




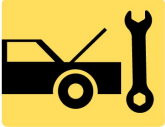





# Automotive Maintenance and Light Repair, 1<sup>ST</sup> Edition









## Chapter 63 CLUTCHES









### Opening Your Class

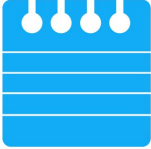





KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers <b>Automotive Maintenance and Light Repair</b> . It correlates material to task lists specified by ASE and NATEF.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to 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. <ul style="list-style-type: none"><li>— Prepare for ASE Manual Drive Train and Axles (A3) certification test content area “A” (Clutch Diagnosis and Repair).</li><li>— List the parts that are included in the clutch system.</li><li>— Describe how the clutch works.</li><li>— Explain the importance of proper clutch pedal freeplay.</li><li>— List the steps necessary to replace a clutch.</li><li>— Describe the characteristic noise each clutch component part makes when defective.</li></ul>
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.











ICONS	Ch63 CLUTCHES
	<p><b>1. SLIDE 1 CH63 CLUTCHES</b></p> <p><b>2. SLIDES 2-3 EXPLAIN OBJECTIVES</b></p>
 	<p>Check for <b>ADDITIONAL VIDEOS &amp; ANIMATIONS</b>  @ <a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a>  <b>WEB SITE REGULARLY UPDATED</b></p>
	<p><b>CLUTCH COMPONENT ID</b>  <b>WWW.MYAUTOMOTIVELAB.COM</b>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/a8_animation/chapter94_fig_94_1/index.htm">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A8_ANIMATION/CHAPTER94_FIG_94_1/INDEX.HTM</a></p>
	<p><b>4. SLIDES 4-6 EXPLAIN</b> Purpose and Function of a Clutch</p> <p><b>7. SLIDES 7-9 EXPLAIN</b> Component Parts and Operation of a Clutch Assembly</p>
	<p><b>DEMONSTRATION: SHOW EXAMPLES OF A CLUTCH DISC, THROW-OUT BEARING AND PRESSURE PLATE.</b></p>
	<p><b>SHOW ANIMATION: CLUTCH OPERATION</b>  <b>WWW.MYAUTOMOTIVELAB.COM</b>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/a8_animation/chapter94_fig_94_2/index.htm">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A8_ANIMATION/CHAPTER94_FIG_94_2/INDEX.HTM</a></p>
	<p><b><u>Cable Clutch Operation</u></b>  <b><u>Clutch Hydraulic Operation</u></b>  <b><u>Clutch Operation</u></b></p>
	<p><b>10. SLIDE 10 EXPLAIN</b> Figure 63-1 Typical automotive clutch assembly showing all related parts</p>
  <p>QUESTION</p>	<p><b>DISCUSSION: DISCUSS THE EXPERIENCES THEY MAY HAVE HAD WITH CLUTCHES. <u>SLIDE 63-1</u></b></p>
	<p><b>DEMONSTRATION: SHOW EXAMPLES OF A PILOT BEARING AND A BUSHING.</b></p>
  <p>QUESTION</p>	<p><b>DISCUSSION: DISCUSS DIFFERENCE BETWEEN THE PILOT BEARING AND THE BUSHING. WHICH WOULD BE THE BETTER STYLE TO USE AND WHY?</b></p>












