

Automotive Technology 6th Edition

Chapter 93 Electric and Plug-in Hybrid Electric 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 the chapter learning objectives to the students. <ol style="list-style-type: none"> 1. Identify a plug-in hybrid electric vehicle (PHEV) and explain how the high-voltage battery is recharged. 2. Discuss the battery capacity and range correlation of an EV. 3. Describe the levels of chargers used to charge a PHEV or an EV.
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: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 93 Chapter Images: From http://www.jameshalderman.com/automotive_principles.html

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

ICONS	Ch93 Electric and Plug-in HEVS
     	<p>1. SLIDE 1 CH93 Electric and Plug-in Hybrid Electric Vehicles</p> <p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED</p> <p>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</p> <p>http://www.jameshalderman.com/automotive_principles.html</p> <p>DOWNLOAD</p> <p>Crossword Puzzle (Microsoft Word) (PDF) Word Search Puzzle (Microsoft Word) (PDF)</p> <p><u>DISCUSS CHART 93-1</u> The higher capacity of HV battery, further vehicle can travel using electric power only, but longer it takes to be fully charged when plugged into a charger.</p> <p>2. SLIDE 2 EXPLAIN FIGURE 93-1a about the only way to tell a plug-in Prius from a regular Prius is from the badge on the sides or b by the charge port door on the passenger side at the rear.</p> <p>3. SLIDE 3 EXPLAIN FIGURE 93-2 A Chevrolet Volt extended range electric vehicle (EREV) is also called a plug-in hybrid electric vehicle (PHEV) being chargers at a row of charging stations at the Corvette plant in Bowling Green. KY.</p> <p>4. SLIDE 4 EXPLAIN FIGURE 93-3 (a) Charging stations that are equipped with SAE standard J1772 chargers are often found at large companies, colleges, universities, and shopping malls in many parts of the country. (b) A typical SAE J1772 charging station that is in a designated electric vehicle parking location, which is often in a premiere location to encourage use of electric and plug-in electric vehicles.</p>
	<p>EXPLAIN TECH TIP: Turn On Heat or A/C While Still Connected If charging a plug-in hybrid or an electric vehicle, use a smart phone app to access</p>

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	<p>the vehicle to turn on the air conditioning or heat 15 minutes before leaving from work. For example, an owner of a Nissan Leaf, who works in Phoenix, AZ, uses the phone app to start the air conditioning while it is still connected to the charging station at work. Then the interior is nice and cool when the owner is ready to leave work, even though the vehicle has been sitting in the hot sun on a 100-degree day. Because the operation of A/C is occurring while still plugged into charging station, the range of the Leaf is not affected and ride home is done in comfort. The same can be done to heat the interior in cold weather, too.</p> <p>EXPLAIN TECH TIP: <i>Batteries like the Same Temperature Range as Humans</i> Batteries work best when they are kept within a temperature range that is also the most comfortable for humans. Most people are comfortable when the temperature is between 68°F and 78°F (20°C and 26°C).</p> <ul style="list-style-type: none"> • Below 68°F (20°C), most people want heat. • Above 78°F (26°C), most people want cooling. <p>Batteries perform best when they too are exposed to same temperature range. Therefore, a proper heating and cooling system must be used to keep batteries within this fairly narrow temperature range for best performance.</p>
	<p>EXPLAIN TECH TIP: <i>The Rule of Thumb Is 3</i> To help estimate the range of an electric vehicle (EV), multiply battery capacity in kilowatt-hours (kWh) by Three to get a good idea as to the range of the vehicle. For example, a Nissan Leaf has a battery capacity of 24 kWh and, when multiplied by 3, equals 72 miles (24 × 3 = 72).</p>
	<p>DISCUSS CHART 93-2 Selected electric vehicles and their battery capacity and published range..</p>
	<p>DISCUSS FREQUENTLY ASKED QUESTION: <i>What is range anxiety?</i> Range anxiety is a feeling many drivers' experience when driving</p>

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an electric vehicle because they fear running out of electric battery energy before they reach their destination. This condition is very common but, according to studies, this feeling lasts about two weeks after first getting an electric vehicle. Within those first two weeks, driver gets experience regarding how far the vehicle can travel on a full charge and knows that their trip can be completed without any issues.



QUESTION



- 5. **SLIDE 5 EXPLAIN FIGURE 93-4** SAE J 1772 plug is used on most electric and plug-in hybrid electric vehicles and is designed to work with level 1 (110–120 volt) and level 2 (220–240 volt) charging.
- 6. **SLIDE 6 EXPLAIN FIGURE 93-5A** Chevrolet Volt being charged using the supplied 100-volt charger: **5B** always lay out the entire length of the charging cord before plugging the vehicle into the outlet. If the cord is not kept straight, the current flow can not only create a coil but the flow of current can overheat the wires and in some cases can actually cause the insulation to melt.
- 7. **SLIDE 7 EXPLAIN FIGURE 17-6** Nissan Leaf plugged into a charging station at a college.

DISCUSSION: HAVE STUDENTS TALK ABOUT PHEV & EHEV SYSTEMS. WHAT ARE ADVANTAGES OF EHEVS?

HANDS-ON TASK: IF YOU HAVE ACCESS TO A PHEV, HAVE STUDENTS IDENTIFY THE COMPONENTS OF SYSTEM

- 8. **SLIDE 8 EXPLAIN FIGURE 93-7** (a) An SAE combo plug that includes J-1776 design at the top for level 1 and level 2 charging, with added two large terminals that are used to charge using high-voltage DC. (b) A Chevrolet Bolt electrical charging terminal. The orange plastic tab can be pivoted to cover the level 3 terminals if a level 1 or 2 is being used

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   	<p>DISCUSS FREQUENTLY ASKED QUESTION <i>What Is a “CHAdEMO” Connector? CHAdEMO is a Japanese trade name of a quick charging method for level 3 charging using DC electricity at a high rate. “CHAdEMO” is an abbreviation of “CHArge de MOve,” which can be translated to mean “charge for moving.” • SEE FIGURE 93–8.</i></p> <p>9. SLIDE 9 EXPLAIN FIGURE 93–8 A Nissan Leaf electric vehicle charging ports located at the front of the vehicle under a hinged door for easy access.</p> <p>HAVE STUDENTS SEARCH <u>INTERNET</u> TO RESEARCH PHEVS FOR SALE IN US. WHAT IS COST OF THESE VEHICLES? WHAT NEW FEATURES ARE AVAILABLE AND IS THERE ANY NEWER BATTERY TECHNOLOGY AVAILABLE? HAVE STUDENTS REPORT THEIR FINDINGS TO CLASS.</p>