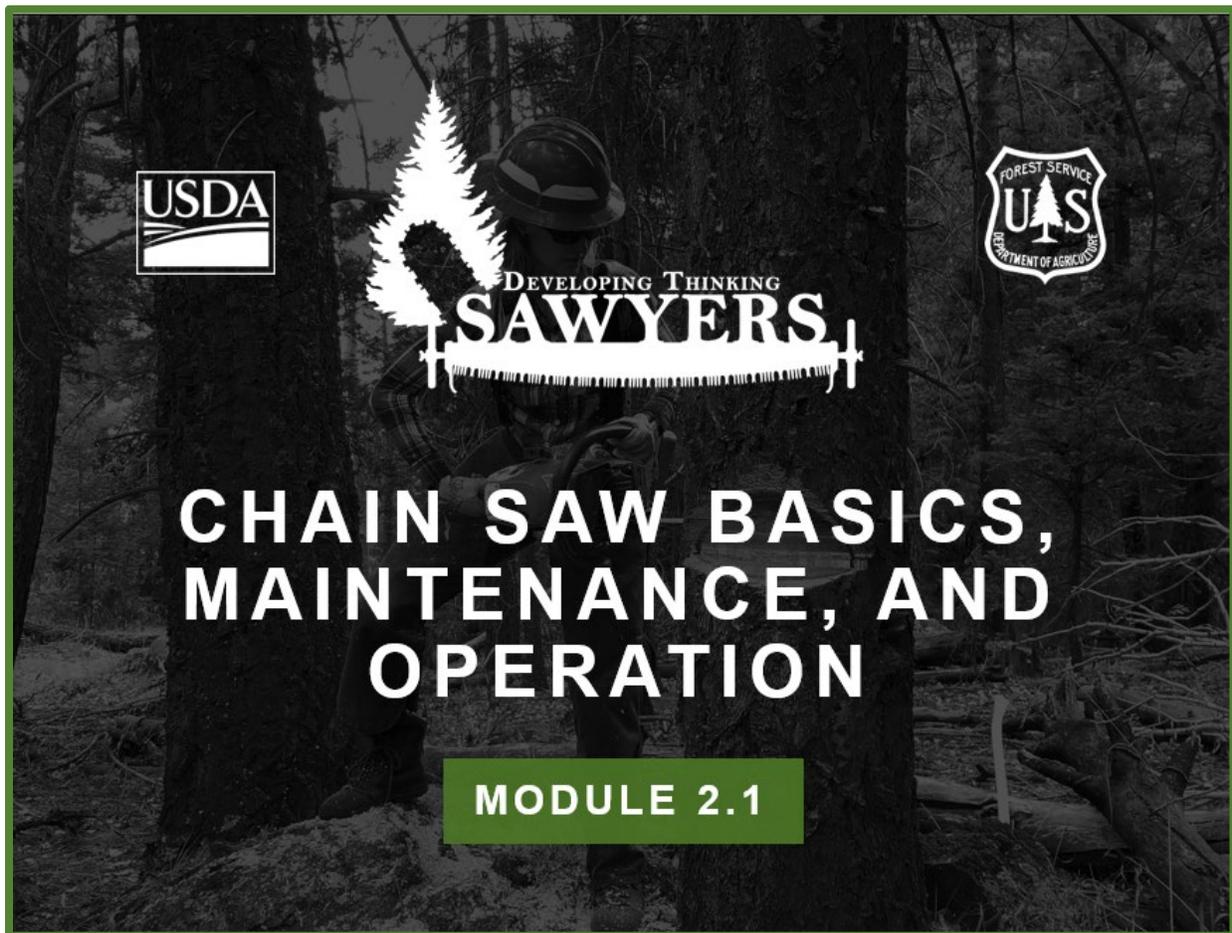


# USDA Forest Service National Sawyer Training: Developing Thinking Sawyers



## Instructors Guide

**USDA Forest Service National Sawyer Training:  
Developing Thinking Sawyers**  
Module 2.1: Chain Saw Basics, Maintenance, and Operation

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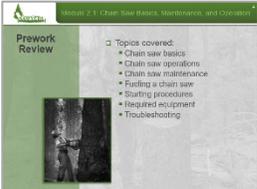
## Module 2.1: Chain Saw Basics, Maintenance, and Operation

This module describes chain saw components and how they work and explains the correct way to fuel, start, and operate a chain saw.

Slide/Action	Content
	<h3>Welcome and Introduction</h3> <p><b>Time:</b> 150 Minutes</p> <p><b>Note:</b> Do not read the slides to the students; speak in a conversational tone and use the slides to actively engage them in two-way conversation. Add the occasional brief story or anecdote from your experience to illustrate key concepts.</p> <p><b>DISPLAY FIRST SLIDE</b></p>
<p><i>Slide 1: Chain Saw Basics Maintenance and Operation</i></p> 	<h3>Introduction</h3> <p><b>Say:</b></p> <p>This module describes chain saw components and how they work and explains the correct way to fuel, start, and operate a chain saw. After completing the module, you will practice what you've learned.</p> <p>Before you try to start a chain saw for the first time, it is important for you to understand how the basic chain saw components work and the engineered safety features of the saw you handle.</p> <p><b>DISPLAY NEXT SLIDE</b></p>
<p><i>Slide 2: Module Topics</i></p> 	<h3>Module Topics Review</h3> <p>Review the module topics on the slide.</p> <p><b>DISPLAY NEXT SLIDE</b></p>

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## Module 2.1: Chain Saw Basics, Maintenance, and Operation