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	<p>11. <b>SLIDE 11 EXPLAIN Figure 63-2 (a)</b> When the clutch is in the released position (clutch pedal depressed), the clutch fork is applying a force to the throwout (release) bearing, which pushes on the diaphragm spring, releasing the pressure on the friction disc.</p> <p>12. <b>SLIDE 12 EXPLAIN Figure 63-2 (b)</b> When clutch is in engaged position (clutch pedal up), diaphragm spring exerts force on the clutch disc, holding it between flywheel and the pressure plate</p>
	<p><b>DISCUSSION: SHOW LEVERAGE ADVANTAGES USED IN CLUTCH APPLICATIONS, SUCH AS THE LENGTH OF THE CLUTCH FORK PUSHING ON THE THROWOUT BEARING IN FIGURE 63–2. ANOTHER EXAMPLE WOULD BE THE LEVERS USED IN A LEVER AND-ROD LINKAGE</b></p>
	<p>13. <b>SLIDE 13 EXPLAIN Figure 63-3</b> transmission has just been removed. Note that this type of transmission incorporates the bell housing, which was therefore removed at the same time as the transmission. The clutch fork and throwout (release) bearing also came off together. All that remained attached to the engine was the flywheel, clutch disc, and pressure plate.</p>
	<p><b>HANDS-ON TASK: HAVE STUDENTS INSPECT LEVER-AND-ROD, CABLE, &amp; HYDRAULIC CLUTCH LINKAGE SYSTEMS. WHAT ARE ADVANTAGES AND DISADVANTAGES OF EACH?</b></p>
	<p><b>HANDS-ON TASK: CROSS-CURRICULAR</b></p>
	<p><b>ACTIVITY: PHYSICS HAVE THE STUDENTS USE THE INTERNET TO RESEARCH LEVERS AND FULCRUMS. HAVE THEM MAKE A LIST OF AT LEAST FOUR LEVERS AND FULCRUMS USED IN EVERYDAY LIFE. (EXAMPLES: BIKE PEDAL CRANK, VEHICLE JACK HANDLE, AND PLAYGROUND EQUIPMENT.) DEVELOP A SIMPLE PICTURE OF EACH EXAMPLE TO SHARE WITH THE CLASS.</b></p>
	<p><b>CLUTCH SYSTEM COMPONENTS</b></p>
	<p><b><a href="http://www.myautomotivelab.com">WWW.MYAUTOMOTIVELAB.COM</a></b></p>
	<p><small><a href="http://media.pearsoncmg.com/ph/chet/chet_myLABS/akamai/template/video640x480.php?title=CLUTCH%20SYSTEM%20COMPONENTS&amp;clip=PANDC/CHET/2012/AUTOMOTIVE/AUTO_PARTS_SPECIALIST/EXP18.MOV&amp;caption=CHET/CHET_myLABS/akamai/2012/AUTOMOTIVE/AUTO_PARTS_SPECIALIST/XML/EXP18.XML">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_myLABS/akamai/template/video640x480.php?title=CLUTCH%20SYSTEM%20COMPONENTS&amp;clip=PANDC/CHET/2012/AUTOMOTIVE/AUTO_PARTS_SPECIALIST/EXP18.MOV&amp;caption=CHET/CHET_myLABS/akamai/2012/AUTOMOTIVE/AUTO_PARTS_SPECIALIST/XML/EXP18.XML</a></small></p>

ICONS	Ch63 CLUTCHES
	<p>14. <b>SLIDE 14 EXPLAIN</b> Component Parts and Operation of a Clutch Assembly</p> <p>15. <b>SLIDE 15 EXPLAIN Figure 63-4</b> A typical cable-operated clutch.</p> <p>16. <b>SLIDE 16 EXPLAIN Figure 63-5</b> A hydraulic clutch linkage uses a master cylinder and a slave cylinder.</p> <p>17. <b>SLIDE 17 EXPLAIN Figure 63-6</b> A typical clutch master cylinder and reservoir mounted on the bulkhead on the driver's side of the vehicle. Brake fluid is used in the hydraulic system to operate the slave cylinder located on the bell housing.</p> <p>18. <b>SLIDES 18-21 EXPLAIN</b> Component Parts and Operation of a Clutch Assembly</p>
	<p>22. <b>SLIDE 22 EXPLAIN Figure 63-7</b> racing or high-performance clutch disc lacks the features of a stock clutch disc that help provide smooth engagement.</p>
	<p><b>DISCUSSION: DISCUSS THE DIFFERENCES BETWEEN A HIGH PERFORMANCE CLUTCH AND STANDARD CLUTCH.</b></p>
	<p><b>DISCUSSION: DISCUSS WHY A HIGH PERFORMANCE CLUTCH HAS TO USE BETTER MATERIALS AND DESIGN THAN A STANDARD VEHICLE CLUTCH.</b></p>
	<p>23. <b>SLIDES 23-25 EXPLAIN</b> Component Parts and Operation of a Clutch Assembly</p> <p>26. <b>SLIDE 26 EXPLAIN Figure 63-8</b> typical stock clutch friction disc that uses coil spring torsional dampers.</p>
	<p>27. <b>SLIDE 27 EXPLAIN Figure 63-9</b> marcel is a wavy spring that is placed between the two friction surfaces to cushion the clutch engagement.</p>
	<p><b>DEMONSTRATION: SHOW TORSION DAMPENING SPRINGS IN A CLUTCH DISC. DEMONSTRATE HOW THESE SPRINGS DAMPEN THE TWISTING MOTION OF THE CLUTCH DISC AS THE CLUTCH IS ENGAGED.</b></p>
	<p>28. <b>SLIDE 28 EXPLAIN Figure 63-10</b> Cutaway of the center section of a clutch plate showing the various layers of steel plates used in the construction.</p> <p>29. <b>SLIDES 29-33 EXPLAIN</b> Component Parts and Operation of a Clutch Assembly</p>




