

Automotive Electrical & Engine Performance 8/E












Chapter 11 Magnetism & Electromagnetism





Opening Your Class







KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Electrical & Engine Performance 8th edition provides complete coverage of automotive areas pertaining vehicle electrical systems and engine performance. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, and Animations that are listed in this Lesson Plan. This Lesson Plan also references ASEEducation (NATEF) Task Sheets available from Jim's web site.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	<p>Explain the chapter learning objectives to the students.</p> <ol style="list-style-type: none"> 1. Explain how magnetism and voltage are related. 2. Explain how an electromagnet works. 3. Describe how an ignition coil works. <p>This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "A" (General Electrical/Electronic System Diagnosis).</p>
Establish the Mood or Climate	Provide a <i>WELCOME</i> , Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: This lesson plan is based on **Automotive Electrical & Engine Performance 8th Edition** Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 11 Chapter Images: From
http://www.jameshalderman.com/books_a8.html#anchor2

ICONS	Ch11 Magnetism & Electromagnetism
          	<p>1. SLIDE 1 CH11 MAGNETISM & ELECTROMAGNETISM</p> <p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED</p> <p>NO VIDEOS IN THIS CHAPTER. Check www.youtube.com</p> <p>At the beginning of this class, you can download the crossword puzzle & Word Search from Jim's web site to familiarize your class with terms in this chapter & then discuss them, see below: HTTP://WWW.JAMESHALDERMAN.COM/BOOKS_A8.HTML#ANCHOR2 DOWNLOAD CROSSWORD PUZZLE (MICROSOFT WORD) (PDF) WORD SEARCH PUZZLE (MICROSOFT WORD) (PDF)</p> <p><u>Magnetic Induction</u></p> <p><u>Magnets</u></p> <p>2. SLIDE 2 EXPLAIN: Figure 11-1 Freely suspended natural magnet (lodestone) will point toward magnetic north pole.</p> <p><u>DEMONSTRATION:</u> SHOW HOW TO MAGNETIZE A SMALL OBJECT SUCH AS A NAIL OR PAPER CLIP. HAVE STUDENTS MAGNETIZE A SMALL OBJECT</p> <p><u>EXPLAIN TECH TIP:</u> A Cracked Magnet Becomes Two Magnets. Magnets are commonly used in vehicle crankshaft, camshaft, and wheel speed sensors. If a magnet is struck and cracks or breaks, result is 2 smaller-strength magnets. Because the strength of the magnetic field is reduced, sensor output voltage is also reduced. A typical problem occurs when a magnetic crankshaft sensor becomes cracked, resulting in a no-start condition. Sometimes cracked sensor works well enough to start an engine that is</p>

ICONS	Ch11 Magnetism & Electromagnetism
	<p>cranking at normal speeds, but does not work when the engine is cold. • SEE FIGURE 11-2.</p> <ol style="list-style-type: none"> SLIDE 3 EXPLAIN FIGURE 11-2 Magnet breaks or is cracked, it becomes 2 weaker magnets. SLIDE 4 EXPLAIN Figure 11-3 Magnetic lines of force leave north pole & return to south pole of bar magnet. SLIDE 5 EXPLAIN Figure 11-4 Iron filings and a compass can be used to observe magnetic lines of force. SLIDE 6 EXPLAIN Figure 11-5 Magnetic poles behave like electrically charged particles—unlike poles attract and like poles repel.
	<p><u>EXPLAIN TECH TIP: Magnetize a Steel Needle</u> A piece of steel can be magnetized by rubbing a magnet in one direction along steel. This causes atoms to line up in steel, so it acts like a magnet. The steel often does not remain magnetized, whereas true magnet is permanently magnetized. When soft iron or steel is used, such as a paper clip, it loses its magnetism quickly. The atoms in a magnetized needle can be disturbed by heating it or by dropping the needle on a hard object, which causes the needle to lose its magnetism. Soft iron is used inside ignition coils because it does not keep its magnetism.</p>
 	<ol style="list-style-type: none"> SLIDE 7 EXPLAIN Figure 11-6 crankshaft position sensor and reluctor (notched wheel). <p><u>EXPLAIN TECH TIP: Electricity and Magnetism</u> Electricity and magnetism are closely related because any electrical current flowing through a conductor creates a magnetic field. Any conductor moving through magnetic field creates electrical current. This relationship can be summarized as follows:</p> <ul style="list-style-type: none"> Electricity creates magnetism. Magnetism creates electricity. <p>This relationship is important because wires carrying current should always be routed as factory intended to avoid causing interference with another circuit or electronic component. This is important</p>

