Automotive Technology 6th Edition
Chapter 13 Scientific Principles & Materials
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 as listed: 1. Discuss the use of scientific methods and energy principles in solving problems. 2. Explain the relationship between torque, work, power, and horsepower. 3. Explain the importance of Newton's laws of motion, kinetic energy, inertia, and mechanical principles in brake design. 4. Describe the types of plastics, iron, steel, and aluminum alloys.
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 the 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 13 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Ch13 Scientific Principles & Materials
	**1. SLIDE 1 SCIENTIFIC PRINCIPLES & MATERIALS**
	**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**
	http://www.youtube.com/watch?v=GKGtkzgKfkc Scientific Method http://www.youtube.com/watch?v=30o4omX5qfo Work http://www.youtube.com/watch?v=MDSr51e5GFw Torque http://www.youtube.com/watch?v=CQYELiTtUs8 Newton's First Law http://www.youtube.com/watch?v=BSWl_Zj-CZs Potential and Kinetic Energy http://www.youtube.com/watch?v=fFFgWl6t-6c Mass and Inertia http://www.youtube.com/watch?v=ShS3mxVZCGU SAE Steel Grades
	**2. SLIDE 2 Figure 13-1** Energy, which is the ability to perform work, exists in many forms**.**
	**DEMONSTRATION: SHOW STUDENTS AN EXAMPLE OF KINETIC VERSUS POTENTIAL ENERGY USE IN THE SHOP.**
	**3. SLIDE 3 EXPLAIN Figure 13-2** ***Torque*** is a twisting force equal to distance from pivot point times force applied expressed in units called pound-feet (lb-ft) or Newton-meters (Nm)

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	**DISCUSS FREQUENTLY ASKED QUESTION: WHAT IS DIFFERENCE BETWEEN TORQUE & WORK? Designations for torque and work are often confusing. Torque is expressed in pound-feet because it represents a force exerted a certain distance from the object and Acts as a lever. Work, however, is expressed in footpounds because work is the movement over a certain Distance (feet) multiplied by the force applied (pounds). Engines produce torque and service technicians exert Torque represented by the unit pound-feet.**
	**DISCUSSION: ASK STUDENTS TO DISCUSS PRINCIPLES OF TORQUE. WHY IS IT EXPRESSED IN LB-FT?**
	**TASK: HAVE STUDENTS TIGHTEN SEVERAL BOLTS BY USING A TORQUE WRENCH, AND HAVE THEM DISCUSS HOW PRINCIPLE OF TORQUE APPLIES.**
	**4. SLIDE 4 EXPLAIN Figure 13-3** Work is calculated by multiplying force times distance. If you push 100 pounds 10 feet, you have done 1,000 foot-pounds of work.
	**DISCUSSION: ASK STUDENTS TO DISCUSS DIFFERENCES BETWEEN TORQUE AND WORK. STUDENTS SHOULD PROVIDE PRACTICAL EXAMPLES OF EACH.**
	**5. SLIDE 5 EXPLAIN Figure 13-4 One horsepower is = to 33,000 foot-pounds (200 lbs @ 165 ft) of work/minute.**

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	**DISCUSSION: ASK STUDENTS TO DISCUSS HOW HORSEPOWER IS CALCULATED. WHAT IS DIFFERENCE BETWEEN TORQUE AND HORSEPOWER OF AN ENGINE?**
	**MATH ANIMATIONS** Math Formula Horse Power (View) (Download) Math Formula Vehicle Speed (View) (Download) Math Formula, lb in to lb ft - Torque (View) (Download)
	**Graph of torque and horsepower will always show the torque and horsepower curves crossing at 5,252 rpm.**
	**DISCUSSION: DISCUSS NEWTON'S 3 LAWS OF MOTION, GIVING AUTOMOTIVE-RELATED EXAMPLES OF EACH. ASK STUDENTS TO DISCUSS PRINCIPLES OF KINETIC ENERGY AND HOW THEY APPLY TO AUTOMOBILE OPERATION**
	6. **SLIDE 6 EXPLAIN TEXT Figure 13-5** Kinetic energy increases in direct proportion to the weight of the vehicle. 7. **SLIDE 7 EXPLAIN FIGURE 13-6** Kinetic energy increases as square of any increase in vehicle speed.
	**DISCUSS FREQUENTLY ASKED QUESTION: What Is the Difference Between Mass and Weight? Mass is the amount of matter in an object. One of the properties of mass is inertia. Inertia is the resistance to being put in motion and the tendency to remain in motion once it is set in motion. The weight of an object is the force of gravity on the object and may be defined as the mass times the acceleration of gravity. Therefore, mass means the property of an object and weight is a force.**