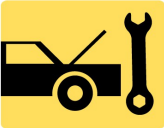


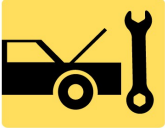
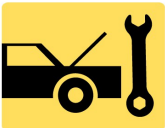




ICONS	Ch63 CLUTCHES
   <p>QUESTION</p> 	<p>34. SLIDE 34 EXPLAIN Figure 63-11 coil spring (lever style) clutch pressure plate.</p> <p>35. SLIDE 35 EXPLAIN Figure 63-12 Typical diaphragm-style pressure plate that uses a Belleville spring.</p> <p><b>DEMONSTRATION: SHOW PRESSURE PLATES AND HOW THE LEVER STYLE AND DIAPHRAGM STYLE WORK TO DISENGAGE THE CLUTCH PLATE.</b></p> <p><b>DISCUSSION: DISCUSS WHY MANUFACTURERS USE 2 TYPES OF PRESSURE PLATES. WHAT ARE ADVANTAGES AND DISADVANTAGES OF EACH?</b></p> <p>36. SLIDES 36-41 EXPLAIN Component Parts and Operation of a Clutch Assembly</p> <p>42. SLIDE 42 EXPLAIN Figure 63-13 flywheel after it has been machined (ground) to provide the correct surface finish for the replacement clutch disc.</p> <p>43. SLIDE 43 EXPLAIN Figure 63-14 starter motor will spin but the engine will not crank if the ring gear on the flywheel is broken.</p> <p>44. SLIDES 44-51 EXPLAIN Component Parts and Operation of a Clutch Assembly</p> <p>52. SLIDE 52 EXPLAIN Figure 63-15 cutaway of a dual-mass flywheel used on a Ford diesel pickup truck.</p>
   	<p><b>DEMONSTRATION: SHOW FLYWHEELS WITH PILOT BEARINGS AND SOME WITHOUT.</b></p> <p><b>SAFETY FLYWHEELS CAN BE VERY HEAVY, AND CAUTION SHOULD BE USED WHEN LIFTING. FLYWHEELS ALSO PRESENT A FINGER PINCHING HAZARD. REMIND THE STUDENTS TO FOLLOW APPROPRIATE SAFETY PRECAUTIONS.</b></p> <p><b>DEMONSTRATION: SHOW TWO ROTATING OBJECTS OF CONSIDERABLY DIFFERENT WEIGHTS. AN EXAMPLE WOULD BE A BICYCLE TIRE COMPARED TO A CAR TIRE. DEMONSTRATE DIFFERENCE IN <u>INERTIA</u> BETWEEN THE TWO.</b></p>