Slide/Action	Content
<p><i>Slide 3: Objectives</i></p> 	<p><b>Objectives Review</b></p> <p>Review the objectives on the slide.</p> <p><b>DISPLAY NEXT SLIDE</b></p>
<p><i>Slide 4: Prework Review</i></p> 	<p><b>Prework Review REVIEW</b></p> <p>Review the topics covered in the prework packet.</p> <p><b>Say:</b></p> <p>We will cover some of these topics again here in the classroom because they are important for safety or because we have more details you need to know. The rest we will review now.</p> <p><b>INSTRUCTOR NOTE:</b></p> <p>Allow students a few moments to answer the questions in the student guide, then discuss the answers. Confirm the right answers and correct any misconceptions.</p> <p><b>Review Questions</b></p> <p><b>Q:</b> What are some guidelines for selecting a chain saw?  <b>A:</b> Choose the type of chain saw appropriate for the job and the one that best fits your ability.</p> <p><b>Q:</b> Why should you always read and keep the owner's manual?  <b>A:</b> To know how to maintain and operate your make and model of saw.</p> <p><b>Q:</b> What items do you check in the five-point safety check?  <b>A:</b> Chain brake, trigger interlock, chain catch, antivibration system, spark arrestor</p>

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Slide/Action	Content
<p>Slide 5: Chain Saw Basics</p> 	<p><b>Q:</b> What are some guidelines for transporting a chain saw? <b>A:</b> Answers may vary, but should include:</p> <ul style="list-style-type: none"><li>▪ Never transport a chain saw or fuel in the passenger compartment.</li><li>▪ Cover the chain saw bar with a sheath during transport to prevent damaging the saw cutter tooth or other property.</li><li>▪ Always use a sheath (required) that covers the bumper spikes (dogs) and muffler when transporting a chain saw over your shoulder. This greatly decreases the risk of serious physical harm. A sturdy shoulder pad is also recommended.</li><li>▪ Follow the aircraft personnel or pilot’s instructions when transporting a chain saw using aircraft or watercraft.</li><li>▪ Follow the packer’s instructions when transporting a chain saw using pack stock.</li></ul> <p><b>Q:</b> Describe three ways to start a chain saw. <b>A:</b> On the ground, firmly supported between your legs, with the bar extended over a log or branch.</p> <p><b>DISPLAY NEXT SLIDE</b></p> <h3>Chain Saw Basics</h3> <p><b>Say:</b></p> <p>There are two basic types of power saws available on the market today: gas-powered and battery-powered. When selecting the right tool for the job, you should also consider powerhead size, bar length, your skill level, and the specific task at hand.</p> <p>Personal fitness and strength are other considerations, as these factors can dramatically affect your ability to handle, hold, and manipulate a chain saw. Bigger is not always better. Over a short period, handling even a 12-pound chain saw can become physically challenging. Your risk of injury increases significantly as fatigue sets in.</p> <p><b>DISPLAY NEXT SLIDE</b></p>

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## Module 2.1: Chain Saw Basics, Maintenance, and Operation

Slide/Action	Content
<p data-bbox="240 380 435 436"><i>Slide 6: Chain Saw Components 1</i></p>  <p>The diagram, titled 'Chain Saw Components', shows a side view of a chainsaw with various parts labeled. The labels include: Chain brake, Front handle, On/off switch and choke, Throttle trigger, Throttle interlock, Rear handle, Bucking/bumper spikes (dogs), Oil tank cap, Flywheel/fan cover, Fuel tank cap, and Pull start grip.</p>	<h3 data-bbox="500 380 852 415">Chain Saw Components 1</h3> <p data-bbox="500 422 553 457"><b>Say:</b></p> <p data-bbox="500 474 1372 617">When you first purchase or receive a chain saw you must become familiar with the make and model. Here I have a [make and model]. First, we will discuss the different components of the saw and their functions.</p> <p data-bbox="500 646 695 674"><b>INSTRUCTOR NOTE</b></p> <p data-bbox="500 695 1417 842">While holding up the chain saw, point-out the different components identified in each slide. Explain the function of each of the components. If a component requires specific maintenance, now is the time to discuss that maintenance.</p> <ul data-bbox="548 867 1401 1570" style="list-style-type: none"><li>▪ <b>Bucking/bumper spikes (dogs):</b> Used to help hold the saw steady against wood.</li><li>▪ <b>Chain brake:</b> Stops the chain's motion.</li><li>▪ <b>Front handle:</b> Used to hold and balance the saw.</li><li>▪ <b>On/off switch:</b> Turns the saw on and off.</li><li>▪ <b>Throttle trigger:</b> Controls the speed of the engine.</li><li>▪ <b>Throttle interlock:</b> Prevents the throttle from engaging unless you depress the interlock on the handle.</li><li>▪ <b>Rear handle:</b> Used to hold the saw.</li><li>▪ <b>Fuel tank cap:</b> Provides access to the fuel tank and seals the tank to prevent spillage.</li><li>▪ <b>Pull-start grip:</b> A rubber or plastic handle attached to the starter pull rope.</li><li>▪ <b>Flywheel cover:</b> Covers the flywheel and holds the recoil starter.</li><li>▪ <b>Oil tank cap:</b> Provides access to the oil tank and seals the tank to prevent spillage.</li></ul> <p data-bbox="500 1587 711 1614"><b>DISPLAY NEXT SLIDE</b></p>

