Automotive Technology 5th Edition

Chapter 13 Scientific Principles & Materials

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 5th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
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 5th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 13: ATE5 Chapter Images

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.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)

DISCUSSION: ASK STUDENTS TO DISCUSS THE 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.

ICONS	Ch13 Scientific Principles & Materials
	**5. SLIDE 5 EXPLAIN Figure 13-4 One horsepower is = to 33,000 foot-pounds (200 lbs @ 165 ft) of work/minute.**
	**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 READ & EXPLAIN TEXT Figure 13-5** Kinetic energy increases in direct proportion to the weight of the vehicle. **7. SLIDE 7 READ & EXPLAIN FIGURE 13-6** Kinetic energy increases as the square of any increase in vehicle speed. **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.

ICONS	Ch13 Scientific Principles & Materials
	**ANIMATION: SHOW ANIMATION ON LEVERS**
	12. **SLIDE 12 EXPLAIN Figure 13-11** outdoor thermometer used to measure temperature, not heat. 13. **SLIDE 13 EXPLAIN Figure 13-12** This interior plastic part is labeled PE-HD, means polyethylene-high density
	**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?**
	**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?**

ICONS	Ch13 Scientific Principles & Materials
	**HOMEWORK** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)**

Crossword