Automotive Technology 6th Edition
Chapter 89 ONBOARD DIAGNOSIS
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. Explain the purpose and function of on-board diagnostics generation-II (OBD-II) systems. 2. List the various continuous and non-continuous monitors. 3. Explain the information that can be obtained from an on-board diagnostics monitor and the criteria to enable an OBD monitor. 4. Explain the numbering designation of OBD-II diagnostic trouble codes.
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 89 Chapter Images: From

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

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

ICONS	Chapter 89 ONBOARD DIAGNOSIS

1. SLIDE 1 CH89 ON-BOARD DIAGNOSIS

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 89-1** A typical malfunction indicator lamp (MIL) often labeled "check engine" or "service engine soon" (SES).

DISCUSSION: Have students talk about purpose of onboard diagnostic systems. How did computer control systems function prior to OBD-I? Have the students discuss OBD-I. What were some of shortcomings/problems of OBD-I?

DISCUSS FREQUENTLY ASKED QUESTION:

What is a Drive Cycle? **A drive cycle is a vehicle being driven under specified speed and times that allows all monitors to run. PCM is looking at a series of data points representing speed and time and determines from these data points when conditions are right to perform a monitor or a test of a component. These data points and, therefore, drive cycle are vehicle-specific and are not same for each vehicle. Some common conditions for a drive cycle to successfully run all of the monitors include:**

1. **Cold start with intake air temperature (IAT) and engine coolant temperature (ECT) close to each other, indicating that engine has**

ICONS	Chapter 89 ONBOARD DIAGNOSIS
	cooled to the temperature of surrounding air temperature. 2. Fuel level within a certain range, usually between 15% and 85%. 3. Vehicle speed within a certain speed range for certain amount of time, usually 4 to 12 minutes. 4. Stop and idle for a certain time. Each monitor requires its own set of parameters needed to run the test, and sometimes these conditions cannot be met. For example, some evaporate emissions control (EVAP) systems require a temperature that may not be possible in winter months in a cold climatic area. A typical universal drive cycle that works for many vehicles includes the following steps. MIL must be off. No DTCs present. Fuel fill between 15% and 85%. Cold start—Preferred = 8-hour soak at 68°F to 86°F. Alternative = ECT below 86°F. STEP 1 With ignition off, connect scan tool. STEP 2 Start engine and drive between 20 and 30 mph for 22 minutes, allowing speed to vary. STEP 3 Stop and idle for 40 seconds, gradually accelerate to 55 mph. STEP 4 Maintain 55 mph for 4 minutes using a steady throttle input. STEP 5 Stop and idle for 30 seconds, then accelerate to 30 mph. STEP 6 Maintain 30 mph for 12 minutes. STEP 7 Repeat steps 4 and 5 four times.

ICONS	Chapter 89 ONBOARD DIAGNOSIS
	HANDS-ON TASK: Have the students locate the **diagnostic link connector (DLC)** on several OBD-I vehicles using component locators. Ask students to compare various locations to standardized locations on an OBD-II vehicle
Education Foundation	**ON-VEHICLE ASEEDUCATION TASK:** Locate and interpret vehicle and major component identification numbers: Diagnose causes of emissions or driveability concerns with stored or active DTCS; obtain, graph, & interpret scan tool data: Describe importance of running all **OBDII Monitors** for repair verification.
QUESTION	**DISCUSSION:** Have the students discuss examples of **OBD-II monitors** and how they operate. What is a monitor?
DEMO	**DEMONSTRATION:** Connect a scan tool to OBD-II vehicle & show students how to access monitor status. Then demonstrate Comprehensive Component Monitor operation by disconnecting a sensor such as engine coolant temperature with the key on. Show illuminated MIL & stored DTC. **FIGURE 89-1**
	Certain 1996 & 1997 OBD-II vehicles could set a misfire DTC from operation on rough roads. Misfire Monitor was very sensitive on these vehicles & could misinterpret slight crankshaft speed variations caused by rough roads as ignition misfires
DEMO	**DEMONSTRATION:** Demonsstrate operation of **misfire monitor** by closing electrode gap on spark plug and operating the engine. Once misfire has been detected, connect scan tool & show DTC
	Depending on PCM's determination of misfire's severity, misfire monitor may set pending code until ignition is cycled OFF & engine is operated 2^{nd} time. After 2^{nd} failure, matured DTC sets, with MIL on