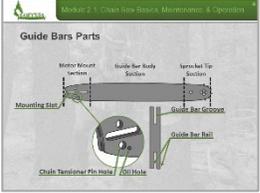
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Slide/Action	Content
<p>Slide 7: Chain Saw Components 2</p> 	<p><b>Chain Saw Components 2</b> <b>Say:</b></p> <ul style="list-style-type: none"><li>▪ <b>Air filter cover:</b> Stops dirt, dust, and sawdust from entering the air filter, thereby protecting the carburetor.</li><li>▪ <b>Cooling fins:</b> Provide cooling to the motor cylinder.</li><li>▪ <b>Muffler:</b> Reduces exhaust noise.</li><li>▪ <b>Bar studs:</b> Hold the bar in place.</li><li>▪ <b>Chain catch:</b> Prevents the chain from contacting you in the event of a broken or thrown chain.</li><li>▪ <b>Tension adjustment screw:</b> Moves the guide bar to maintain proper tension on the saw chain.</li><li>▪ <b>Clutch drum cover:</b> Covers the sprocket and clutch.<ul style="list-style-type: none"><li>• <b>Clutch drum (under the cover):</b> Couples the engine to the chain sprocket when you accelerate the engine above idle speed.</li></ul></li></ul> <p><b>INSTRUCTOR NOTE:</b> <b>Components not shown</b></p> <ul style="list-style-type: none"><li>▪ <b>Chain sprocket:</b> The toothed wheel that drives the saw chain. Sprockets come in different styles and sizes (e.g., rim sprocket, spur sprocket).</li><li>▪ <b>Oiler adjustment screw:</b> Adjusts the amount of oil dispensed to the bar and chain.</li><li>▪ <b>Choke:</b> Used for starting a cold saw.</li><li>▪ <b>Fuel filter:</b> Prevents dirt and other contaminants from entering the saw's carburetor.</li><li>▪ <b>Spark plug:</b> Ignites fuel in the cylinder.</li><li>▪ <b>Decompression valve:</b> Reduces pressure in the cylinder head to enable the chain saw to start more easily.</li><li>▪ <b>Directional marks (gunning sights):</b> Used for aiming the undercut and backcut.</li></ul> <p><b>DISPLAY NEXT SLIDE</b></p>

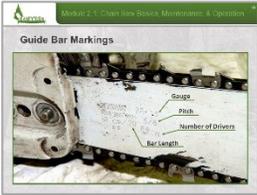
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## Module 2.1: Chain Saw Basics, Maintenance, and Operation

Slide/Action	Content
<p><i>Slide 8: Guide Bar Parts</i></p>  <p>The diagram shows a cross-section of a guide bar with labels for various parts: Motor Mount Section, Guide Bar Body Section, Sprocket Tip Section, Mounting Slot, Guide Bar Groove, Guide Bar Rail, Chain Tensioner Pin Hole, and Oil Hole.</p>	<h3>Guide Bar Parts</h3> <p><b>Say:</b> Displayed is a typical guide bar and its components.</p> <p>Guide bars have several standard sections and features, including:</p> <ul style="list-style-type: none"><li>▪ <b>Motor mount section</b><ul style="list-style-type: none"><li>• <b>Chain tensioner pin hole:</b> Where you insert the chain tension pin.</li><li>• <b>Oil hole:</b> Where chain oil from the oiler flows to the chain drivers along the guide bar groove.</li><li>• <b>Mounting slot:</b> Where you insert the guide bar mounting studs to hold the guide bar in place.</li></ul></li><li>▪ <b>Guide bar body section</b><ul style="list-style-type: none"><li>• <b>Guide bar rails:</b> The tie strap of the chain rides on top of these rails.</li><li>• <b>Guide bar groove:</b> Where the chain drivers ride to guide the cutting teeth around the guide bar.</li></ul></li><li>▪ <b>Sprocket tip section</b><ul style="list-style-type: none"><li>• <b>Sprocket tip:</b> Toothed sprocket that guides the chain around the tip of the bar.</li></ul></li></ul> <p><b>DISPLAY NEXT SLIDE</b></p>
<p><i>Slide 9: Guide Bar Types</i></p>  <p>The image shows two guide bars. The top one is a standard bar with a sprocket tip, and the bottom one is a lightweight bar with aluminum inserts. The text 'Guide Bar Types' is visible, with 'Standard' and 'Lightweight' options.</p>	<h3>Guide Bar Types</h3> <p><b>Say:</b> Guide bars come in a wide variety of sizes and uses. You must select a properly sized bar for the powerhead and the job.</p> <p>Let's first become familiar with the types of guide bars.</p> <ul style="list-style-type: none"><li>▪ <b>Standard:</b> Bar tip has a roller sprocket for reduced friction and wear.</li><li>▪ <b>Lightweight:</b> In addition to the features of the standard bar, lightweight bars have aluminum inserts that reduce some weight. The weight difference is most noticeable on longer bars. Keep in mind that lightweight bars can be less rigid.</li></ul>

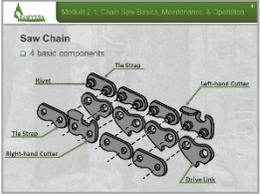
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Slide/Action	Content
<p data-bbox="233 737 440 800"><i>Slide 10: Guide Bar Markings</i></p>  <p data-bbox="207 800 464 995">The image shows a close-up of a chainsaw guide bar. It has several markings and labels: 'Gauge' pointing to the groove in the bar, 'Pitch' pointing to the distance between rivets, 'Number of Drivers' pointing to the rivets, and 'Bar Length' pointing to the overall length of the bar. The bar is silver and black.</p>	<p data-bbox="500 380 643 411"><b>Transition:</b></p> <p data-bbox="500 432 1284 464">Guide bars are marked with information that references the:</p> <ul data-bbox="548 489 1068 653" style="list-style-type: none"><li>▪ Bar length</li><li>▪ Number of drivers for the chain used</li><li>▪ Pitch of chain used</li><li>▪ Gauge of chain used</li></ul> <p data-bbox="500 667 703 699"><b>DISPLAY NEXT SLIDE</b></p> <p data-bbox="500 737 773 768"><b>Guide Bar Markings</b></p> <p data-bbox="500 779 553 810"><b>Say:</b></p> <p data-bbox="500 831 1357 894">Use the correct bar manufactured for the make and model of your saw.</p> <p data-bbox="500 926 1414 1073">Not all chains will fit every bar. Not all bars will fit every chain saw. You should understand and use the right bar and chain combinations. It is important that the <b>gauge and pitch</b> of the saw chain, guide bar, and sprocket all match.</p> <ul data-bbox="548 1098 1414 1619" style="list-style-type: none"><li>▪ <b>Gauge</b>—Measures the thickness of the drive link and corresponds to the groove in the bar.<ul data-bbox="597 1178 1357 1251" style="list-style-type: none"><li>• The bar gauge and chain gauge must match. The most common gauges are .050 inch, .058 inch, and .063 inch.</li></ul></li><li>▪ <b>Pitch</b>—A measurement between rivets.<ul data-bbox="597 1308 1406 1545" style="list-style-type: none"><li>• To determine pitch, measure the distance between three rivets and divide by 2.</li><li>• The most common pitches are .325 inch, <math>\frac{3}{8}</math> inch, and .404 inch.</li><li>• The pitch of the drive sprocket must match the pitch of the bar nose sprocket.</li></ul></li><li>▪ <b>Number of drivers</b>—The length of the bar dictates the required number of drivers on a chain.</li></ul>

