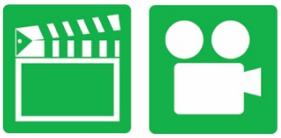
Automotive Electrical & Engine Performance 8/E
Chapter 21 Lighting & Signaling Circuits
Opening Your Class

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.	Explain the chapter learning objectives to the students. 1. Explain adaptive front lighting and other lighting systems in an automobile. 2. Describe how an exterior lighting system works. 3. Read and interpret a bulb chart. 4. Discuss the operation of brake lights and turn signals. 5. Inspect, replace, and aim headlights and bulbs. 6. Discuss troubleshooting procedures for lighting and signaling circuits. This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "E" (Lighting System Diagnosis and Repair).
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 8th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 21 Chapter Images: From

http://www.jameshalderman.com/books_a8.html#anchor2

ICONS	Ch21 Lighting & Signaling Circuits
	**1. SLIDE 1 CH21 Lighting & Signaling Circuits**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **Videos**
  	**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**
	**Hazard Lights**
	**Headlight Circuit** **Headlight Circuit, Parking Lights** **Headlight Circuit, High Beam** **Headlight Circuit, Low Bea**
	2. **SLIDE 2 EXPLAIN FIGURE 21–1** a typical headlight circuit diagram on an older vehicle that does not use a controller, such as the body control module (BCM) to control the operation of the lights. Note that the headlight switch is represented by a dotted outline indicating that other circuits (such as dash lights) also operate from the switch. 3. **SLIDE 3 EXPLAIN FIGURE 21–2** a schematic showing inputs from the multi-function switch and headlight switch to smart junction box (SJB). SJB then uses body control module (BCM) to operate the lights.
	**DEMONSTRATION: Pass a dual-filament bulb around classroom and point out double contacts on the bottom and the metal case used for ground**

ICONS	Ch21 Lighting & Signaling Circuits
	**DISCUSSION:** **Have students discuss how a dual filament bulb works. What are advantages of a dual filament bulb versus single filament bulb?**
	**DISCUSSION:** **Have students discuss benefits of using LEDs in place of conventional lamps. What are environmental impacts? What are cost benefits?**
	4. **SLIDE 4 EXPLAIN FIGURE 21–3** an LED emits light when a photon is released at the PN junction.
	**DEMONSTRATION:** **Show examples of 3157, 3157NA, and 3157A bulbs, or similar bulbs, to help them distinguish difference between bulb suffixes**
	5. **SLIDE 5 EXPLAIN FIGURE 21–4** a replacement LED taillight bulb is constructed of many small, individual light-emitting diodes.. 6. **SLIDE 6 EXPLAIN FIGURE 21-5** This single-filament bulb is being tested with a digital multimeter set to read resistance in ohms. The reading of 1.1 ohms is the resistance of the bulb when cold. As soon as current flows through the filament, the resistance increases about 10 times. It is the initial surge of current flowing through the filament when bulb is cool that causes many bulbs to fail in cold weather as a result of reduced resistance. As temperature increases, resistance increases. 6. **SLIDE 6 EXPLAIN FIGURE 21–6** dual-filament (double-contact) bulbs contain both a low-intensity filament for taillights or parking lights, and a high-intensity filament for brake lights and turn signals. Bulbs come in a variety of shapes and sizes. the numbers shown are the trade numbers
	**DISCUSS CHART 21-1** **Some automotive bulb trade numbers with their amperage and wattage rating. Check service information for the exact bulb to use.**
	**DEMONSTRATION:** **Show the students how to test the resistance of bulb using a DMM.**

ICONS	Ch21 Lighting & Signaling Circuits
    	**DISCUSSION:** **Have students talk about importance of selecting correct bulb for a lab vehicle. How is the amount of light produced by a bulb determined?** **DEMONSTRATION:** **BUILD a light bulb circuit on TRAINER measure resistance of each bulb with a DMM & using Ohm's Law and calculate the resistance of several different lamps with a given source voltage of 9 and 12 volts.** **HANDS-ON TASK: Have students build and measure the same circuit FROM DEMO on a TRAINER** 8. **SLIDE 8 EXPLAIN FIGURE 56–7** Bulbs that have the same trade number have the same operating voltage and wattage. NA means that the bulb uses a natural amber glass ampoule with clear turn signal lenses. Hazard Lights (View) (Download) Lights, Turn & Stop (View) (Download) Rear Lights (View) (Download) Stop Lights (View) (Download) Turn Indicators (View) (Download) 9. **SLIDE 9 EXPLAIN FIGURE 21–8** A typical older-type brake light circuit showing the brake switch and all of the related circuit components. 10. **SLIDE 10 EXPLAIN FIGURE 21–9** schematic of BCM-controlled brake light circuit that includes brake pedal position (BPP) switch, which creates signals to the powertrain control module (PCM) with inputs labeled BPS (brake pedal position) and BOO (brake on-off).. 11. **SLIDE 11 EXPLAIN FIGURE 21–10** Three styles of flasher units. 12. **SLIDE 12 EXPLAIN FIGURE 21–11** A steering column with the steering wheel removed, showing the turn signal canceling cam used to return the lever to the neutral position after a turn. The switches are an input to the body control module for left and right turn signal operation.. 13. **SLIDE 13 EXPLAIN FIGURE 21–12** Replacement side marker LED lamps that could be used to replace standard bulbs. However, the current draw is lower and

