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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** | AC/DC Electronics |
| **Lesson/Unit Title** | Magnetism |
| **TEKS Student Expectations** | **130.405. (c) Knowledge and Skills**  (4) The student develops skills for managing a project  (A) The student is expected to implement project management methodologies, including initiating, planning, executing, monitoring and controlling, and closing a project  (B) The student is expected to develop a project schedule and complete work according to established criteria  (8) The student implements the concepts and skills that form the technical knowledge of electronics using project-based assessments.  (C) The student is expected to demonstrate an understanding of magnetism and induction as they relate to electronic circuits.  (9) The student applies the concepts and skills to simulated and actual work situations.  (B) The student is expected to apply electrical theory to generators, electric motors, and transformers. |
| **Basic Direct Teach Lesson**  (Includes Special Education Modifications/Accommodations and  one English Language Proficiency Standards (ELPS) Strategy) | |
| **Instructional Objectives** | The student will be able to:   1. Describe magnets and magnetism 2. Define terms associated with magnetism 3. Name two ways of producing artificial magnets 4. Distinguish between high, medium, low, and non-permeable magnetic materials 5. Select true statements concerning magnetic lines of force, magnetic fields, magnetic flux, and flux density 6. Discuss the use of the right- and left-hand rules for conductors and coils using an illustration 7. Discuss the method and effect of induction 8. List practical applications of induction in the electronics field 9. Demonstrate the ability to show the existence of magnetic lines of force around a magnet 10. Demonstrate that magnetic poles can attract and repel 11. Construct a simple electromagnet and check its operation |
| **Rationale** | Upon completion of this lesson, the student will be able to demonstrate an understanding of magnetism concepts by correctly performing the procedures outlined on the lab activity sheets and by scoring 70 % on the Basic Electronics – DC Magnetism Exam. |
| **Duration of Lesson** | * Three - 50-minute classes * One - 50-minute lab |
| **Word Wall/Key Vocabulary**  *(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* | **Magnetism** - A property of certain materials (e.g. iron, nickel, and cobalt) that exerts a mechanical force on other magnetic materials, and can cause induced voltages in conductors when relative movement is present  **Magnet** - An object that will attract iron, nickel, or cobalt and will produce an external magnetic field  **Natural magnet** - Any material found in the earth that exhibits the properties of magnetism (example: the lodestone, which contains magnetite[ a form of iron] and has been magnetized by the earth’s magnetic field)  **Artificial magnet** - A device that has been made magnetic by induction  **Magnetic induction** - Where a magnetic field causes an un-magnetized ferromagnetic substance to become magnetized  **Magnetic lines of force** - A set of imaginary curved lines around a magnet that indicates the strength and direction of the magnetic field  **Magnetic field** - The area around a magnet through which the lines of force flow  **Permanent magnet** - A magnetic device that retains its magnetism after it is removed from a magnetic field  **Electromagnet** - A core of soft iron that is temporarily magnetized by sending current through a coil of wire wound around the core  **Permeability** - The ability to pass or conduct magnetic field lines (note: some materials, such as iron, have high permeability, others such as aluminum have medium permeability, and others like silver and gold have low permeability.)  **Magnetic poles** - One of the two ends of a magnet where magnetic field lines converge or diverge (note: by convention, the north-seeking pole is marked with N, a plus, or is colored red.)  **Ferromagnetic** - Magnetic materials with high values of permeability that range from 50 to 5000 (note: steel, cobalt, nickel, and alnico are ferromagnetic materials.)  **Diamagnetic** - Non-magnetic materials; these have a permeability of less than one (note: diamagnetic materials include bismuth, antimony, copper, and zinc.) |
| **Materials/Specialized Equipment Needed** | * Magnetism Lab Activity Handout #1 - Show the existence of magnetic lines of force around a magnet * Magnetism Lab Activity Handout #2 - Demonstrate that magnetic poles can attract and repel * Magnetism Lab Activity Handout #3 - Construct a simple electromagnet and check its operation * Basic Electronics – DC Magnetism Exam * Basic Electronics – DC Magnetism Exam Key |
| **Anticipatory Set**  (May include pre-assessment for prior knowledge) |  |