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Slide/Action	Content
<p style="text-align: center;"><i>Slide 11: Saw Chain</i></p>  <p>The diagram shows a section of a saw chain with five links. Labels with arrows point to: 'Rivet' (the pin connecting links), 'Tie Strap' (the strap connecting the cutter to the drive link), 'Left-hand Cutter' (a tooth pointing left), 'Right-hand Cutter' (a tooth pointing right), and 'Drive link' (the link without a cutter).</p>	<p>Things you need to know when ordering a new chain:</p> <ul style="list-style-type: none"><li>▪ Gauge</li><li>▪ Pitch</li><li>▪ Number of drivers</li><li>▪ Cutter type</li></ul> <p><b>DISPLAY NEXT SLIDE</b></p> <p><b>Saw Chain Say:</b></p> <p>A saw chain has four major components:</p> <ul style="list-style-type: none"><li>▪ <b>Rivet:</b> Holds the parts of the chain together and allows them to rotate.</li><li>▪ <b>Drive link:</b> Guides the chain around the bar and transfers rotational energy from the drive sprocket.</li><li>▪ <b>Tie strap:</b> Links the cutter tooth to the drive link.</li><li>▪ <b>Cutter tooth:</b> Does the cutting. The saw chain has left- and right-hand cutters that enable the chain to cut evenly through the wood.</li></ul> <p><b>Activity: The Saw Chain</b></p> <p>Have the students pass around an actual chain or plastic model and have them identify the different parts.</p> <p><b>IMPORTANT!</b> Students must wear gloves if you pass around an actual chain.</p> <p><b>DISPLAY NEXT SLIDE</b></p>

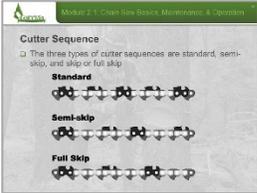
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Slide/Action	Content
<p data-bbox="215 380 459 436"><i>Slide 12: How a Cutter Tooth Works</i></p> 	<h3 data-bbox="500 380 873 411">How a Cutter Tooth Works</h3> <p data-bbox="500 422 553 453"><b>Say:</b></p> <p data-bbox="500 474 889 506">The chain tooth has five parts:</p> <ul data-bbox="548 527 1414 1157" style="list-style-type: none"><li>▪ <b>Depth gauge:</b> The depth gauge (commonly referred to as the raker) regulates the thickness of the wood chip the chain saw will remove. If you file the depth gauge too low, the saw chain will jump, jerk, and chatter, causing the chain saw motor to bog down or lose power. If you do not file the depth gauge enough (too high), the chain will not cut enough wood.</li><li>▪ <b>Cutting corner:</b> The cutting corner starts the cut into the wood fiber. If the point is rolled over or dulled by hitting dirt, rocks, or metal, you must sharpen it for it to work correctly.</li><li>▪ <b>Top plate:</b> The top plate begins separating the wood chip from the kerf and also regulates the kerf width.</li><li>▪ <b>Side plate:</b> The side plate does most of the cutting by severing the long fibers in the kerf.</li><li>▪ <b>Chisel angle:</b> The chisel angle is on the front of the top plate. This angle separates the wood chip from the kerf. The chisel angle works in unison with the depth gauge.</li></ul> <p data-bbox="500 1178 711 1209"><b>DISPLAY NEXT SLIDE</b></p>
<p data-bbox="215 1251 459 1283"><i>Slide 13: Cutter Types</i></p> 	<h3 data-bbox="500 1251 683 1283">Cutter Types</h3> <p data-bbox="500 1293 553 1325"><b>Say:</b></p> <p data-bbox="500 1346 1398 1409">The three most common types of cutter teeth are chipper, chisel, and semi-chisel.</p> <ul data-bbox="548 1430 1414 1703" style="list-style-type: none"><li>▪ <b>Chipper:</b> The easiest to file. It will tolerate the most dirt and dust.</li><li>▪ <b>Chisel:</b> The most aggressive cutter type. There are two types of chisel chain: square ground and round ground. You can use a round file or a specialized file to sharpen a chisel chain. Square ground can be more difficult to file than other types of chain. Chisel chain does not tolerate dirty cutting conditions.</li></ul>

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Slide/Action	Content
<p style="text-align: center;"><i>Slide 14: Cutter Sequence</i></p> 	<ul style="list-style-type: none"><li>▪ <b>Semi-chisel:</b> A less aggressive cutter type than chisel. Use a round file when filing semi-chisel chain. Semi-chisel chain tolerates dirt and dust.</li></ul> <p><b>DISPLAY NEXT SLIDE</b></p> <p><b>Cutter Sequence</b> <b>Say:</b></p> <p>The three types of cutter sequences are standard or full comp, semi-skip, and skip.</p> <p><b>INSTRUCTOR NOTE:</b></p> <p>Pass around labeled chain pieces and discuss cutter type and cutter sequence. Explain why you would use different chain for different applications. Point out all the differences while passing around the chain or use a pointer on the PowerPoint image.</p> <p>Discuss the use cases and performance of each cutter sequence.</p> <p><b>Standard/full comp:</b> Has the most cutting teeth of the three sequences. Its many teeth make it the smoothest and fastest cutting. Usually found on saws with short- to medium-length bars or used for jobs that require extensive brushing or limbing.</p> <p><b>Semi-skip:</b> A compromise between standard and full-skip sequence. Half its teeth are close together, like standard, and half are like full-skip. Good for most applications.</p> <p><b>Skip:</b> Best for running on long bars and cutting large, softwood trees. One benefit is that it takes less time to sharpen than the other sequences. Some disadvantages include its lack of cutter teeth, making it grabby in short cuts; its high kickback potential; and its tendency to vibrate. Not a good choice for brushing or limbing.</p> <p><b>DISPLAY NEXT SLIDE</b></p>

