Automotive Technology 5th Edition
Chapter 91 INTRODUCTION TO HYBRID VEHICLES
Opening Your Class

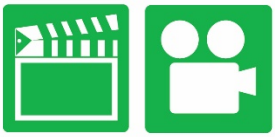
KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
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 learning objectives to students as listed below: 1. Discuss the evolution of electric vehicles and how driving and owning a hybrid electric vehicle is different from a conventional vehicle. 2. Describe how owning a hybrid electric vehicle is different from a conventional vehicle. 3. Explain the classifications of hybrid electric vehicles. 4. Explain the operation of belt-alternator-starter (BAS) systems. 5. Discuss the common features of most hybrids and the levels of hybrid vehicle.
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: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 91 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Chapter 91 Introduction To Hybrid Vehicles
     	**1. SLIDE 1 CH91 INTRODUCTION TO HYBRID ELECTRIC VEHICLES** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF** **Videos** **2. SLIDE 2 EXPLAIN Figure 91-1** components of GM electric vehicle (**EV1**). Many of features of this vehicle, such as regenerative braking, currently used on hybrid vehicles were first put into production on this vehicle **DISCUSS FREQUENTLY ASKED QUESTION: *How Fast Does the Motor-Generator Turn the Engine When Starting?* The typical starter motor used on a conventional gasoline or diesel engine rotates the engine from 100 to 300 RPM. Because typical engine idles at about 600 to 700 RPM, starter motor is rotating engine at a speed slower than it operates. This makes it very noticeable when starting because sound is different when cranking compared to when engine actually starts and runs. However, when motor-generator of a hybrid electric vehicle rotates engine to start it, the engine is rotated about 1,000 RPM, which is about the same speed as when it is running. As a result, engine cranking is just barely heard or felt. Engine is either running or not running, which is a truly unique sensation to those not familiar with operation of HEVS.**

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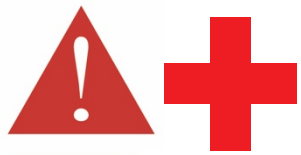
	**DISCUSSION:** Ask the students to discuss **Evolution of Automobiles**. Have them share how automobiles have changed over time. What advances will future vehicles have? **FIGURE 91-1**
	**DISCUSSION:** Review with students different methods of propulsion. What **two common combinations** are being used to classify vehicles as hybrids?
	**DISCUSSION:** Review **Ohm's law:** 1 volt is required to push 1 ampere through 1 ohm of resistance; therefore, if voltage is doubled, then number of amperes of current flowing through circuit will also double if the resistance of circuit remains the same. How does Ohm's law apply to electric vehicles?
	**SAFETY** Remind students to use **INSULATED TOOLS** when working on vehicles that use **HIGH VOLTAGE.**
	**DISCUSSION:** Gather information about newest **ZEV Vehicles** available. Ask students to identify current benefits, problems, and future of these vehicles.
	**DISCUSSION:** Have the students consider the benefits or drawbacks concerning cost of a vehicle vs. fuel savings. How long will you need to drive a vehicle with fuel savings in order to offset its extra cost as compared to driving an internal combustion engine vehicle?
	**DEMONSTRATION:** Measure **amperage & voltage in series and parallel circuits** on vehicle. Call attention to the change in amperes and volts between series and parallel circuits.
	3. **SLIDE 3 EXPLAIN Figure 91-2** Using a standardized plug to recharge an electric vehicle or a plug-in hybrid electric vehicle such as this Toyota Prius takes many hours depending on voltage of charger.
	**DEMONSTRATION: Start hybrid vehicle** with students. Have them compare & contrast this start with a combustion engine vehicle start. Ask students to discuss differences between 2 starts.

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	**DISCUSSION: Show the students charge port for a hybrid electric vehicle. Discuss the procedures involved with recharging along with electrical requirements of a charging facility. FIGURE 91-2**
	4. **SLIDE 4 EXPLAIN Figure 91-3** A drawing of the power flow in a typical series-hybrid vehicle. 5. **SLIDE 5 EXPLAIN Figure 91-4** This diagram shows the components included in a typical series-hybrid design. The solid-line arrow indicates the transmission of torque to the drive wheels. The dotted-line arrows indicate the flow of electrical current
	6. **SLIDE 6 EXPLAIN Figure 91-5** The power flow in a typical parallel-hybrid vehicle. 7. **SLIDE 7 EXPLAIN Figure 91-6** Diagram showing the components involved in a typical parallel-hybrid vehicle. The solid-line arrows indicate the transmission of torque to the drive wheels, and the dotted-line arrows indicate the flow of electrical current
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***What are one, two, and three motor hybrids?*** **Hybrids can have one, two, or three electric motor/ generators (M/G).** • **One-motor systems include hybrids from VW, Nissan, Honda, and General Motors.** • **Two-motor systems are used by Nissan, Toyota, Honda Ford, and General Motors.** • **Three-motor system hybrids include the Toyota Highlander and Lexus RX400h/450h SUVs, where the rear drive wheels are driven by the rear electric motor/generator.**
	**Parallel Hybrid (View) (Download)** **Regenerative Braking 2 (View) (Download)** **Series Hybrid (View) (Download)**
	8. **SLIDE 8 EXPLAIN Figure 91-7** series-parallel hybrid design allows vehicle to operate in electric motor mode only or in combination with internal combustion engine.