ICONS	Ch21 Lighting & Signaling Circuits
	using these bulbs could cause the lamp outage warning lamp to be turned on. 14. **SLIDE 14 EXPLAIN FIGURE 21–13** A schematic showing a DRL circuit that uses the headlights. Also notice that each headlight has its own fuse to protect the circuit. Check service information for how the DRLs operate on the vehicle being serviced.
	**DEMONSTRATION: Show what a single element stop lamp/turn signal looks like in operation on vehicle. Do same with a vehicle that has dual element bulbs in stop lamp/turn signal circuit.**
	**DISCUSSION: Discuss operation of stop lamp/turn signal circuit with a single filament bulb. How many wires are found at terminal connector? Discuss operation of a stop lamp/turn signal circuit with a dual filament bulb.**
	15. **SLIDE 15 EXPLAIN Figure 21-14** side-marker light goes out whenever there is voltage at both points X and Y. These opposing voltages stop current flow through the side-marker light. The left turn light and left park light are actually the same bulb (usually 2057) and are shown separately to help explain how the side-marker light works on many vehicles
	**DISCUSSION: Discuss function of TURN SIGNAL FLASHER. How does each different type of flasher accomplish this task? Discuss how to locate turn signal flasher. Use component location view in ON-LINE service information to find flasher**
	**DEMONSTRATION: Display a schematic of a typical turn signal circuit & show students which switches are ganged together. Show how ganged switches change state at same time.**
	**DEMONSTRATION: Using TRAINER ; simulate a turn signal bulb circuit & measure its resistance and amperage using a DMM**
	**HANDS-ON TASK: Have students build Turn Signal circuit on TRAINER, as shown in PREVIOUS DEMO & measure its resistance and amperage using a DMM.**

ICONS	Ch21 Lighting & Signaling Circuits
 	**ASEEDUCATION TASK E1:** **Diagnose (troubleshoot) the causes of brighter-than-normal, intermittent, dim, or no light operation; determine needed action.**
 	**ASEEDUCATION TASK E2:** **Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed.**
	16. **SLIDE 16 EXPLAIN FIGURE 21–15** typical composite headlamp assembly. Lens, housing, and bulb sockets are usually included as a complete assembly. 17. **SLIDE 17 EXPLAIN FIGURE 21–16** Handle a halogen bulb by base to prevent skin's oil from getting on glass. 18. **SLIDE 18 EXPLAIN FIGURE 21–17** right side of this headlight assembly has been restored, but still needs to be polished. The left side is cloudy and not yet restored**.** 19. **SLIDE 19 EXPLAIN FIGURE 21–18** igniter contains the ballast and transformer needed to provide high-voltage pulses to the arc-tube bulb.
	Courtesy Lights (View) (Download) Headlight Circuit, Parking Lights (View) (Download) Headlight Circuit, High Beam (View) (Download) Headlight Circuit, Low Beam (View) (Download)
 	**ASEEDUCATION TASK E3:** **Aim headlights**
 	**DISCUSSION:** **students discuss HALOGEN BULBS. Why should you never touch a halogen bulb with your fingers?**
	**WARNING: Always adhere to all warnings because high voltage output of ballast assembly can cause serious personal injury or death.**

ICONS	Ch21 Lighting & Signaling Circuits
	**20. SLIDE 20 EXPLAIN FIGURE 21–19** (a) The color of light is measured in degrees Kevin (K). The higher the temperature of the light is, the bluer the appearance. (Line drawing to be drafted) (b) HID (xenon) headlights emit a whiter light than halogen headlights and usually look blue compared to halogen bulbs. **21. SLIDE 21 EXPLAIN Figure 21-20** HID (xenon) headlights emit a whiter light than halogen headlights and usually look blue compared to halogen bulbs
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***What Is Difference between Temperature of the Light and Brightness of Light?*** **The temperature of light indicates color of light. The brightness of light is measured in lumens. A standard 100-watt incandescent light bulb emits about 1,700 lumens. A typical halogen headlight bulb produces about 2,000 lumens, and a typical HID bulb produces about 2,800 lumens.**
	**DISCUSSION: Discuss operation & operational states of HID (High-Intensity Discharge Headlights). What components make up the system? What costs are associated with HID lights? What is a ballast resistor?** **HID headlights are also known as xenon lights.**
	
	**DISCUSSION: Have students talk about operation of a transformer. Why is transformer needed in HID headlight system?**
	**ASEEDUCATION TASK E4: Identify system voltage and safety precautions associated with high-intensity discharge headlights.**
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	**22. SLIDE 22 EXPLAIN FIGURE 21–21** Adaptive front lighting systems rotate the low beam headlight in the direction of travel.