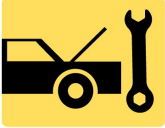
ICONS	Ch63 CLUTCHES
	<p><b>THE RING GEAR CAN BE WELDED OR PRESS-FIT ON A FLYWHEEL</b></p>
	<p><b>53. SLIDES 53-54 EXPLAIN</b> Component Parts and Operation of a Clutch Assembly</p>
	<p><b>55. SLIDE 55 EXPLAIN FIGURE 63-16</b> (a) Before replacing the clutch, bell housing should be cleaned and clutch fork pivot lightly lubricated. (b) input shaft seal should also be replaced to prevent possibility of getting transmission lubricant on friction surfaces of clutch.</p>
	<p><b>56. SLIDE 56 EXPLAIN Figure 63-17</b> transaxle assembly has been removed to replace the clutch. Note the short input shaft. This vehicle did not use a pilot bearing (bushing).</p>
	<p><b>57. SLIDES 57-60 EXPLAIN</b> Component Parts and Operation of a Clutch Assembly</p>
	<p><b>61. SLIDE 61 EXPLAIN Figure 63-18</b> clutch pedal linkage moves the clutch fork, which then applies a force against the release bearing, which then releases the clamping force the pressure plate is exerting on the clutch disc.</p>
	<p><b>62. SLIDE 62 EXPLAIN Figure 63-19</b> release bearing rubs against the tips of the diaphragm spring.</p>
	<p><b>36. SLIDES 63-76 EXPLAIN</b> Component Parts and Operation of a Clutch Assembly</p>
	<p><b>SEARCH INTERNET: HAVE STUDENTS RESEARCH AUTOMOTIVE CAREERS THAT REQUIRE ABILITY TO REPAIR, REPLACE, &amp; TROUBLESHOOT CLUTCHES. PREPARE TO PRESENT TO GROUPS AT NEXT CLASS: CAREER OPPORTUNITIES, THEIR ADVANTAGES AND DISADVANTAGES, &amp; COMPENSATION LEVELS.</b></p> <p><b>CLUTCH DIAGNOSIS</b></p> <p><b>WWW.MYAUTOMOTIVELAB.COM</b></p> <p><small><a href="http://media.pearsoncmg.com/ph/chet/chet_myLABS/akamai/template/video640x480.php?title=diagnosis%20clutch%20problems&amp;clip=pandc/chet/2012/automotive/manual_transmission/diagnosing_clutch_problems.mov&amp;caption=chet/chet_myLABS/akamai/2012/automotive/manual_transmission/xml/diagnosing_clutch_problems.xml">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=DIAGNOSIS%20CLUTCH%20PROBLEMS&amp;CLIP=PANDC/CHET/2012/AUTOMOTIVE/MANUAL_TRANSMISSION/DIAGNOSING_CLUTCH_PROBLEMS.MOV&amp;CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/MANUAL_TRANSMISSION/XML/DIAGNOSING_CLUTCH_PROBLEMS.XML</a></small></p>