| **Direct Instruction \*** | I. Magnetism basics  A. We all know what a magnet does; describing exactly what magnetism is can be harder.  B. The field is invisible and lines of force are only a convenient way to describe the field.  C. Magnetism is a property of certain materials; the most common example is iron.  D. Iron filings show magnetic field lines, but this is really just an artifact of the way the iron filings become magnets and attract each other, end to end.  E. A magnetic field does have a direction and a magnitude.  II. What creates magnetism?  A. Each electron is actually a tiny magnet due to what is called a “magnetic dipole moment.”  B. The dipole moment comes from an electron’s spin.  C. According to the Pauli Exclusion Principle, pairs of electrons must have opposite spins.  D. The net magnetism of electrons that are grouped in pairs is zero because the individual moments cancel.  E. Only materials that allow un-paired electrons (meaning electrons in different orbits) can allow the magnetic moments to add and create a measurable magnetic field.  F. There are several ways to categorize magnets. One way is to look at the difference between permanent magnets and electromagnets.  III. Important terms and units  A. Retentivity describes how long a magnet holds its magnetism and how easy it is to become magnetized.  B. Retentivity also relates to energy loss due to hysteresis when changing magnetism (as in an electromagnet).  C. Permeability is a measurement of how easy a material conducts magnetic lines of flux.  D. To make a stronger magnet you would use a core made of material with high permeability.  E. Ferromagnetism is a term used to describe natural magnets, which are usually made of iron.  F. Ferro is a Latin term for iron and is used for the atomic symbol for iron.  IV. Relationship between currents, forces, and fields  A. Magnetic fields are circular.  B. Electrical fields are straight lines.  C. There is an orthogonal (or perpendicular) relationship between current directions, force directions, and field line directions.  D. Electric and magnetic fields are also called transverse waves, which also means they are perpendicular.  E. Because of the way the directions are at right angles to one another, we have to use rules to tell us the relationships.  F. These rules are called the right- and left-hand rules.  G. The Hall Effect is an example where the use of the Left-hand rule has a practical application.  V. Uses of magnetism  A. One of the most important uses of magnetism is in motors and generators.  B. These two devices combine both electricity and magnetism.  C. Motors primarily use the interaction of two magnetic fields to create physical forces to produce torque.  D. Generators have a conductor moving through a magnetic field to create induction.  E. An AC motor creates a rotating magnetic field that the spinning rotor will try to follow.  VI. Magnetic properties and applications (NASA website <https://www.nasa.gov/pdf/417438main_Magnetic_Math.pdf>  A. The last part has a variety of topics that cover additional features and characteristics of magnetism.  B. Artificial magnets are created by forcing the magnetic moments of the electrons to align.  C. Different magnetic materials have different permeability, creating different strength magnets.  D. Non-magnetic materials are called diamagnetic.  E. There are good problems and examples for using mathematics involving magnetism on the NASA website.  VII. Terms and definitions  A. The terms and definitions can be used as a review of the material.  B. Having covered the material, these terms should make a lot more sense to the students.  C. Terms and definitions make good test and quiz questions.  VIII. Lab activities (Distribute Lab Activity Handouts #1, #2, and #3. Teacher will grade handouts. Distribute exam and grade. Students are required to make 70% on exam.  A. Can be either guided or independent practice  B. Lab Activity Handout #1  C. Lab Activity Handout #2  D. Lab Activity Handout #3  IX. Basic Electronics – DC Magnetism Exam  *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  None |
| **Guided Practice \*** | The students will answer questions about concepts and terms  *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  None |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | The students will create flashcards with terms and definitions. Students will complete the lab activity, Magnetism Lab Activity Handout #1, #2, and #3.  *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  None |
| **Lesson Closure** | Students will quiz each other on terms and concepts using flash cards. |
| **Summative/End of Lesson Assessment \*** | Informal Assessment - The teacher will ask questions and observe students during lab.  Formal Assessment - Students take the Basic Electronics – DC Magnetism Exam that is graded by the teacher.  *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  It is important that lessons accommodate the needs of every learner. These lessons may be modified to accommodate your students with learning differences by referring to the files found on the Special Populations page of this website. |
| **References/Resources/**  **Teacher Preparation** | * Buchla, D. & Floyd, T. (2005). The science of electronics DC/AC. (Chapter 4). Upper Saddle River, NJ:Pearson Prentice Hall. * Floyd, T. (1993). Principles of electric circuits: Electron flow version. New York, NY: Macmillan Publishing Co. * Robertson, L. (1980). Basic electronics I. Mid-American Vocational Curriculum Consortium, Inc. * NASA internet document: <https://www.nasa.gov/pdf/417438main_Magnetic_Math.pdf> |
| **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) |  |
| **Family/Community Connection** |  |
| **CTSO connection(s)** | SkillsUSA  Technology Student Association |
| **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)