

# USDA Forest Service National Sawyer Training: Developing Thinking Sawyers



## Student Guide: Classroom

**USDA Forest Service National Sawyer Training:  
Developing Thinking Sawyers**  
Module 4: Ax Basics, Maintenance, and Use

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## Module 4: Ax Basics, Maintenance, and Use

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### Module 4: Ax Basics, Maintenance, and Use

#### Introduction

This module is an introduction to selecting and properly using an ax. The instructor will present concepts in the classroom and will follow up with demonstrations. You will then practice these techniques in the field under controlled and supervised conditions.

#### Module Topics

- Personal protective equipment (PPE) and ax safety
- Chopping plan
- Chopping techniques
- Ax maintenance

#### Objectives

When you complete this module, you will be able to:

- Describe how an ax works.
- Identify the parts of an ax.
- Describe the importance of the 45-degree angle.
- Select appropriate PPE when using an ax.
- Describe a chopping plan.
- Demonstrate proper chopping techniques.
- Describe how to maintain an ax.

#### Pework Review

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#### *Ax History*

Around the turn of the 19th century, ax manufacturers produced more than 300 different ax-head patterns in the United States; many of these were nearly identical. To simplify identification and eliminate unnecessary or duplicate patterns, the Ax Manufacturers' Association agreed to set a standard, which resulted in a standard chart of ax patterns.

For basic wood operations, there are three types of axes: double-bit axes, single-bit axes, and boys' axes (figure 4.0.1).

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*Ax Types*



**Figure 4.0.1—Ax types.**

- Double-bit ax
  - 3 to 4 pounds
  - Cannot pound wedges
  - Typically has a 36-inch handle
  - Not safe when swung and left in a tree
- Single-bit ax
  - 3 to 6 pounds
  - Chops well and pounds wedges
  - Handle length varies from 26 to 36 inches
- Boy's ax
  - 2 to 3 pounds
  - Good for limbing and pounding wedges
  - Typically has a 28-inch handle

*Choosing an Ax*

Matching the weight of the head and the length of the handle to the specific ax user is paramount to the functionality of the ax. The head weight must be heavy enough to carry sufficient energy into the wood to sever and split the log, and the handle size must be the

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appropriate length for the user to drive the cutting edge powerfully and accurately into the wood fiber.

### *Sizing*

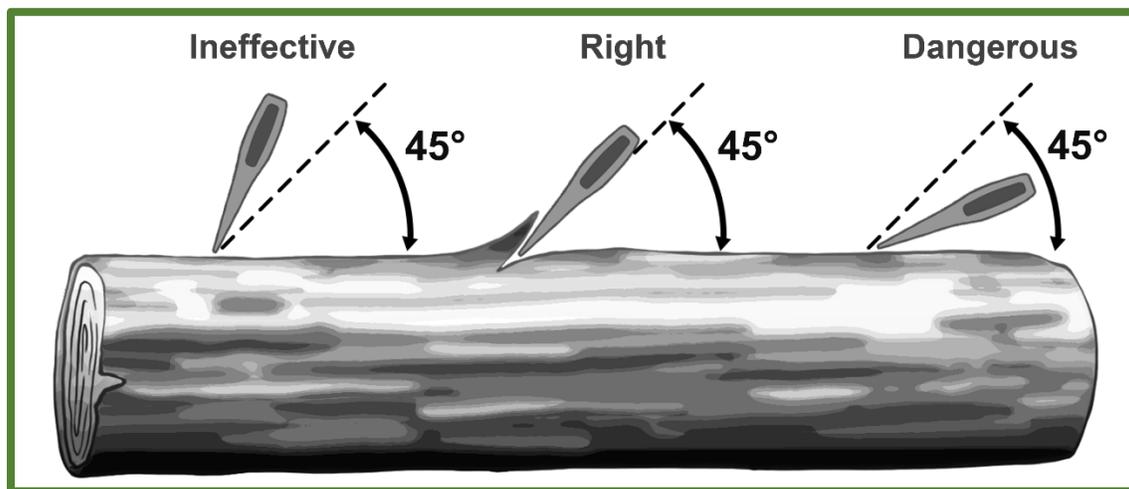
Newer and smaller ax users will find that a 3½-pound head is a good starting point. As ax users become more proficient in swinging the tool, they will probably want to move to a heavier head. Competition choppers typically use a 5½- to 7-pound head. For day-in-and-day-out woods work, an ax this heavy is unwieldy and too heavy. A 4- to 4½-pound ax head is a great size for chopping undercuts, bucking logs, limbing, and wedging.