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	**EXPLAIN TECH TIP: Brakes Cannot Overcome the Laws of Physics: No vehicle can stop on a dime. The energy required to slow or stop a vehicle must be absorbed by the braking system. All drivers should be aware of this fact and drive at a reasonable speed for the road and traffic conditions.**
	**8. SLIDE 8 EXPLAIN Figure 13-7** first-class lever increases force and changes the direction of the force. **9. SLIDE 9 EXPLAIN FIGURE 13-8** A second-class lever increases force in the same direction as it is applied **10. SLIDE 10 EXPLAIN Figure 13-9** third-class lever reduces force but increases the speed and travel of the resulting work. **11. SLIDE 11 EXPLAIN Figure 13-10** brake pedal assembly provides 5:1 mechanical advantage because a 10-lb force input results in 50-lb force into master cylinder.
	**ANIMATION: SHOW ANIMATION ON LEVERS**
	**EXPLAIN TECH TIP: Conductors and Insulators If a material is a good conductor of heat, it is also a good conductor of electricity. Most conductors are metals, such as steel, copper, aluminum, and brass. Most insulators are nonmetals, such as plastic and rubber. Therefore, if a material does not conduct heat, it usually will not conduct electricity.**

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	**DISCUSS FREQUENTLY ASKED QUESTION: How Does a Coat Keep You Warm?** **A coat is worn in cold weather to keep warm. Does it keep the cold out or the heat in? Actually, both, but because heat travels from a warm object (human body) to a colder object (outside cold air), the primary purpose of a coat is to keep the body heat from escaping into the cold air.**
	12. **SLIDE 12 EXPLAIN Figure 13-11** outdoor thermometer used to measure temperature, not heat.
	**EXPLAIN TECH TIP: Quick & Easy Temperature Conversion: Many service information and scan tool data are expressed in degrees Celsius, which is often confusing to those used to temperature expressed in Fahrenheit degrees. A quick & easy way to get an approximate conversion is to take the degrees in Celsius, double it, and add 25. For example,** **Celsius x 2 25=approximate Fahrenheit degrees:** **0°C : 2 · 0 · 25 · 25°F (actual · 32°F)** **10°C : 2 · 20 · 25 · 45°F (actual · 50°F)** **15°C : 2 · 30 · 25 · 55°F (actual · 59°F)** **20°C : 2 · 40 · 25 · 65°F (actual · 68°F)** **25°C : 2 · 50 · 25 · 75°F (actual · 77°F)** **30°C : 2 · 60 · 25 · 85°F (actual · 86°F)** **35°C : 2 · 70 · 25 · 95°F (actual · 95°F)** **40°C : 2 · 80 · 25 · 105°F (actual · 104°F)** **45°C : 2 · 90 · 25 · 115°F (actual · 113°F)** **50°C : 2 · 100 · 25 · 125°F (actual · 122°F)**
	13. **SLIDE 13 EXPLAIN Figure 13-12** This interior plastic part is labeled PE-HD, means polyethylene-high density

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	**HANDS-ON TASK** **WATER BOIL EXPERIMENT TASK PAGE 22**
	**DEMONSTRATION: SHOW STUDENTS WHERE DIFFERENT TYPES OF PLASTICS ARE USED ON AN AUTOMOBILE & HOW TO IDENTIFY WHICH TYPE OF PLASTIC IS USED IN EACH APPLICATION. WHY WOULD THIS BE IMPORTANT FOR BODY SHOP TECHNICIAN TO KNOW?**
	**HANDS-ON TASK: HAVE STUDENTS DO A BURN TEST TO DETERMINE IF PLASTIC PART IS POLYPROPYLENE OR ABS PLASTIC, FOLLOWING APPROPRIATE SAFETYPRECAUTIONS.**
	**DISCUSSION: ASK STUDENTS TO TALK ABOUT DESIGNATIONS OF STEEL, AND IDENTIFY WHERE VARIOUS TYPES OF SAE STEEL ARE USED ON AN AUTOMOBILE.**
	**DISCUSSION: ASK STUDENTS TO DISCUSS USE OF ALLOYS OF ALUMINUM ON AN AUTOMOBILE. WHAT ARE CHARACTERISTICS OF ALUMINUM THAT MIGHT MAKE IT PREFERABLE TO STEEL FOR CERTAIN USES ON AUTOMOTIVE SYSTEMS?**
	**DISCUSS FREQUENTLY ASKED QUESTION:** **What Is Thermodynamics?** **Thermodynamics is the study of relationship among temperature, pressure, and volume changes. The laws of thermodynamics help engineers design and develop engines with higher efficiency. Thermodynamics is therefore used in the design of the cooling system, as well as in the engine. The more heat created by the burning of fuel in engine, the more power the engine can develop using the same or less amount of fuel.**

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	**DISCUSS FREQUENTLY ASKED QUESTION: Can Water and Acid Be Mixed Together? Acids have a very strong affinity for water and as a result, if water is poured into acid, the resulting reaction would be extremely violent and acid would be forced outward in all directions. Always pour acid into water, never water into acid. Technicians seldom need to work with acids because even battery electrolytes from the water and acid are premixed to help prevent the possibility of a technician creating a harmful reaction.**
	**HOMEWORK OPTION: HAVE STUDENTS COMPARE TORQUE AND HORSEPOWER, USING MATHEMATIC EXAMPLES TO EXPLAIN DIFFERENCE. GRADE INFORMATION FOR CORRECTNESS.**
	**MATHEMATICS HOMEWORK OPTION: HAVE STUDENTS CALCULATE THE KINETIC ENERGY OF A 3,500-LB VEHICLE MOVING AT 45 MPH. THEN HAVE THEM CALCULATE THE KINETIC ENERGY OF A 4,000-LB VEHICLE MOVING AT 30 MPH. WHICH VEHICLE HAS GREATER KINETIC ENERGY?**