (May include pre-assessment for prior knowledge) | Teacher Preparation:  Review basic DC theory and Ohm’s law.  We have used a CD player as a real-world example of how we use electricity and electronics. There are plenty of other devices (that students use) that can be used. Tell students if they want to understand how these work they must understand some of the basics of electricity and electronics. Try to read ahead and relate some of the information given in the basics to the more advanced electronics of the next section, Basic Electronics. The coverage of the CD is a little spotty at times, but do your best to keep focus on applications of the electricity and electronics covered.  Learner Preparation:  Students need a basic understanding of algebra in order to solve equations and define variables.  Introduction (LSI Quadrant I):  SAY: Today we are going to start learning about the basics of electricity and electronics.  ASK: Does anyone know where electricity comes from? (conversion of energy from one form to another, like chemical to electrical or mechanical to electrical) SHOW: Here is a wire.  SAY: This wire is a solid. However, there are particles in here that move and allow electrical current to flow.  ASK: Does anyone know what particle in this wire allows electricity to flow? (the electrons)  ASK: Does anyone here know how this really works?  SAY: There are tiny pits and spaces that a laser reads as binary one’s and zero’s. The one’s and zero’s are in a form of binary code that represents the music.  ASK and SHOW: A CD player. This player converts the binary code into music. Does anyone here know how this works?  SAY: This converts the code to a voltage signal using principles of the audible hearing frequency range.  SAY: Frequencies from 20 to 20 thousand cycles per second are produced by sending the signal out as a voltage 44 thousand 100 times per second. |
| **Direct Instruction \*** | Outline (LSI Quadrant II):  Instructors can use the handouts, and note pages. If needed, Instructors are encouraged to make a PowerPoint presentation in conjunction with the following outline.  Basic Electricity and Electronics – Speakers and CD   * A speaker is like a DC motor, converting electrical energy into mechanical energy, and can be used as an introduction to that topic. * A microphone is like an AC generator converting mechanical energy (sound pressure waves) into electrical energy. * Lower frequencies require more sound pressure variation, higher frequencies require less. * The more sound pressure needed, the more energy needed. Bass requires far more energy than treble. * All signal information uses the same 16 bits per channel, regardless of the amplitude (unlike MP3 data). * Changes in frequency are not a part of the recorded signal itself but are the result of signal changes from sample to sample.   Basic Electricity and Electronics   * The first major concept is that electrons do the work in an electrical circuit. * This provides a great framework to review basic atomic structure. * Electrons must be separated from the atom both to flow for current and to build up the charge needed to provide the force (voltage) used in an electric circuit   Like charges repel, unlike charges attract   * This is called the weak electrical force. * Electrons have a negative charge. * Protons have a positive charge. * Electrons are attracted to the protons in the nucleus. * Protons are attracted to protons in the nucleus through the strong electrical force.   The electron configuration creates the similar properties that allow groups of elements to form the familiar periodic table of the elements   * Electrons orbit the nucleus in shells or layers. * Different layers can have different numbers of electrons. * The most electrons an atom can have in an outer shell is 8. * 8 electrons in an outer shell creates a stable atom and a stable molecule, or combination of atoms. * Atoms combine into molecules to get 8 electrons in the outer shell, which are shared basic digital principles and introducing the next topic, transistors. |
| **Guided Practice \*** | **Guided Practice (LSI Quadrant III):**   * Question and answer with definitions. Example: * What is the definition of voltage? * What is the definition of current? * What is the definition of resistance? * What is the formula for Ohm’s Law? * What is the symbol for voltage (V)? * What is the symbol for current? (I) * What are the three fundamental particles in an atom? |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | **Independent Practice (LSI Quadrant III):**   * Have students study how a speaker works. Wikipedia is a good source. * Have students work problems involving Ohm’s law. Students should work a number of problems, solving for each of the three quantities.   As an extension/enrichment activity, you can end this section by asking students to do further research on CD audio.   * Students can do a research paper and/or a presentation on CD audio. One particularly interesting feature is that even though CD audio was advanced technology for its time, it relied on analog signal principles the same way that AM or FM radio does. * Advanced students can do research on MP3 technology. * How does digital radio or the new HD TV broadcasts differ from older analog transmission? |
| **Lesson Closure** | * Review (LSI Quadrants I and IV): * Question: Can you see a speaker cone move for high frequency sounds? What about for low frequencies? How does sound volume relate to speaker cone movement? * Answer: No and yes. However, you can feel the speaker move for the high frequency signals. What does this say about our sense of touch vs. vision? Touch the speaker gently, by the way. This may be a good way to introduce the concepts of amplitude vs. frequency, and power required to produce. * Question: Can you see electricity? How do you know it’s there? Can you feel it? * Answer: You cannot see it, but you can see many of its effects, like light and heat. For safety, you never want to touch an electrical circuit. Use a multimeter or other testing device. * Question: What element has 6 protons? What element has 23 protons? What element has 23 neutrons? * Answer: Carbon, Vanadium, and we can’t tell without more information (like atomic weight, not atomic number). No element. Perhaps an isotope of Scandium. * Question: Ohm’s Law uses what 3 quantities? * Answer: Voltage, current, resistance. * Question: What are some other forms of energy we can convert to electrical energy? Question: Why do we use electricity instead of other forms of energy? * Answer: We do use other forms of energy, but electricity can be converted into those other forms, and electricity is easy to transmit efficiently while many of the other forms of energy are not as easy to transmit. |
| **Summative/End of Lesson Assessment \*** | Informal Assessment (LSI Quadrant III):   * Students should write out definitions, and complete Problems Worksheet.   Formal Assessment (LSI Quadrant III, IV):   * Basic Electricity and Electronics Quiz. |
| **References/Resources/**  **Teacher Preparation** | Basic Electricity and Electronics  Worksheet and Quiz |
| **Additional Required Components** | |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** |  |
| **Recommended Strategies** | |
| **Reading Strategies** |  |
| **Quotes** |  |
| **Multimedia/Visual Strategy**  **Presentation Slides + One Additional Technology Connection** |  |
| **Graphic Organizers/Handout** |  |
| **Writing Strategies**  **Journal Entries + 1 Additional Writing Strategy** |  |
| **Communication**  **90 Second Speech Topics** |  |
| **Other Essential Lesson Components** | |
| **Enrichment Activity**  (e.g., homework assignment) | CD audio can be studied for presentations or research papers. Students that are interested can do research on speaker operation, design, and optimization (woofer, midrange, tweeter). One interesting subject is how MP3 technology works, and how it is different from CD audio. Wikipedia is a good source, but a better source is <https://www.oreilly.com/learning> |
| **Family/Community Connection** |  |
| **CTSO connection(s)** | SkillsUSA |
| **Service Learning Projects** |  |
| **Lesson Notes** |  |

1. Visit the Texas College and Career Readiness Standards at <http://www.thecb.state.tx.us/collegereadiness/CRS.pdf>, Texas Higher Education Coordinating Board (THECB), 2009. [↑](#footnote-ref-1)