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	**DISCUSSION:** Have students compare & contrast components of series and parallel hybrid vehicles, referring to **FIGURES 91-3 to 91-7**. Ask students to identify the pros and cons of components.
	**DISCUSSION:** Have students identify other **fuels** that can replace diesel fuel. How will these alternate fuels help reduce fuel costs?
	**DISCUSSION:** Review idle stop mode with the students and highlight the difference between a **conventional starter & voltage motor generator**.
	9. **SLIDE 9 EXPLAIN Figure 91-8** This chart shows what is occurring during various driving conditions in a BAS-type hybrid.
	**DISCUSSION:** Have students talk about belt alternator starter systems. What are the advantages of **BAS systems**? **FIGURE 89-8**
	10. **SLIDE 10 EXPLAIN Figure 91-9** The components of a typical belt alternator-starter (BAS) system.
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***Can Hybrids Use the HOV Lane?*** **In most locations the answer is yes, but it depends on type of hybrid vehicle. The high-occupancy vehicle (HOV) lane in many cities is reserved for use by vehicles that are carrying more than one occupant as a way to encourage carpooling and the use of public transportation. In California, only those hybrids classified as being high fuel-economy models and those meeting certain emission ratings qualify. Those that do qualify, such as the Toyota Prius, are issued stickers that show that they are entitled to be in the HOV lane even if there is just the driver in vehicle. High-performance hybrids, such as the Honda Accord hybrid, do not meet**

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	the specified fuel economy rating to allow owners to be issued HOV stickers, which are also limited as to how many in the entire state can be issued. • SEE FIGURE 91–10.
	**11. SLIDE 11 EXPLAIN Figure 91-10** This sticker on a hybrid vehicle allows the driver to use the high-occupancy vehicle (HOV) lanes even if there is only one person in the vehicle as a way to increase demand for hybrid vehicles in California.
	**HANDS-ON TASK: If you have access to a vehicle with a BAS system, have students identify the components of system, referring to FIGURE 91-9 as needed.**
	**DISCUSSION: Discuss benefits & drawbacks of BAS system. Should vehicle with a BAS system be considered hybrid vehicle? Can BAS system be added to a converted diesel vehicle to help it be considered a full hybrid vehicle? FIGURE 91-9**
	**12. SLIDE 12 EXPLAIN Figure 89-11** A combination starter/alternator is used to provide idle stop function to conventional vehicles. This very limited and low cost system is called a micro-hybrid drive.
	**DISCUSSION: Hold a discussion on the MICRO-HYBRID DRIVE SYSTEM: What is a bidirectional tensioner and what role does it play in a micro hybrid-drive system? Why does this belt tensioner need to provide tension in both directions? FIGURE 91-11**
	**HANDS-ON TASK: : If you can obtain either a BAS or MICRO-HYBRID conversion kit, have your class convert a common ICE vehicle into a mild hybrid by adding a BAS or MICRO-HYBRID system. This is also an opportunity for students to review safety procedures & electrical principles to develop a better understanding of hybrid vehicles.**
	**EXPLAIN TECH TIP: *Watch Out for Motoring Mode*** **When a hybrid electric vehicle (HEV) is operating at low speeds, it is often being propelled by the electric motor alone, sometimes called motoring mode. As a result, vehicle is very quiet and is said**

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	to be operating in quiet mode. During this time, the driver should be aware that vehicle is not making any sound and should be careful when driving in congested areas. Service technicians should also be extremely careful when moving a HEV around the shop due to the silence of the vehicle.
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***What Is an Assist Hybrid?*** **An assist hybrid-electric vehicle is a term used to describe vehicle where the electric motor is not able to start moving the vehicle on electric power alone. This type of hybrid includes all mild hybrids (36 to 42 volts), as well as the medium hybrids that use 144- to 158-volt systems.**
	**DEMONSTRATION: While a hybrid engine is in idle stop mode, connect a five-gas analyzer. Have students take note of the CO2 reading to confirm zero or low CO2 levels in idle stop mode. Next, connect a five-gas analyzer to an ICE and compare CO2 readings at idle. Discuss results.**
	**DISCUSSION: What are common voltage ratings for mild, medium, and full hybrid vehicles?**
	Remind students of safety precautions required for working on hybrid electric vehicles
	**DISCUSSION: Have students discuss efficiencies of electric motors and internal combustion engines. Which is more efficient overall—electric motor or ICE?**
	**HANDS-ON TASK: Have the students RESEARCH independent repair shops that work on hybrid electric vehicles. What types of repairs are they doing, and what safety precautions are being observed? Have students share their findings with class.**

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  	**ON-VEHICLE ASEEDUCATION TASK:** Locate and interpret **HEV** vehicle labels and calibration decals. Automatic Temperature Control, ATC Sun Load (View) (Download) Automatic Temperature Control, ATC Temperature, Heat (View) (Download) Automatic Temperature Control, ATC Air Quality (View) (Download) Automatic Temperature Control, ATC Temperature, Cool, Adjust (View) (Download) Automatic Temperature Control, ATC Temperature, Cool (View) (Download) Automatic Temperature Control, ATC Temperature, Humidity (View) (Download) Compressor Temperature Sensor (View) (Download)