### *Chopping Plan*

Ax usership has three elements: having a properly tuned ax that fits your body, swinging an ax with power and accuracy, and deciding how and where to chop. This decision is known as the chopping plan, or the mental portion of the task of chopping.

### *The 45-degree Angle*

The bit of the ax slices through wood fibers, and correctly shaped cheeks split the wood along the grain allowing chips to pop out from the log. Proper delivery of the bit into the wood makes an ax a very efficient tool. Figure 4.0.2 shows that a 45-degree angle is the optimum angle for severing fibers and removing chips. Swinging an ax at a 45-degree angle slices and splits wood along its grain. An angle shallower than 45-degrees will glance off the log in a dangerous manner. An angle steeper than 45-degrees will not slice and split the wood and would be a very inefficient use of an ax.



**Figure 4.0.2—Importance of the 45-degree angle.**

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*Review Questions*

What are the three main types of axes used today?

How do you decide on the appropriate handle length?

What are some important considerations when selecting an ax?

Why is the 45-degree chopping angle important?

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**PPE and Ax Safety**

Personal protective equipment (PPE) is a requirement that helps protect sawyers from injuries. The required PPE needed to wield an ax includes long pants, sturdy leather boots, eye protection, long sleeves, and a helmet.

An ax can easily chop through pants, chain saw chaps, or boots. The best way to protect yourself is to be aware of your surroundings and to use proper chopping form. Using proper form helps with control and will help ensure your safety.

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### Required PPE

- Long pants
- Sturdy leather boots
- Eye protection
- Long sleeves
- Helmet
- Hand protection

### Chopping Techniques and Safety

The instructor will present several chopping techniques throughout this module that cover a variety of situations. Gaining an understanding of how to perform these techniques and accomplish a job safely and efficiently begins with proper chopping form and handling.

Taking the time to clear and prepare your work area before chopping is a must. When you apply a few general principles to all your chopping techniques, you help to ensure a safe, efficient, and effective operation.

Preparing your work area, proper chopping form (figure 4.0.3), and appropriate PPE are only part of ax safety. Focusing on the operation and how you are using the ax will help ensure your safety.



**Figure 4.0.3—Proper chopping form.**

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## Chopping Plan

Ax work incorporates three elements: having a properly tuned ax that fits your body, swinging an ax with power and accuracy, and deciding how and where to chop. This decision is known as the chopping plan.

Knots are very hard to sever, binds add complexity, footing can make some locations inaccessible, and you may need to employ different techniques to chop through larger logs. Proper delivery of the bit into the wood makes an ax a very efficient tool.

## Removing Wood by Volume

A saw cuts on a two-dimensional plane, but when using an ax, the task becomes three-dimensional as the ax removes wood chips in volume. For an ax to remove wood chips, the bit of the ax slices through wood fibers, splitting the wood along the grain and allowing chips to pop out from the log. The **face** is the opening where the ax has removed the chips. When properly done, the ax user will form two faces in the log by chopping on both the left and right sides of the planned point of separation, which will construct a “V.”

## Ax Angle

Swinging an ax at a 45-degree angle slices and splits wood along its grain. The diagram in figure 4.0.4 shows how a 45-degree angle is the optimum angle for severing fibers and removing chips. Figure 4.0.5 shows an incorrect, straight-down cut.

An angle shallower than 45-degrees will glance off the log in a dangerous manner. An angle steeper than 45-degrees will not slice and split the wood and would be a very inefficient use of an ax.

Using a 45-degree angle will allow you to construct a free face and effectively remove wood chips.



Figure 4.0.4—Correct, 45-degree angle cut.