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Slide/Action	Content
<p>Slide 15: Chain Saw Maintenance</p> 	<h3 style="color: #4F7942;">Chain Saw Maintenance</h3> <p><b>Say:</b> A properly maintained saw improves performance, reduces downtime, requires less effort to operate, reduces fatigue, and minimizes operator risk.</p> <p>The goal of this section is to educate you on basic, routine saw maintenance to keep your saw performing safely and as designed.</p> <p style="color: #4F7942;"><b>DISPLAY NEXT SLIDE</b></p>
<p>Slide 16: Major Systems 1</p> 	<h3 style="color: #4F7942;">Major Systems 1</h3> <p><b>Say:</b> There are three major systems on a chain saw that you must maintain: the safety system, the powerhead system, and the bar and chain system.</p> <p>The <b>safety system</b> includes the throttle interlock, antivibration system, handlebars, chain brake, and chain catcher.</p> <p style="color: #4F7942;"><b>DISPLAY NEXT SLIDE</b></p>
<p>Slide 17: Major Systems 2</p> 	<h3 style="color: #4F7942;">Major Systems 2</h3> <p><b>Say:</b> The <b>powerhead system</b> includes the spark arrester, decompression valve, cylinder cooling fins, spark plug, air filter, carburetor, fuel filter, fuel tank, fan housing, and flywheel fins.</p> <p style="color: #4F7942;"><b>DISPLAY NEXT SLIDE</b></p>

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Slide/Action	Content
<p>Slide 18: Major Systems 3</p> 	<p><b>Major Systems 3</b></p> <p><b>Say:</b> The <b>bar and chain system</b> includes the chain, guide bar, sprocket, chain tensioner, oilway, and oil adjustment screw. The oilway and oil adjustment screw are lubrication components of the bar and chain system.</p> <p><b>Transition:</b> You should do a routine visual inspection of these components on the saw to reduce downtime.</p> <p><b>DISPLAY NEXT SLIDE</b></p>

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Slide/Action	Content
<p data-bbox="207 373 467 472"><i>Slide 19: Bar and Chain Installation and Inspection</i></p> 	<p data-bbox="500 373 1084 409"><b>Bar and Chain Installation and Inspection</b></p> <p data-bbox="500 415 555 451"><b>Say:</b></p> <p data-bbox="500 457 1344 525">Follow along in your student guide as I demonstrate the steps for installing and inspecting the bar and chain on this saw.</p> <p data-bbox="500 550 701 577"><b>INSTRUCTOR NOTE:</b></p> <p data-bbox="500 598 1393 667">Follow the steps below as you demonstrate the installation and inspection of the bar and chain. Do not tighten the chain tension yet.</p> <p data-bbox="500 693 1193 720"><b>DEMONSTRATION: BAR AND CHAIN INSTALLATION AND INSPECTION</b></p> <ol data-bbox="592 735 1372 892" style="list-style-type: none"><li>1. Wear gloves.</li><li>2. Remove the clutch cover by disengaging the chain brake and removing the bar nuts.</li><li>3. Remove the bar and chain.</li></ol> <p data-bbox="500 903 1409 972"><b>Note:</b> Inform students of the importance of rotating/flipping the chain saw bar over when doing routine maintenance.</p> <ol data-bbox="592 987 1412 1596" style="list-style-type: none"><li>4. Inspect the chain.</li><li>5. Clean the bar channel groove oil ports, bar sprocket, and drive sprocket.</li><li>6. Adjust the chain tensioner so that it inserts into the bar adjustment hole.</li><li>7. Reinstall the bar and chain.<ul data-bbox="690 1239 1412 1554" style="list-style-type: none"><li>○ Fit the bar over the bar studs, making sure the chain has the correct orientation (the cutting points point toward the powerhead on the bottom of the bar).</li><li>○ Place the chain over the drive sprocket, making sure the chain drives engage.</li><li>○ Fit the chain drivers into the bar grove along the length of the bar (top and bottom) and around the drive sprocket.</li></ul></li><li>8. Replace the clutch cover.</li></ol> <p data-bbox="500 1612 1404 1759"><b>Note:</b> Some models have chain tensioners located in the clutch cover, while others have them in the saw body. Regardless of the location, take care to locate the adjustment pin through the bar adjustment hole when replacing the clutch cover.</p> <ol data-bbox="592 1774 1242 1806" style="list-style-type: none"><li>9. Ensure the chain brake is functioning properly.</li></ol> <p data-bbox="500 1816 711 1843"><b>DISPLAY NEXT SLIDE</b></p>

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Slide/Action	Content
<p>Slide 20: Video: Chain Tension</p> 	<p><b>Video: Chain Tension</b></p> <p><b>Say:</b></p> <p>We will now watch a video about proper chain tension.</p> <p><b>Video Debrief</b></p> <p>After the video, ask the class:</p> <p><b>Q:</b> What is the first step in adjusting tension? <b>A:</b> Loosen the bar nuts.</p> <p><b>Q:</b> What is “snap tight”? <b>A:</b> An extra quarter to half turn on the tensioner so the chain snaps back into place when it pulls out of the bar rails.</p> <p><b>Say:</b></p> <p>Follow along in your student guide as I apply what we learned in the video to this chain saw we just inspected.</p> <p><b>INSTRUCTOR NOTE:</b></p> <p>Follow the steps below as you adjust the chain tension.</p> <p><b>Demonstration: Correct Chain Tension</b></p> <ol style="list-style-type: none"><li>1. With the bar nuts lightly installed, raise the tip of the bar.</li><li>2. Carefully move the bar and chain forward by turning the chain tensioner to remove slack, making sure the drivers remain in the bar slots and are properly located on the sprocket.</li><li>3. You should be able to pull down on the chain (at the middle of the bar) until three drivers just clear the bar rails. The chain should <b>snap</b> back in place.</li><li>4. Tighten the bar nuts. Do not overtighten them because studs can pull from the case.</li></ol>