ICONS	Chapter 89 ONBOARD DIAGNOSIS
	DISCUSSION: Have the students discuss **enabling criteria** and why they are important. What are conditions that must be met for each monitor to run?
	DISCUSSION: Have the students discuss criteria for a **TRIP** and why they are important for the OBD-II system. What is a trip?
	DISCUSSION: Have the students talk about **DRIVE CYCLES.** What is a drive cycle and how does it differ from a trip?
	DISCUSSION: Have students discuss **numbering of DTCs.** What are major categories of OBD-II designated DTCs? Explain numbering for OBD-II DTCs & give some examples & explanations (e.g., P0301- cylinder #1 misfire detected; P0441- incorrect evaporative purge flow detected)
	3. **SLIDE 3** EXPLAIN **Figure 89-2** OBD-II DTC identification format.
	ON-VEHICLE ASEEDUCATION TASK B1: Retrieve and record diagnostic trouble codes (DTC), OBD monitor status, and freeze frame data; clear codes when applicable. B4. Describe the use of OBD monitors for repair verification.
	ON-VEHICLE ASEEDUCATION TASK B4: Describe the use of OBD monitors for repair verification.
	DTC (View) (Download) Retrieving Trouble Codes, Code Reader (View)
	DISCUSSION: Have the students talk about **Types of DTCs.** How are OBD-II DTCs classified for importance? **CHART 89-1 PCM Determination of faults chart.**

ICONS	Chapter 89 ONBOARD DIAGNOSIS
	DEMONSTRATION: Create a one-trip failure of a two-trip code; for example, create a type B misfire by closing spark plug electrodes & operating engine one time. Show students how to find pending DTCs with scan tool **CHART 89-1**
	DISCUSSION: Have the students discuss **PENDING CODES.** What are pending codes and where are they stored?
	FREQUENTLY ASKED QUESTION: ***What Are Pending Codes?*** Pending codes are set when operating conditions are met and component or circuit is not within normal range, yet ***conditions have not yet been met to set a DTC.*** For example, a sensor may require two consecutive faults before a DTC is set. If a scan tool displays a pending code or a failure, a driveability concern could also be present. The pending code can help the technician to determine root cause before the customer complains of a check engine light indication.
	HANDS-ON TASK: Have the students create pending DTCs on LAB VEHICLES their own cars. Have them retrieve the pending codes and freeze-frame data.
	DISCUSSION: Have the students discuss **PCM tests.** What is **rationality testing**? What is **functionality testing**?
	DEMONSTRATION: ON OBD-II Vehicle Disconnect a sensor, such as a coolant temperature sensor, to show students how PCM tests functionality. Show students DTC and create an opposing DTC by shorting connector terminals together.
	DISCUSSION: Have the students talk about **MODE SIX INFORMATION.** What is mode six data, and how can it be useful for diagnosis?

ICONS	Chapter 89 ONBOARD DIAGNOSIS
	**FREQUENTLY ASKED QUESTION: *How Can You Tell Generic from Factory?*** **When using a scan tool on an OBD-II-equipped vehicle, if display asks for make, model, and year, then factory or enhanced part of the PCM is being accessed. If generic or global part of PCM is being scanned, then there is no need to know the vehicle identification details.**
	**HANDS-ON TASK: Have the students connect an enhanced scan tool to a LAB VEHICLE or their own vehicles. Have them access OEM data & list available parameters. Have them access generic OBD-II data and create similar list for comparison.**