Figure 4.0.5—Incorrect, straight-down cut.

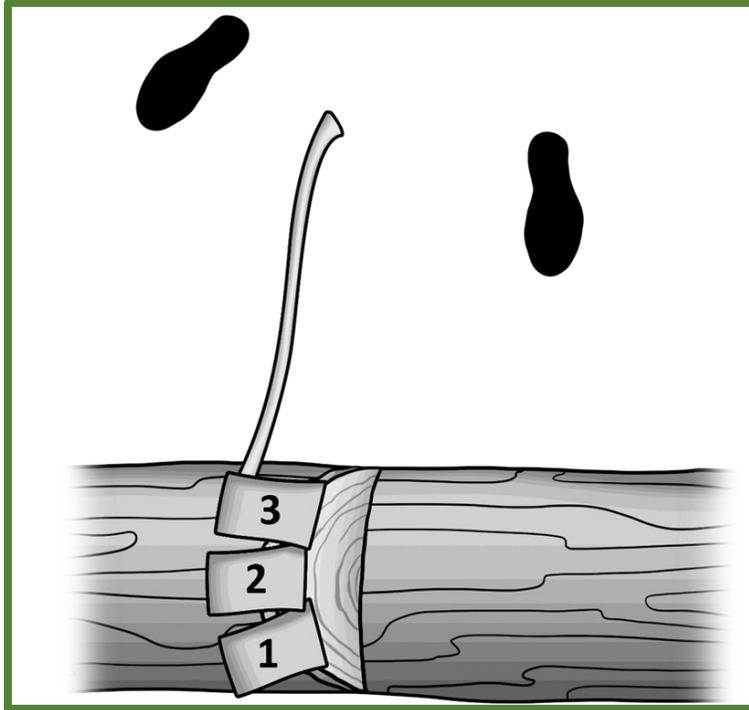
## Constructing a Free Face

An ax user typically makes the **free face** with three cuts (figure 4.0.6):

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1. The first cut chops the far side of the log.
2. The second cut overlaps the first cut and is in the middle of the log.
3. The third stroke overlaps the second cut near the other side of the log.



**Figure 4.0.6—Constructing a free face.**

As the ax bit severs wood fibers, the cheeks of the ax split the wood to the constructed free face. This combination of severing and splitting is why it is important to strike the log at a 45-degree angle.

Next, we will look at different chopping plans.

### *Chopping From Both Sides*

When possible, it is more desirable to cut the log from two sides. Chopping a log from both sides reduces the amount of wood you must remove and the time it takes to complete the task.

Figure 4.0.7 shows how chopping a log from both sides and lining up the two cuts to meet in the middle removes one-third of the amount of wood than does cutting from only one side of the log. Slightly offsetting the notches facilitates severing the log on the final blow.

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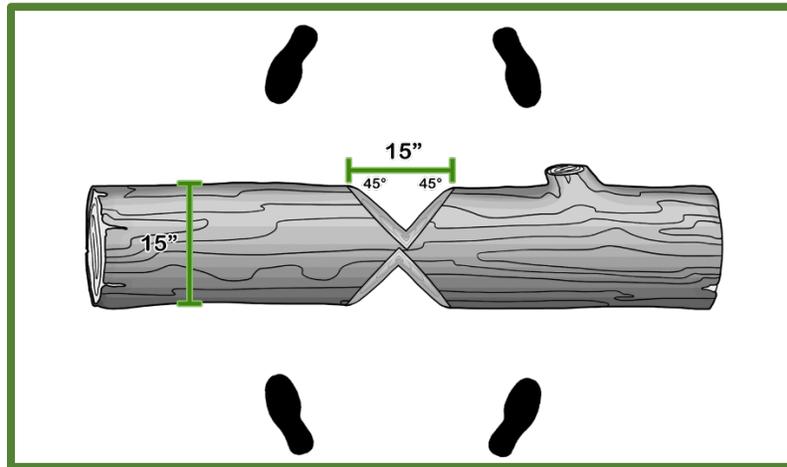


Figure 4.0.7—Chopping from both sides.