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Slide/Action	Content
<p>Slide 21: Video: How to Properly Maintain and Sharpen Chains</p> 	<p><b>Note:</b> Once again, point out the tension screw and demonstrate its use, including proper versus improper tension. Discuss the importance of the proper tension and how it can affect the performance of the chain saw.</p> <p><b>Remember:</b> Refer to your owner’s manual for proper tensioning procedure.</p> <p><b>Transition:</b> Maintaining a sharp chain is critically important and will help improve your safety, reduce physical fatigue, and lessen the wear of the bar and powerhead. Pay attention to the amount of sawdust you generate; this is a great indicator of a dull chain (sawdust) or a sharp chain (woodchips).</p> <p><b>DISPLAY NEXT SLIDE</b></p> <p><b>Video: How to Properly Maintain and Sharpen Chains</b></p> <p>We will now watch a video of a sawyer sharpening a saw chain.</p> <p><b>Video Debrief</b></p> <p>After the video, ask the class:</p> <p><b>Q:</b> What tools are necessary for sharpening a chain?  <b>A:</b> Round file, flat file, and depth gaugers (rakers)</p> <p><b>Q:</b> What would be a good indication that you are filing in the wrong direction?  <b>A:</b> Easier to put the file through the stroke; easier to line up the marks on the file guide</p> <p><b>DISPLAY NEXT SLIDE</b></p>

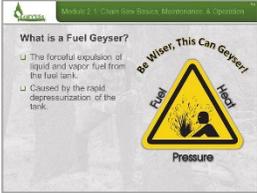
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Slide/Action	Content
<p><i>Slide 22: Gas-Powered Chain Saws</i></p> 	<h3>Gas-Powered Chain Saws</h3> <p><b>Say:</b></p> <p>Gas-powered chain saws have two-stroke motors that require a fuel-oil mixture. Chain saw fuel is most often mixed at a 50-to-1 ratio (50 parts gas to 1 part two-cycle oil). Follow the manufacturer's recommendations, as they may vary.</p> <h4>Mixing Fuel</h4> <p>To mix fuel for a chain saw:</p> <ol style="list-style-type: none"><li>1. Add the correct amount of two-stroke mix oil to the fuel container.</li><li>2. Add the correct amount of gasoline to the fuel container to obtain the correct fuel-to-oil ratio.</li><li>3. Cap the fuel container and shake the mixture for 20 to 30 seconds to ensure proper blending.</li></ol> <p><b>Notes:</b></p> <ul style="list-style-type: none"><li>▪ You should use the fuel-oil mixture within 30 days of mixing.</li><li>▪ Commercially produced, premixed fuel may also be available and has a longer shelf life. Refer to the manufacturer's guidance on shelf life.</li></ul> <p><b>DISPLAY NEXT SLIDE</b></p>
<p><i>Slide 23: Fueling a Chain Saw</i></p> 	<h3>Fueling a Chain Saw</h3> <p><b>Say:</b></p> <p>You should always fuel the chain saw on bare ground at least 20 feet from any ignition source. Allow the chain saw to cool before refueling. You should also refill the bar oil when you refill the fuel.</p> <p>To fuel a chain saw:</p> <ol style="list-style-type: none"><li>1. Wipe away accumulated sawdust and dirt from the gas and oil filler caps.</li><li>2. After filling, replace the fuel cap and wipe up any spillage.</li><li>3. Remove the oil cap and fill with bar oil.</li><li>4. Replace the oil cap and wipe up spillage.</li><li>5. Move at least 10 feet away from the fill site before you start the chain saw.</li></ol>

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Slide/Action	Content
<p>Slide 24: What is a Fuel Geysers?</p> 	<p><b>Note:</b> While the order you use to refill the fuel and oil tanks on your saw is not critical, make it a habit of performing the task the same way each time to prevent filling the tank with the wrong fluid.</p> <p><b>DISPLAY NEXT SLIDE</b></p> <p><b>What is a Fuel Geysers?</b></p> <p><b>Say:</b></p> <p>A <b>fuel geysers</b> is the forceful expulsion of liquid and vapor fuel from the fuel tank caused by the rapid depressurization of the tank. Heat and agitation cause the pressure increase. A delayed fuel geysers can occur after opening the fuel container.</p> <p>Fuel geysers can occur anytime fuel, heat, and pressure combine in fuel transport containers or small, gas-powered engines, such as chain saws, leaf blowers, and portable pumps. They have resulted in injury when sprayed fuel and vapor have ignited.</p> <p><b>What do I need to know to protect myself?</b></p> <p>Along with the fueling procedures listed above, take the following precautions when fuel, heat, and pressure are present (these steps may prevent significant burns in the event of fuel spray):</p> <ul style="list-style-type: none"><li>▪ Always assume fuel tanks and fuel containers are pressurized.</li><li>▪ Always check fuel levels before opening the fuel tank or filler cap; more than half a tank may geysers.</li><li>▪ Cover the fuel cap with a rag when opening to contain potential fuel geysers spray.</li><li>▪ Be extra vigilant when equipment is running poorly and the fuel level is above half a tank.</li><li>▪ Do not use fuel older than 1 month.</li></ul>