ICONS	Ch11 Magnetism & Electromagnetism
     	<p>when installing or servicing spark plug wires, which carry high voltages and can cause high electromagnetic interference.</p> <p>8. SLIDE 8 EXPLAIN Figure 11-7 magnetic field surrounds a straight, current-carrying conductor.</p> <p>DEMONSTRATION: WRAP A NUMBER 16 NAIL WITH 20 TURNS OF INSULATED WIRE. CONNECT ENDS OF THE WIRE TO A D CELL BATTERY. SHOW STUDENTS HOW THE NAIL IS NOW A MAGNET AND CAN PICK UP SMALL METAL OBJECTS</p> <p>HANDS-ON TASK: HAVE STUDENTS BUILD THEIR OWN ELECTROMAGNETS. LET THEM TRY MORE THAN ONE BATTERY, MORE TURNS OF WIRE, OR A LARGER CORE. HAVE THEM DOCUMENT THE STRENGTH OF EACH VERSION OF THE ELECTROMAGNET TO DECIDE WHAT PRODUCES A STRONGER MAGNET AND WHAT DOES NOT.</p> <p>9. SLIDE 9 EXPLAIN Figure 11-8 left-hand rule for magnetic field direction is used with electron flow theory.</p> <p>10. SLIDE 10 EXPLAIN Figure 11-9 right-hand rule for magnetic field direction is used with the conventional theory of electron flow</p> <p>DISCUSSION: DICUSS RIGHT-HAND & AND LEFT-HAND RULES OF MAGNETISM. WHICH RULE IS USED TO DETERMINE DIRECTION OF MAGNETIC FLUX LINES IN MOST AUTOMOTIVE CIRCUITS?</p> <p>11. SLIDE 11 EXPLAIN Figure 11-10 Conductors with opposing magnetic fields will move apart into weaker fields.</p> <p>12. SLIDE 12 EXPLAIN Figure 11-11 Electric motors use interaction of magnetic fields to produce mechanical energy.</p> <p>13. SLIDE 13 EXPLAIN Figure 11-12 magnetic lines of flux surrounding a coil look similar to those surrounding a bar magnet.</p> <p>14. SLIDE 14 EXPLAIN Figure 11-13 left-hand rule for coils is shown.</p> <p>15. SLIDE 15 EXPLAIN Figure 11-14 iron core concentrates magnetic lines of force surrounding a coil.</p>

ICONS**Ch11 Magnetism & Electromagnetism**

16. SLIDE 16 **EXPLAIN** Figure 11-15 electromagnetic switch that has a movable arm is referred to as a relay

DISCUSS FREQUENTLY ASKED QUESTION: SOLENOID OR RELAY? OFTEN, EITHER TERM IS USED TO DESCRIBE THE SAME PART IN SERVICE INFORMATION. • SEE CHART 47-1 FOR SUMMARY OF DIFFERENCES.

DISCUSS CHART 47-1 COMPARISON BETWEEN A RELAY AND A SOLENOID.

ANIMATION: ELECTROMAGNETISM IN RELAY:
Relay

17. SLIDE 17 **EXPLAIN** Figure 11-16 (a) A starter with attached solenoid. All of the current needed by the starter flows through the two large terminals of the solenoid and through the solenoid contacts inside

18. SLIDE 18 **EXPLAIN** Figure 11-16 (b) relay is designed to carry lower current compared to a solenoid and uses a movable arm




19. SLIDE 19 **EXPLAIN** Figure 11-17 Voltage can be induced by the relative motion between a conductor and magnetic lines of force.

20. SLIDE 20 **EXPLAIN** Figure 11-18 Maximum voltage is induced when conductors cut across the magnetic lines of force (flux lines) at a 90-degree angle.

21. SLIDE 21 **EXPLAIN** Figure 11-19 Mutual induction occurs when expansion or collapse of a magnetic field around one coil induces a voltage in a second coil.

22. SLIDE 22 **EXPLAIN** FIGURE 11-20 Some ignition coils are electrically connected, called married (top figure) whereas others use separated primary and secondary windings, called divorced (lower figure).

23. SLIDE 23 **EXPLAIN** Figure 11-21 A GM waste-spark ignition coil showing the section of laminations that is shaped like the letter E. These mild steel laminations improve the efficiency of the coil.

ICONS	Ch11 Magnetism & Electromagnetism
  	<p>24. SLIDE 24 EXPLAIN Figure 11-22 coil-on-plug (COP) design typically uses a bobbin-type coil.</p> <p>25. SLIDE 25 EXPLAIN Figure 11-23 To help prevent underhood electromagnetic devices from interfering with the antenna input, it is important that all ground wires, be properly grounded.</p> <p>EXPLAIN TECH TIP: <i>Cell Phone Interference</i> A cellular phone emits a weak signal if it is turned on, even though it is not being used. This signal is picked up and tracked by cell phone towers. When cell phone is called, it emits a stronger signal to notify the tower that it is on and capable of receiving a phone call. It is this “handshake” signal that can cause interference in the vehicle. Often this signal causes some static in the radio speakers even though the radio is off, but it can also cause a false antilock brake (ABS) trouble code to set. These signals from the cell phone create a voltage that is induced in the wires of the vehicle. Because cell phone usually leaves with the customer, the service technician is often unable to verify the customer concern. Remember, the interference occurs right before the cell phone rings. To fix the problem, check that all of the body-to-engine ground wires are clean and tight and add additional ground wires if needed.</p> <p><u>TASK SHEET</u> INSPECT & TEST SWITCHES, CONNECTORS, RELAYS, SOLENOID SOLID STATE DEVICES, AND WIRES OF ELECTRICAL/ELECTRONIC CIRCUITS; PERFORM NECESSARY ACTION</p>