### Chopping From One Side

Imagine that you come across a log that is 15 inches in diameter. To cut through the log chopping from one side only, you will need to chop twice the diameter of the log. For this log, that would be 30 inches. Chopping from both sides reduces the width of the cuts to 15 inches on both sides (see figure 4.0.7).

If you choose to chop from only one side of the log, the cuts you must make would be **twice the log diameter apart**—or 30 inches apart (figure 4.0.8). Popping out chips from a log making cuts 30 inches apart is almost impossible, so you need to start smaller. There are two different methods to create a notch wide enough to chop through a log this size.

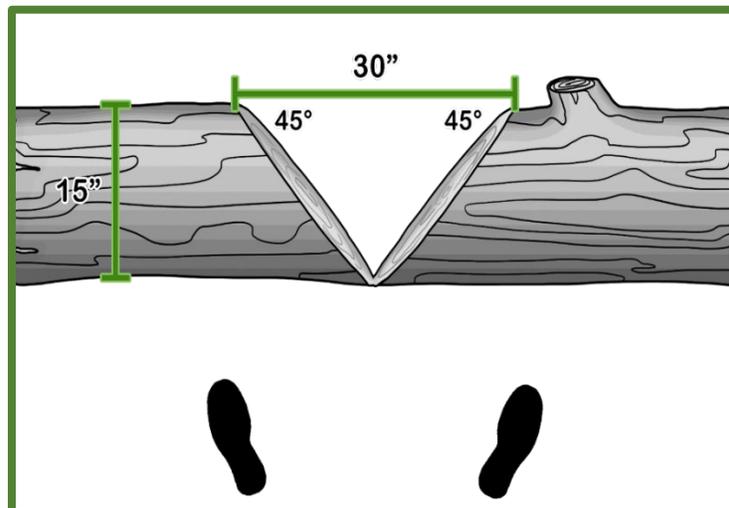


Figure 4.0.8—Chopping from one side.

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*Chopping Large Logs—Connecting Notches*

The first method is to make two smaller notches and then connect them as shown in figure 4.0.9. As you can see, the ax user makes two smaller notches and then connects the two notches by splitting the wood in between them to get through the log.



Figure 4.0.9—Connecting two separate notches.

The second method is to start a notch and cut until the two sides or faces have closed. Then, open the notch wider by chopping on one side of it (figure 4.0.10). The ax user can repeat this process as many times as needed to sever the log.

**Note:** Throughout the rest of this module, **faces** refers to the two sides of a cut.



Figure 4.0.10—Connecting two faces of one notch.

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*Standing on the Log*

When bucking a downed log that rests on or near the ground, chopping from both sides while standing on top is often the most efficient way to operate. Standing on top of a log and chopping equal sized notches from both sides that connect in the middle (figure 4.0.11) allows the ax user to remove the smallest amount of wood yet still fully sever the log. When this is the case, you may choose to cut footholds into the log, so you have a flat place to stand.



**Figure 4.0.11—Standing on the log.**

As you mentally develop your chopping plan, you need to consider the chopping techniques you will be using to ensure the safest and most efficient swing possible.

**Chopping Techniques**

There are two basic chopping techniques—swinging overhead (figure 4.0.12) or swinging over your shoulder (figure 4.0.13). Your preferred style will be based on your comfort level and the type of chopping that you do. However, to master the use of an ax, you must master both the overhead and the over-the-shoulder chopping techniques.

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**Figure 4.0.12—Overhead chop.**



**Figure 4.0.13—Over-the-shoulder chop.**

### Overhead Chop

Ax users generally prefer the overhead chopping technique. The overhead chop delivers the ax to the log with the most power and accuracy.

The overhead technique allows the ax user to swing with his dominant hand on both sides of the log (figure 4.0.14). Because the overhead chop follows the body's bilateral symmetry, it is the most accurate and powerful chopping method.