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Slide/Action	Content
<p>Slide 25: Video: Fuel Geysering: Predictable?</p> 	<p>If the equipment is running poorly or you suspect vapor lock:</p> <ul style="list-style-type: none"><li>▪ Do not open the fuel cap. Relieving the pressure does not alleviate a <b>vapor lock</b>.</li><li>▪ Check the fuel level through the tank or use the bar oil level to gauge the fuel level.</li><li>▪ If the fuel level is more than half full, <b>do not open the tank!</b></li><li>▪ Allow the equipment to thoroughly cool. This can take more than 45 minutes.</li><li>▪ Restart the equipment when it is cool.</li></ul> <p>It is <b>your</b> job to protect yourself and others. Know how to handle your equipment to avoid fuel geysers anytime fuel, heat, and pressure are present.</p> <p><b>DISPLAY NEXT SLIDE</b></p> <p><b>Say:</b> Now, we will watch a video showing two examples of a fuel geysers in a lab-controlled scenario.</p> <p>After the video, ask the class if they have questions and provide them with answers.</p> <p><b>Note:</b> The content of this video is covered in the student guide under the heading “What is a Fuel Geysers?”</p> <p><b>DISPLAY NEXT SLIDE</b></p>
<p>Slide 26: Chain saw Operations</p> 	<h3>Chain Saw Operations</h3> <p><b>Say:</b> Because you must release one hand to pull the starter cord, which compromises your grip and some of the control that two-handed operation normally provides, take extra care each time you start a chain saw.</p> <p><b>Important:</b> Consult your owner's manual for the correct choke and switch settings for your saw.</p> <p><b>DISPLAY NEXT SLIDE</b></p>

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Slide/Action	Content
<p data-bbox="232 380 443 436"><i>Slide 27: Five-point Safety Check</i></p> 	<h3 data-bbox="500 380 841 411">Five-Point Safety Check</h3> <p data-bbox="500 422 553 453"><b>Say:</b></p> <p data-bbox="500 459 1398 604">Before starting a chain saw, conduct the five-point safety check. Ensuring that all parts are in working order will help prevent injury during use. We will watch a video about the five-point safety check in a minute. First, watch as I do a safety check on this saw.</p> <p data-bbox="500 632 971 657"><b>DEMONSTRATION: FIVE-POINT SAFETY CHECK</b></p> <p data-bbox="500 680 1149 711">The five inspection points for the safety check are:</p> <ol data-bbox="532 737 1398 1062" style="list-style-type: none"><li>1. Activate the chain brake to ensure that it locks and unlocks the chain properly.</li><li>2. Squeeze the trigger to ensure it is locked.<ul data-bbox="597 863 1349 926" style="list-style-type: none"><li>• Squeeze again while pressing the interlock to ensure it unlocks.</li></ul></li><li>3. Confirm the chain catch pin is present.</li><li>4. Check that the antivibration system and fasteners are tight.</li><li>5. Check that the spark arrester screen is present.</li></ol> <p data-bbox="500 1079 711 1104"><b>DISPLAY NEXT SLIDE</b></p>
<p data-bbox="224 1150 451 1207"><i>Slide 28: Holding the Chain Saw</i></p> 	<h3 data-bbox="500 1150 824 1182">Holding the Chain Saw</h3> <p data-bbox="500 1192 553 1224"><b>Say:</b></p> <p data-bbox="500 1247 1398 1350">Your thumb and fingers should always be wrapped completely around the handlebar. This is essential for maintaining control of the chain saw and for effective use of the chain brake.</p> <p data-bbox="500 1373 1382 1444">Your grip on the chain saw should be firm but not overly tight. Chain saw safety features are designed for right-handed use.</p> <p data-bbox="500 1470 711 1495"><b>DISPLAY NEXT SLIDE</b></p>

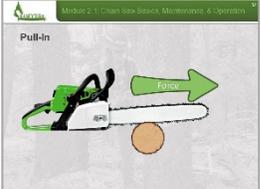
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Slide/Action	Content
<p><i>Slide 29: Stance</i></p> 	<p><b>Stance</b></p> <p><b>Say:</b></p> <p>You obtain the ideal stance when you maintain your balance with your feet spread apart, knees bent slightly, back straight, and a firm grip on the chain saw. Proper ergonomics are critical for minimizing fatigue and possible injury.</p> <p><b>DEMONSTRATION</b></p> <p>Demonstrate the proper stance.</p> <p><b>DISPLAY NEXT SLIDE</b></p>
<p><i>Slide 30: Video: Five-Point Safety Check and Starting a Chain Saw</i></p> 	<p><b>Video: Five-Point Safety Check and Starting a Chain Saw</b></p> <p><b>Say:</b></p> <p>Now we will watch a video of a sawyer completing a five-point safety check and starting a chain saw using various methods.</p> <p><b>NOTE:</b> Consult your owner’s manual for the correct choke settings for the make and model of your chain saw.</p> <p><b>Video Debrief</b></p> <p>After the video, ask the class if they have questions and provide them with answers.</p> <p><b>INSTRUCTOR NOTE:</b></p> <p>The content of this video is covered in the student guide under the headings “General Guidelines” and “Ways to Support the Chain Saw.”</p> <p><b>DISPLAY NEXT SLIDE</b></p>
<p><i>Slide 30: Reactive Forces</i></p> 	<p><b>Reactive Forces</b></p> <p><b>Say:</b></p> <p>Always be aware of the potential reactive forces that the chain saw cutting system may cause. Reactive forces will vary at different points around the bar, and in the opposite direction from the direction the chain moves around the bar.</p> <p>Next, we will discuss the three reactive forces: pushback, pull-in, and kickback.</p> <p><b>DISPLAY NEXT SLIDE</b></p>

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Slide/Action	Content
<p><i>Slide 31: Pushback</i></p> 	<p><b>Pushback</b></p> <p><b>Say:</b></p> <p>Pushback occurs when you use the top of the bar to cut. When you use the top of the bar, energy transfers to you as the chain saw comes in contact with the wood. Although this reactive force is generally not as powerful as the one you experience during kickback, it can knock you off balance.</p> <p><b>DEMONSTRATION: PUSHBACK</b></p> <p>Show how the saw behaves in a pushback by demonstrating the motion of the pushback reactive force.</p> <p><b>DISPLAY NEXT SLIDE</b></p>
<p><i>Slide 32: Pull-in</i></p> 	<p><b>Pull-In</b></p> <p><b>Say:</b></p> <p>Pull-in occurs when you cut with the bottom of the bar and energy transfers as the chain pulls the saw forward. The tree or log will stop pull-in as the bucking spikes or as the powerhead contacts the wood.</p> <p><b>DEMONSTRATION: PULL-IN</b></p> <p>Show how the saw behaves in a pull-in by demonstrating the motion of the pull-in reactive force.</p> <p><b>DISPLAY NEXT SLIDE</b></p>

