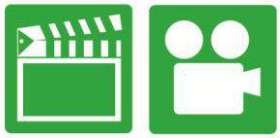
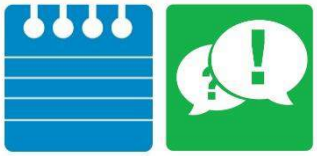
Automotive Electrical & Engine Performance 7/E

Chapter 11 Magnetism & Electromagnetism

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	**This course or class covers Automotive Electrical & Engine Performance. It correlates material to task lists specified by ASE and NATEF.**
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.	Explain the chapter learning objectives to the students. 1. Explain how magnetism and voltage are related. 2. Explain how an electromagnet works. 3. Describe how an ignition coil works. This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "A" (General Electrical/Electronic System Diagnosis).
Establish the Mood or Climate	Provide a *WELCOME,* 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 7/E Chapter Images found on Jim's web site @ www.jameshalderman.com
LINK CHP 11: Chapter Images

ICONS	Ch11 Magnetism & Electromagnetism
         	**1. SLIDE 1 CH11 MAGNETISM & ELECTROMAGNETISM** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **NO VIDEOS IN THIS CHAPTER. Check www.youtube.com** **At the beginning of this class, you can download the crossword puzzle & Word Search from the links below to familiarize your class with the terms in this chapter & then discuss them** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)** **Magnetic Induction** **Magnets** 2. **SLIDE 2 EXPLAIN**: **Figure 11-1** Freely suspended natural magnet (lodestone) will point toward magnetic north pole. **DEMONSTRATION: SHOW HOW TO MAGNETIZE A SMALL OBJECT SUCH AS A NAIL OR PAPER CLIP. HAVE STUDENTS MAGNETIZE A SMALL OBJECT** **EXPLAIN TECH TIP** 3. **SLIDE 3 EXPLAIN Figure 11-2** Magnet breaks or is cracked, it becomes 2 weaker magnets. 4. **SLIDE 4 EXPLAIN Figure 11-3** Magnetic lines of force leave north pole & return to south pole of bar magnet. 5. **SLIDE 5 EXPLAIN Figure 11-4** Iron filings and a compass can be used to observe magnetic lines of force. 6. **SLIDE 6 EXPLAIN Figure 11-5** Magnetic poles behave like electrically charged particles—unlike poles attract and like poles repel.

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	**EXPLAIN TECH TIP**
	7. **SLIDE 7 EXPLAIN Figure 11-6** crankshaft position sensor and reluctor (notched wheel).
	**EXPLAIN TECH TIP**
	8. **SLIDE 8 EXPLAIN Figure 11-7** magnetic field surrounds a straight, current-carrying conductor.
	**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**
	**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.**
	9. **SLIDE 9 EXPLAIN Figure 11-8** left-hand rule for magnetic field direction is used with electron flow theory.
	10. **SLIDE 10 EXPLAIN Figure 11-9 right-hand rule** for magnetic field direction is used with the **conventional theory** of electron flow
	**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?**
	11. **SLIDE 11 EXPLAIN Figure 11-10** Conductors with opposing magnetic fields will move apart into weaker fields.
	12. **SLIDE 12 EXPLAIN Figure 11-11** Electric motors use interaction of magnetic fields to produce mechanical energy.
	13. **SLIDE 13 EXPLAIN Figure 11-12** magnetic lines of flux surrounding a coil look similar to those surrounding a bar magnet.

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	14. **SLIDE 14 EXPLAIN Figure 11-13** left-hand rule for coils is shown. 15. **SLIDE 15 EXPLAIN Figure 11-14** iron core concentrates magnetic lines of force surrounding a coil. 16. **SLIDE 16 EXPLAIN Figure 11-15** electromagnetic switch that has a movable arm is referred to as a relay
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**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. 24. **SLIDE 24 EXPLAIN Figure 11-22** coil-on-plug (COP) design typically uses a bobbin-type coil.

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  	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. **EXPLAIN TECH TIP** **NATEF TASK SHEET INSPECT & TEST SWITCHES, CONNECTORS, RELAYS, SOLENOID SOLID STATE DEVICES, AND WIRES OF LECTRICAL/ELECTRONIC CIRCUITS; PERFORM NECESSARY ACTION**