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**Figure 4.0.14—Steps for an overhead chop.**

### *Overhead Chop Steps*

1. Orient your hips, shoulders, and feet perpendicular to the direction of the kerf. Square up your body in relation to the cut, not the log.
2. It is important to keep your chin in alignment with the plane and preferably pointed down as much as possible. If your chin drifts, it means your head is drifting, which can lead to a host of problems with the alignment of your eyes, shoulders, and the ax.
3. The grip of the ax may drift from this plane, although it is preferable to keep it in alignment as well. Your head must not drift from this center plane at all.
4. Raise the ax over your head with your forearms at 90-degree angles to the handle. Stand straight up so that at the peak height of your swing, the handle is roughly 90-degrees perpendicular to your body.
5. Try to keep your forearms at 90-degree angles to the handle until just before you make contact with the wood. Now, slow your arm and body rotation, and allow the ax to build velocity as it extends beyond 90 degrees to your forearms. Focus on the precise location to place the blow, and time the impact for the moment just before you attain full extension (the point where the ax handle starts to become uncomfortable to grasp as it tries to rotate out of your grip). If it were a baseball bat, your wrists would have to

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rotate around the handle relative to swing direction to maintain grip (~160 degrees to your forearm). Correct execution will result in minimal handle shock to the hands while maximizing ax head velocity with minimal effort. Remember that you are working for efficiency, not racing.

6. To release the bit, tilt the grip of the handle outward (away from yourself) until the handle points roughly at your torso; this disengages the heel of the ax. Pull the grip toward you, and the bit will release from the kerf.
7. In general, ax users perform the first set of swings on the side of their dominant hand, known as the **forehand** swing. When switching to the opposite side of the face (or notch), this is known as the **backhand** swing. In an overhead chopping style, you do not have to switch hand positions for the backhand swing (i.e., you may chop right-handed on the left side). This is because the structure of the overhead chop makes it essentially the same chop. Reorient your entire body in relation to the backhand cut and chop overhead with an identical motion.

Many novice ax users have a bad habit of looking off to the side or around the ax to gauge accuracy. To prevent this, envision resting your chin on the center of your chest during the downward stroke. If you align your body correctly from your feet through your hips and shoulders, you will raise the ax properly and follow through to cut on your mark, preventing a glancing blow that might injure you.

### *Video: Overhead Chops*

Watch the video and then discuss it with your instructor and the class.

### *Over-the-Shoulder Chop*

For an over-the-shoulder chop, maintain an athletic stance, and as much as possible, keep the ax in a single plane with your shoulders engaged and forward facing (figure 4.0.15). To achieve this, you must chop left-handed on the left side of the face and right-handed on the right side of the face. This requires you to chop well with your nondominant side, which demands considerable experience. Practice the over shoulder chop with both hands from the early stages of training.

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Figure 4.0.15—Over-the-shoulder chop.

*Over-the-Shoulder/Ambidextrous Chop Steps*

1. Orient your hips and shoulders toward the angle of your cut. Shift the direction of your feet toward the angle. Unlike in an overhead stance, your foot placement requires minimal movement.
2. Raise the bit over your shoulder in a smooth, unrushed manner. The pol of the ax should almost touch your shoulder.
3. As you wind up the swing, keep your wrists at 90-degree angles to the ax handle, as in the overhead chop.
4. For a right-handed chop, your left elbow will straighten almost entirely, while your right elbow will be bent.
5. Try to keep your wrists at 90-degree angles to the handle just before you make contact with the wood. Now, slow your arm and body rotation and allow the ax to build velocity as it extends beyond 90 degrees to your forearms. Focus on the precise location to place the blow, and time the impact for the moment just before you attain full extension (the point where the axe handle starts to become uncomfortable to grasp as it tries to rotate out of your grip). If it were a baseball bat, your wrists would have to rotate around the handle, relative to swing direction, to maintain grip (~160

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degrees to your forearm). Correct execution will result in minimal handle shock to the hands while maximizing ax head velocity with minimal effort.

### Note:

To snap your wrist, slow your arm and body rotation and allow the ax to build velocity as it extends beyond 90 degrees to your forearms.

If you achieve this basic form, the ensuing swing should commence fairly naturally. It is more difficult to achieve the whip-like motion of the body in this position, making the culminating snap of the wrist even more important.