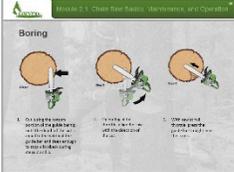
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Slide/Action	Content
<p data-bbox="235 380 440 407"><i>Slide 33: Kickback</i></p> 	<h3 data-bbox="500 380 626 407">Kickback</h3> <p data-bbox="500 422 553 449"><b>Say:</b></p> <p data-bbox="500 474 1403 579">Kickback can occur during saw operations when the upper portion of the bar nose contacts a solid object or becomes pinched. This can force the bar violently up and back toward you in an uncontrolled arc.</p> <p data-bbox="500 604 1403 709">Common kickback injuries involve saw cuts to the face, neck, and shoulder. Remain vigilant for this potential danger and plan all cuts to avoid it.</p> <p data-bbox="500 741 906 768"><b>DEMONSTRATION: AVOIDING KICKBACK</b></p> <p data-bbox="500 789 915 816">Show what a kickback looks like.</p> <p data-bbox="500 842 748 869"><b>Avoiding Kickbacks</b></p> <p data-bbox="500 894 1321 963">Hold the saw with both hands, securely gripping the handle and handlebar between your thumb and forefinger.</p> <ul data-bbox="548 989 1403 1310" style="list-style-type: none"><li>▪ Always be aware of the location of the bar nose and avoid cutting in the kickback danger zone (the upper quadrant of the bar nose).</li><li>▪ Avoid overreaching with the bar and contacting other objects with the upper quadrant of the bar nose.</li><li>▪ Allow the chain to come to a complete stop or engage the chain brake before pulling the saw smoothly from a cut.</li><li>▪ Position your body not to be in the kickback arc.</li></ul> <p data-bbox="500 1325 699 1352"><b>INSTRUCTOR NOTE:</b></p> <p data-bbox="500 1360 1403 1507">Please use the “Saw Station Guide” in appendix A for a walkthrough of the “Saw Basics” saw station that will allow students to practice starting and handling the saw, performing a five-point safety check, and gauging reactive forces.</p> <p data-bbox="500 1518 708 1545"><b>DISPLAY NEXT SLIDE</b></p>

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Slide/Action	Content
<p data-bbox="250 380 423 407"><i>Slide 35: Boring</i></p> 	<p data-bbox="500 380 589 407"><b>Boring</b></p> <p data-bbox="500 420 1243 447">Boring is a technique you can use for a variety of reasons:</p> <ul data-bbox="548 459 1414 678" style="list-style-type: none"><li>• To explore the condition of the wood fiber, validating the occurrence and extent of decay</li><li>• To help determine the extent and location of either tension or compression in a log</li><li>• To construct an exact hinge width</li></ul> <p data-bbox="500 707 667 735"><b>Boring steps:</b></p> <ol data-bbox="548 747 1406 961" style="list-style-type: none"><li>1. Cut, using the bottom portion of the guide bar tip, until the depth of the cut is equal to the width of the guide bar and deep enough to stop a kickback during steps 2 and 3.</li><li>2. Operating at full throttle, align the saw with the direction of cut.</li><li>3. With saw at full throttle, press the guide bar straight into the trunk.</li></ol>

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Slide/Action	Content
<p><i>Slide 36: Knowledge Check</i></p> 	<h3>Knowledge Check</h3> <p><b>INSTRUCTOR NOTE</b></p> <p>Allow students a few moments to answer the questions in the student guide. Discuss the answers and correct any misconceptions.</p> <p><b>Q:</b> Where do you look to determine what type of chain you should order for your chain saw? <b>A:</b> The markings on the guide bar.</p> <p><b>Q:</b> What are some guidelines for fueling a chain saw? <b>A:</b> Answers should include:</p> <ul style="list-style-type: none"><li>▪ Always fuel on bare ground.</li><li>▪ Maintain at least 20 feet from any ignition source.</li><li>▪ Allow the chain saw to cool first.</li><li>▪ Also refill the bar oil.</li></ul> <p><b>Q:</b> What is a fuel geyser? <b>A:</b> The forceful expulsion of liquid and vapor fuel from the fuel tank caused by the rapid depressurization of the tank. Heat and agitation cause the pressure increase.</p> <p><b>Q:</b> How can you protect yourself from a fuel geyser? <b>A:</b> Answers should include:</p> <ul style="list-style-type: none"><li>▪ Always assume fuel tanks and fuel containers are pressurized.</li><li>▪ Ensure the cap is correctly secured.</li><li>▪ Always check fuel levels before opening the fuel tank or filler cap. Fuel levels of more than half a tank may geyser.</li><li>▪ Cover the fuel cap with a rag when opening to contain potential fuel geyser spray.</li><li>▪ Be extra vigilant when equipment is running poorly and the fuel level is more than half a tank.</li><li>▪ Do not use fuel older than 1 month.</li></ul> <p><b>Q:</b> What are the forms of reactive force? <b>A:</b> Push back, pull-in, and kickback</p> <p><b>DISPLAY NEXT SLIDE</b></p>

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Slide/Action	Content
<p><i>Slide 34: Summary</i></p>  <p><i>Slide 35: Questions</i></p> 	<p><b>Summary</b></p> <p><b>REVIEW</b> Review the summary objectives listed on the slide. <b>DISPLAY NEXT SLIDE</b></p> <p><b>Questions</b></p> <p><b>Ask:</b> Do you have questions about chain saw basics, maintenance, and operation?</p>

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