

Course	Agricultural Science II
Unit	Agricultural Mechanics II
Subunit	Tool Sharpening and Reconditioning
Lesson	Sharpening and Reconditioning a Twist Drill, Lawn Mower Blade, and Chain Saw Chain
Estimated Time	Four 50-minute blocks

Student Outcome

Identify the safety procedures for tool sharpening and reconditioning.
Dress a grinding wheel.
Sharpen a twist drill.
Sharpen a lawn mower blade.
Maintain a chain saw chain.




Learning Objectives






1. Identify safety procedures for using a bench grinder.
2. Identify some ways grinding wheels are classified.
3. Demonstrate the correct procedure for dressing a grinding wheel.
4. Explain some considerations for sharpening a twist drill.
5. Explain some considerations for sharpening a lawn mower blade.
6. Explain some considerations for maintaining a chain saw chain.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
 - ☐ PPt 1 – Dressing the Grinding Wheel Using a Mechanical Wheel Dresser
 - ☐ PPt 2 – Parts of a Twist Drill Cutting Tip
 - ☐ PPt 3 – Placement of the Drill for Sharpening
 - ☐ PPt 4 – Judging Lip Clearance
 - ☐ PPt 5 – Using a Gauge to Check the Shape and Clearance of a Twist Drill
 - ☐ PPt 6 – Filing a Lawn Mower Blade
 - ☐ PPt 7 – Parts of a Cutter
 - ☐ PPt 8 – Using the Depth Gauge Tool
 - ☐ PPt 9 – Proper Chain Tension
2. Activity Sheets
 -  AS 1 – Dressing a Grinding Wheel (Instructor)
 -  AS 1 – Dressing a Grinding Wheel (Student)
 -  AS 2 – Sharpening a Twist Drill (Instructor)

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-  AS 2 – Sharpening a Twist Drill (Student)
 -  AS 3 – Sharpening a Lawn Mower Blade (Instructor)
 -  AS 3 – Sharpening a Lawn Mower Blade (Student)
 -  AS 4 – Maintaining a Chain Saw Chain (Instructor)
 -  AS 4 – Maintaining a Chain Saw Chain (Student)
3. *Agricultural Mechanics Unit for Agricultural Science II* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2002.
 4. *Curriculum Enhancement for Agricultural Mechanics Unit for Agricultural Science II, “Unit IV – Tool Sharpening and Reconditioning.”* University of Missouri-Columbia: Instructional Materials Laboratory, 2004.
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Supplies & Equipment

- ☐ See AS 1 through AS 4 for materials and equipment needed to complete the Activity Sheets.
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Supplemental Information

1. Internet Sites
 - ☐ “Grinders – Bench, Floor, and Hand.” Environmental Health and Safety. University of Nebraska-Lincoln. Accessed October 17, 2007, from <http://ehs.unl.edu/sop/s-grinders.pdf>.
 - ☐ Maxwell, S. “Keeping Your Chainsaw Sharp.” *Mother Earth News*, no. 194 (October/November 2002). Accessed October 17, 2007, from <http://www.motherearthnews.com/DIY/2002-10-01/Keeping-Your-Chainsaw-Sharp.aspx>.
 2. Print
 - ☐ Cooper, E. *Agricultural Mechanics: Fundamentals and Applications*. 3rd ed. Albany, NY: Del Mar Publishers, 1997.
 - ☐ Phipps, L. *Mechanics in Agriculture*. 4th ed. Danville, IL: Interstate Publishers, 1992.
 - ☐ Phipps, L., and G. Miller. *Introduction to Agricultural Mechanics*. Upper Saddle River, NJ: Prentice Hall Interstate, 2004.
 - ☐ Walker, J. *Modern Metalworking*. Tinley Park, IL: The Goodheart-Willcox Company, Inc., 2000.
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Interest Approach

Safety procedures for using a bench grinder were discussed in *Agricultural Mechanics Unit of Agricultural Science I*, Unit I Lesson 2. Basic procedures for sharpening and reconditioning common hand tools were discussed in *Agricultural Mechanics Unit for Agricultural Science I*, Unit IV. As a review of this material, ask what tools are commonly used for sharpening and reconditioning and what safety procedures should be observed when using a bench grinder.

Communicate the Learning Objectives

1. Identify safety procedures for using a bench grinder.
2. Identify some ways grinding wheels are classified.
3. Demonstrate the correct procedure for dressing a grinding wheel.
4. Explain some considerations for sharpening a twist drill.
5. Explain some considerations for sharpening a lawn mower blade.
6. Explain some considerations for maintaining a chain saw chain.








Instructor Directions	Content Outline
Objective 1 <i>Introduce the lesson by discussing safety procedures for use of a bench grinder. Some of this material was covered in Agricultural Mechanics Unit for Agricultural Science II, Unit I Lesson 2; some additional points have been added for this lesson. The instructor should include any other relevant safety considerations as well.</i>	Identify safety procedures for using a bench grinder. Wear protective clothing. A face shield and a leather apron are recommended when using the grinder. Wear any additional protective clothing, such as an appropriate filter or respirator, when recommended by the instructor. Disconnect the grinder from its power source before making any inspections or adjustments. Make sure all guards are in place before starting the grinder. Be sure the speed of the grinder does not exceed the operating speed of the wheel. Stand to the side of the wheel when starting the grinder and let the wheel run before using. Wheels that are going to break generally do so within the first minute of use. Move the work slowly back and forth across the face of the wheel to avoid overheating the workpiece or wearing grooves in the wheel. Do not force the workpiece into the grinding wheel. Allow the speed and grit of the wheel to do the work.