### Video: *Over-the-Shoulder Chops*

Watch the video and then discuss it with your instructor and the class.

To keep a functional tool in the woods, you need to be very careful to only hit wood with your ax.

### Finishing Cuts

Damage to the ax can happen when an ax user misses the intended mark or swings completely through a log and strikes something on the other side unintentionally.

The single-bit ax is the best companion to the crosscut saw because the sawyer can use it to pound wedges. A single-bit ax only has one finely tuned edge and the poll of the ax. Therefore, to prevent damage to the bit of the ax, you will typically finish severing a log with the poll end of the ax.

To do this, first chop through the log until you have almost fully severed it. Then switch to the poll end of the ax, and use the overhead chop to strike down through the center of the cut and break the log in two (figure 4.0.16).



Figure 4.0.16—Finishing cuts.

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### Chopping Out an Undercut

During felling operations and in complex bucking situations, you will need to chop on a vertical or near-vertical log. Use an over-the-shoulder chop in these situations (figure 4.0.17). When chopping on a vertical log, the risk of a glancing blow and the ax striking you is higher.

### Chopping Out an Undercut Steps

1. Spread your feet apart in an athletic stance with your toes pointed about 90 degrees apart.
2. For a right-handed chop, your right leg should be back and away from the tree. For a left-handed chop, your left leg should be back and away from the tree. Keeping the respective leg back allows you to base your power off that leg and positions your body so that if a glancing blow was to happen, you are in a safe place where the ax will not strike you.
3. Raise the bit over your shoulder in a smooth, unrushed manner. The poll of the ax should almost touch your shoulder.
4. As you wind up the swing, keep your wrists at 90-degree angles to the ax handle.
5. For a right-handed chop, your left elbow will straighten almost entirely, while your right elbow will be bent.
6. Striking at a 45-degree angle from over your shoulder to the impact point on the tree will allow the ax to enter the tree efficiently and safely, thus severing fibers and popping out chips.

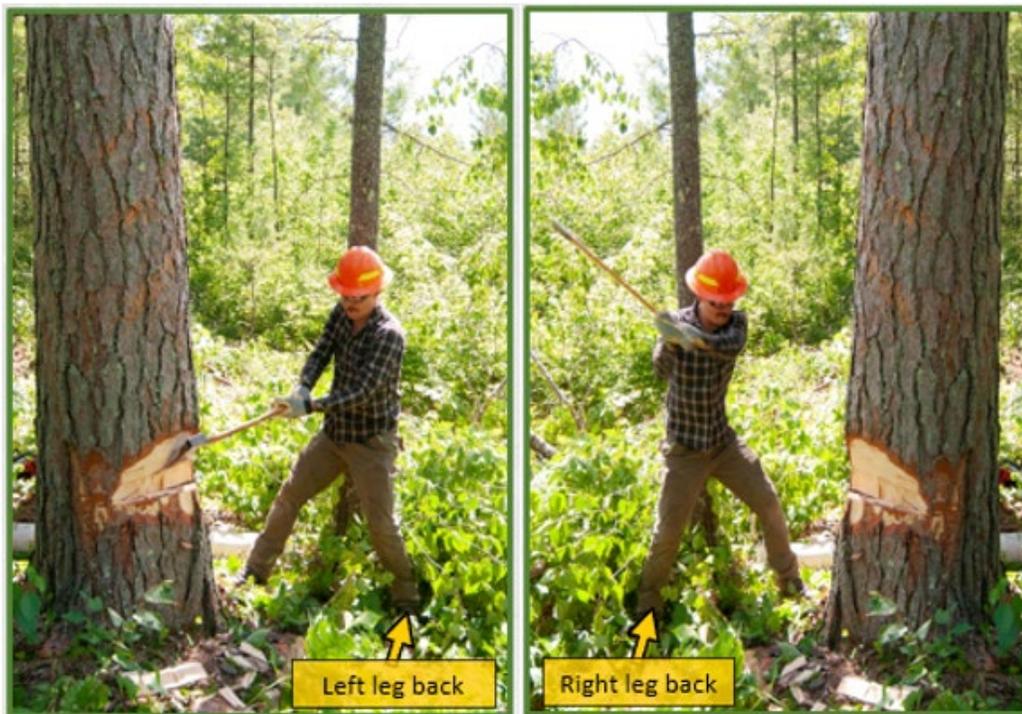


Figure 4.0.17—Chopping out an undercut.