ICONS	Ch63 CLUTCHES
 QUESTION	<p><b><u>DISCUSSION:</u></b> DISCUSS THE REASON FOR DISCONNECTING BATTERY, AS STATED IN TEXT, BEFORE REPLACING THE CLUTCH.</p>
 QUESTION	<p><b><u>DISCUSSION:</u></b> DISCUSS THE OPERATION OF THE CLUTCH-FORK PIVOT. HOW CAN WEAR ON THIS PIVOT AFFECT THE OPERATION OF THE CLUTCH?</p>
 QUESTION	<p><b><u>DISCUSSION:</u></b> DISCUSS THE EFFECT OF BAD RELEASE BEARING. WHAT WOULD THE DRIVER NOTICE ABOUT THE OPERATION OF THE CLUTCH?</p>
	<p><b><u>DEMONSTRATION:</u></b> SHOW RELEASE BEARING. SHOW HOW ONE PART IS STATIONARY WITH THE VEHICLE AND THE OTHER PART MUST SPIN AT ENGINE SPEED.</p>
	<p><b><u>DISCUSSION:</u></b> DISCUSS THE IMPORTANCE OF PROPER ALIGNMENT AND LUBRICATION OF RELEASE BEARING.</p>
	<p><b><u>HANDS-ON TASK:</u></b> HAVE STUDENTS PUSH IN AND RELEASE CLUTCH ON A VEHICLE AND FEEL FOR THE TRANSMITTED CLUTCH FEEL IN A LEVER SYSTEM.</p>
	<p><b><u>EVEN A GOOD CLUTCH SYSTEM MAKES NOTICEABLE NOISE CHANGES DURING RELEASE AND ENGAGEMENT.</u></b></p>
	<p><b><u>THERE IS MORE TRANSMITTED FEEL IN A LEVER SYSTEM THAN IN A HYDRAULIC OR CABLE SYSTEM.</u></b></p>
	<p><b><u>DEMONSTRATION:</u></b> SHOW HOW AN IMPROPERLY ADJUSTED CLUTCH LINKAGE WILL CAUSE THE CLUTCH TO SLIP OR NOT DISENGAGE.</p>
	<p><b><u>DEMONSTRATION:</u></b> SHOW THE STUDENTS HOW SOUND IN THE CLUTCH AREA CHANGES WHEN THE CLUTCH IS RELEASED AND ENGAGED.</p>

ICONS	Ch63 CLUTCHES
	<p><b>DEMONSTRATION: SHOW HOW TO MARK A DRIVE SHAFT'S RELATIONSHIP TO THE PINION FLANGE BEFORE REMOVING THE SHAFT.</b></p>
  <p>QUESTION</p>	<p><b>DISCUSSION: DISCUSS WHAT IT MEANS TO KEEP DRIVE SHAFT IN PHASE WHEN REMOVED</b></p>
	<p><b>YOU CAN USE AN OLD TRANSMISSION INPUT SHAFT AS AN ALIGNMENT TOOL IF A SHAFT OF RIGHT TYPE IS AVAILABLE.</b></p>
	<p><b>CHECK THE PILOT BUSHING OR BEARING FOR CLEARANCE WITH THE INPUT SHAFT OF TRANSMISSION BEFORE &amp; AFTER INSTALLING THE BUSHING. THE INSIDE DIAMETER OF A BUSHING CAN CHANGE SLIGHTLY AFTER INSTALLATION. INADEQUATE CLEARANCE MAY RESULT IN DAMAGE TO THE BUSHING OR INABILITY TO INSTALL THE SHAFT INTO THE BUSHING.</b></p>
	<p><b>BRAKE CLEANER USED FOR BRAKES WORKS VERY WELL TO CLEAN CLUTCH COMPONENTS.</b></p>
	<p><b>CLUTCH REPLACEMENT &amp; BLEEDING</b>  <b>WWW.MYAUTOMOTIVELAB.COM</b></p>
	<p><small><a href="http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=replacing%20clutch%20components%207%20bleeding%20system&amp;clip=pandc/chet/2012/automotive/manual_transmission/replacing_clutch_components_bleeding.mov&amp;caption=chet/chet_mylibs/akamai/2012/automotive/manual_transmission/xml/replacing_clutch_components_bleeding.xml">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLIBS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=REPLACING%20CLUTCH%20COMPONENTS%207%20BLEEDING%20SYSTEM&amp;CLIP=PANDC/CHET/2012/AUTOMOTIVE/MANUAL_TRANSMISSION/REPLACING_CLUTCH_COMPONENTS_BLEEDING.MOV&amp;CAPTION=CHET/CHET_MYLIBS/AKAMAI/2012/AUTOMOTIVE/MANUAL_TRANSMISSION/XML/REPLACING_CLUTCH_COMPONENTS_BLEEDING.XML</a></small></p>
	<p><b>DEMONSTRATION: SHOW THE PROPER WAY TO LUBRICATE THE BUSHING, RELEASE BEARING, OUTPUT SHAFT SPLINES, AND RELEASE BEARING SUPPORT.</b></p>
	<p><b>77. SLIDE 77 EXPLAIN</b> Figure 63-20 Heavy chatter marks on the pressure plate indicate that oil or grease has gotten onto the clutch facing.</p>
	<p><b>DEMONSTRATION: SHOW HOW TO PROPERLY CHECK CLUTCH-PEDAL FREE TRAVEL. USE A DIAL INDICATOR TO MEASURE FOR PROPER FREE TRAVEL</b></p>