ICONS	Ch21 Lighting & Signaling Circuits
    	**DISCUSSION:** Have the students talk about benefits of **LED Headlights.** How long do they last? What are their environmental benefits? **HANDS-ON TASK:** Have students download Headlight Circuit for a lab vehicle & have a discussion on circuit 23. **SLIDE 32 EXPLAIN FIGURE 21–22** A typical adaptive front lighting system uses two motors: one for the up and down movement and the other for rotating the low-beam headlight to the left and right. 24. **SLIDE 24 EXPLAIN FIGURE 21–23** Typical dash-mounted switch that allows driver to turn off the front lighting system. 25. **SLIDE 25 EXPLAIN FIGURE 21–24** A dash symbol used to inform the driver that automatic headlights are on. 26. **SLIDE 26 EXPLAIN FIGURE 21–25** (a) A typical headlight-aiming diagram as found in service information. (b) Adjustments to move the headlight-aiming point left or right or up and down are usually made using a screwdriver to move the headlight housing. 27. **SLIDE 27 EXPLAIN FIGURE 21–26** Fog lights are often included on many vehicles, such as these on a Lexus SUV. **DISCUSS FREQUENTLY ASKED QUESTION:** ***What Are Rear Fog Lights?*** **Some vehicles, usually European vehicles, are equipped with rear (red) fog lights. These are used so that drivers behind can see the vehicle in front. These could be on whenever fog lights are turned on, or they could be on a separate switch. These rear fog lights are sometimes confused with brake lights being on because they are often as bright as brake lights. Check the owner's manual or service information if a fault is reported about the rear fog lights.**

ICONS	Ch21 Lighting & Signaling Circuits
	**DISCUSSION:** Have students discuss operation of **ADAPTIVE FRONT LIGHTING Systems (AFS).** Which types of vehicles are equipped with AFS? How can a diagnostic scan tool be used to test the function AFS Systems
	**HANDS-ON TASK:** Have students download a wiring diagram for **ADAPTIVE FRONT LIGHTING** Systems (AFS) equipped vehicle. Locate components on a vehicle if possible and tag them.
	**DEMONSTRATION:** Provide schematic of **ADAPTIVE FRONT LIGHTING Systems (AFS).** Show students location of each component in system and which other modules and sensors in vehicle are used in conjunction with
	**28. SLIDE 28 EXPLAIN FIGURE 21–27** automatic dimming mirror compares amount of light toward front of the vehicle to the rear of vehicle and allows a voltage to cause the gel to darken the mirror.
	**DISCUSSION:** Operation of **Daytime Running Lights (DRL).** What are safety benefits of daytime running lights?
	**Daytime Running Lamps (DRLs): Vehicles with DRLs may not have flash to pass function. Newer vehicles may use a Lamp Control Module (LCM) to control DRLs electronically.**
	**29. SLIDE 29 EXPLAIN FIGURE 21–28** Ford headlight circuit showing the control of the power side of the circuit comes from the smart junction box (SJB).
	**DEMONSTRATION:** Build Rheostat or potentiometer circuit on a **TRAINER**. Discuss operation of a rheostat. Show them how resistance in a rheostat changes as knob is turned. What automotive applications might use rheostats? What is difference between rheostat & potentiometer?
	**Dimmer Switch connected mechanically to control lever & common failure item (depending on use) due to mechanical nature of switch**

ICONS	Ch21 Lighting & Signaling Circuits
	**Dome Lights may be controlled electronically through BCM**
	**DISCUSSION:** talk about operation of photoresistors & photodiodes. How could these components be incorporated into automatic Headlight circuits?
	**DISCUSSION:** Discuss how computer is used to control courtesy lights and illuminated entry on some vehicles. What are system's inputs and how does the computer receive data from all of them?
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***What Is the Troxler Effect?*** **The Troxler effect, also called Troxler fading, is a visual effect where an image remains on the retina of the eye for a short time after the image has been removed. The effect was discovered in 1804 by Ignaz Paul Vital Troxler (1780–1866), a Swiss physician. Because of the Troxler effect, headlight glare can remain on the retina of the eye and create a blind spot. At night, this fading away of the bright light from the vehicle in the rear reflected by the rearview mirror can cause a hazard.**
	**30. SLIDES 30-35 OPTIONAL TAILLIGHT BULB REPLACEMENT**
	**35. SLIDES 35-46 OPTIONAL OPTICAL HEADLIGHT AIMING**