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### Limbing

An ax is an efficient tool for removing limbs from downed trees (figure 4.0.18). Removing limbs with an ax often takes one or two swings and is much more efficient than limbing with a handsaw.

Limbing with an ax is an inherently dangerous task because you will be chopping overhead and over your shoulder on many different planes. Always planning your follow-through swing in a manner that keeps you and the ax safe is imperative in limbing operations.

When limbing, chop the limbs at a 45-degree angle. Chopping the limb on the side of the log opposite from where you are standing is the safest way to limb. This is not always possible due to topography and other obstacles, but it is always possible to have a safe follow through when limbing.



**Figure 4.0.18—Limbing with an ax.**

### *Video: Limbing With an Ax*

Watch the video and then discuss it with your instructor and the class.

### Ax Maintenance

Axes are a necessary tool for sawyers, so it is important to keep them in the best condition possible. Proper maintenance of your ax will extend the life of the ax and help to keep you safe.

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Most experienced ax users carry a small honing stone to sharpen the cutting edge (figure 4.0.19). If you spend much of your day chopping, hone the edge as needed.

Next, clean any dirt or sap off the ax head (figure 4.0.20). Any petroleum-based or citrus-based solvent, isopropyl alcohol, or cleaner works.

If you do not want to use a solvent, you can use a razor scraper, steel wool, or sandpaper.

When working in wet areas, dry off the ax at the end of the day before you put it away. If you are storing your ax in the woods at the end of the day, remove the sheath. Sheaths become wet in the field and hold moisture against the bit, thus causing rust to form overnight.

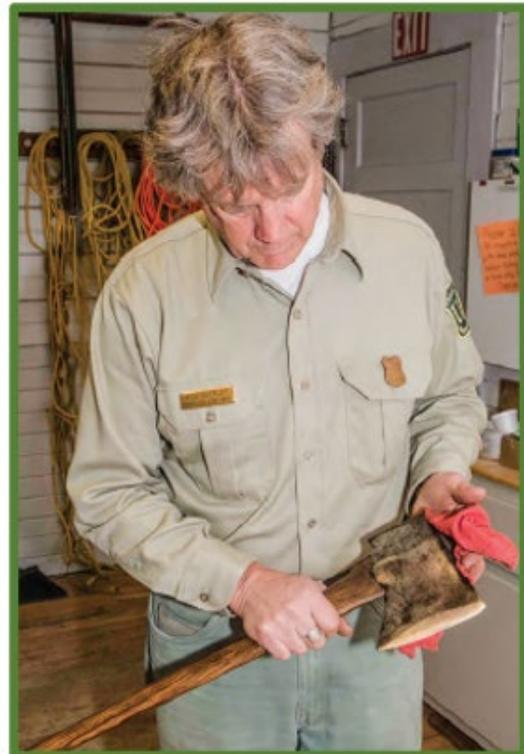
After cleaning an ax head, apply a light coat of oil to preserve the head and prevent rust.

Treat the handle with linseed oil as needed. An adage for applying linseed oil to a new ax handle is apply once a day for a week, once a week for a month, once a month for a year, and once a year forever.

For more in depth information on ax maintenance, refer to the publication [“One Moving Part: The Forest Service Ax Manual.”](#)



**Figure 4.0.19—Sharpen the cutting edge.**



**Figure 4.0.20—Clean off dirt and sap.**

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**Knowledge Check**

Why is it important to maintain a sharp ax?

What are the two basic swings?

Why is mastering both chopping methods important?

## Summary

In this module, you have learned to:

- Describe how an ax works.
- Identify the parts of an ax.
- Describe the importance of the 45-degree angle.
- Select appropriate PPE when using an ax.
- Describe a chopping plan.
- Demonstrate proper chopping techniques.
- Describe how to maintain an ax.

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