ICONS	Ch63 CLUTCHES
	<p><b>DEMONSTRATION: SHOW HOW TO MAKE THE PROPER ADJUSTMENT ON THE CLUTCH LINKAGE FOR SEVERAL TYPES OF SYSTEMS.</b></p>
	<p><b>DEMONSTRATION: SHOW SEVERAL CLUTCH MASTER CYLINDERS. &amp; SEVERAL SLAVE CYLINDERS.</b></p>
 	<p><b><u>NATEF MLR TASK A3B1</u> CHECK AND ADJUST CLUTCH MASTER CYLINDER FLUID LEVEL.</b></p>
 	<p><b><u>NATEF MLR TASK A3B2</u> CHECK FOR SYSTEM LEAKS.</b></p>
	<p><b><u>SEARCH INTERNET: STUDENTS SEARCH WWW.YOUTUBE.COM FOR A VIDEO ON CLUTCH REPLACEMENT &amp; HAVE THEM REPORT OUT AT NEXT CLASS ON WHAT WAS DIFFERENT IN PROCEDURE FROM WHAT THEY LEARNED IN CLASS.</u></b></p>
	<p><b><u>HANDS-ON TASK: HAVE THE STUDENTS GO THROUGH OEM RECOMMENDATIONS FOR ADJUSTING THE CLUTCH. HAVE THEM FOLLOW OEM SPECS FOR PEDAL'S FREE PLAY.</u></b></p>
	<p><b>78. SLIDE 78 EXPLAIN Figure 63-21 (a) replacement hydraulic clutch for a Saturn includes the master cylinder (shown) with the line and the slave cylinder as an assembly. The assembly is even filled with brake fluid! Do not open the master cylinder cap on this unit because Saturn did not provide any method of bleeding air out of the system. (b) slave cylinder attaches to the bell housing of the transaxle.</b></p>
	<p><b>79. SLIDES 79-80 EXPLAIN Clutch Pedal Adjustment</b></p>
	<p><b>81. SLIDES 81-85 EXPLAIN Bleeding the Hydraulic Clutch</b></p>
	<p><b>MINUTE TRANSMISSION JACK</b>  <b>WWW.MYAUTOMOTIVELAB.COM</b>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myLABS/akamai/template/video640x480.php?title=TRANSMISSION%20JACK&amp;clip=PANDC/CHET/2012/AUTOMOTIVE/AUTO_SHOP_SAFETY/CLIP30TRANSJACK1.MOV&amp;caption=CHET/CHET_MYLABS/akamai/2012/AUTOMOTIVE/AUTO_SHOP_SAFETY/XML/CLIP30TRANSJACK1.XML">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=TRANSMISSION%20JACK&amp;CLIP=PANDC/CHET/2012/AUTOMOTIVE/AUTO_SHOP_SAFETY/CLIP30TRANSJACK1.MOV&amp;CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/AUTO_SHOP_SAFETY/XML/CLIP30TRANSJACK1.XML</a></p>

ICONS	Ch63 CLUTCHES
 	<p>139. SLIDES 139-156 EXPLAIN CLUTCH REPLACEMENT</p> <p><b>OPTIONAL HOMEWORK: HAVE STUDENTS USE INTERNET TO RESEARCH EARLY FARM MACHINERY &amp; WHY A FLYWHEEL WAS SUCH AN IMPORTANT PART OF THESE ENGINES. EARLY MACHINERY EXAMPLES COULD BE STEAM ENGINES, HIT AND MISS ENGINES, THRASHERS, &amp; DIESEL ENGINES.</b></p>