Instructor Directions	Content Outline
	<p>Inspect wheels frequently.</p> <ol style="list-style-type: none"> 1. Wheels should be reconditioned to restore their abrasive work surface and bring them back into round. This is called dressing. Students should receive proper instruction and permission before dressing the wheel. 2. Frequent, light dressings are preferable to occasional heavy dressings. 3. Replace wheels that are too worn to be dressed. 4. Replace wheels that have been damaged or dropped.
<p>Objective 2</p> <p><i>It is important to choose the right grinding wheel for the job. Discuss ways in which grinding wheels are classified.</i></p>	<p>Identify some ways grinding wheels are classified.</p> <p>Type of abrasive material – Wheels can be made of natural stone, such as Arkansas stone, or manmade material, such as those made from silicon carbide or aluminum oxide.</p> <p>Grit – Grit is the word used to describe the small abrasive cutting particles. Grit is also a system for classifying abrasives. As the grit number of a grinding wheel increases, the abrasives become finer.</p> <p>Grade – Grade is a system for rating the hardness of grinding wheels, with the letter “A” being the softest and the letter “Z” the hardest. Medium-hard wheels are commonly used for tool sharpening.</p> <p>Bond – Bond refers to the way in which the abrasive particles are held together. Vitrified bonding is the most common process and is generally preferred over other types. With vitrified bonding, a silica agent and the abrasive particles are pressed into a mold and heated until the silica agent melts and becomes glass. The mixture is allowed to cool and harden and retains the shape of the mold when it is removed.</p> <p>Dimensions – Wheels can also be identified by their outside diameter and width.</p>

Instructor Directions	Content Outline
<p>Objective 3</p> <p><i>Wheels require periodic reconditioning to restore their abrasive work surface and bring them back into round. This process is called dressing. Because wheels are dressed on the grinder, students must be able to safely and correctly operate the type of grinder being used before dressing a grinding wheel or performing the activities at the end of this lesson. Basic procedures for using the bench grinder for sharpening and reconditioning hand tools were discussed in Agricultural Mechanics Unit for Agricultural Science I, Unit IV. Review that and any other material on using the grinder as needed. Discuss the correct procedure for dressing a grinding wheel. Refer to PPt 1.</i></p> <p>☐ PPt 1 – Dressing the Grinding Wheel Using a Mechanical Wheel Dresser</p>	<p>Demonstrate the correct procedure for dressing a grinding wheel.</p> <p>Signs that a grinding wheel needs dressing</p> <ol style="list-style-type: none"> 1. The wheel is glazed (the abrasives become dull). 2. The wheel is loaded (the surface fills up with waste material). 3. The wheel is out of round. <p>Techniques for dressing a grinding wheel</p> <ol style="list-style-type: none"> 1. Follow the same safety and use guidelines as those for other procedures using the grinding wheel. 2. Use a mechanical wheel dresser or other appropriate dressing tool. 3. If heavy sparking occurs, increase pressure on the dresser. Excessive sparking indicates that the dresser is being ground away. 4. After dressing the wheel, turn off the grinder, disconnect it from the power source, and examine the wheel. It should be perfectly round and the face should be square with the sides. The grit should be sharp and free of waste particles. 5. If the tool rest was moved for the dressing procedure, readjust it so that it is 1/16 in. from the wheel.
<p>Objective 4</p> <p><i>Like other cutting tools, a twist drill bit is safest and most efficient when it is sharp. Discuss the correct procedure for sharpening a twist drill. General information is listed below; supplement with more detailed procedural information as needed. Refer to PPts 2-5.</i></p> <p>☐ PPt 2 – Parts of a Twist Drill Cutting Tip</p>	<p>Explain some considerations for sharpening a twist drill.</p> <p>Some materials will dull drills faster than others. A drill that is only used on wood can remain sharp for a long time, but a drill that is used on metal becomes dull quickly.</p> <p>Before sharpening a drill, check to see that it is straight.</p> <ol style="list-style-type: none"> 1. If the drill is not straight, try straightening it. 2. If it cannot be straightened, discard it. Bent drills will wobble and make oversize holes. <p>Follow all assigned safety and use guidelines for using the grinding wheel.</p>

Instructor Directions	Content Outline
<p>☐ PPt 3 – Placement of the Drill for Sharpening</p> <p>☐ PPt 4 – Judging Lip Clearance</p> <p>☐ PPt 5 – Using a Gauge to Check the Shape and Clearance of a Twist Drill</p>	<p>Knowing the parts of a twist drill makes it easier to understand the sharpening procedure. The parts of a twist drill cutting tip are listed below.</p> <ol style="list-style-type: none"> 1. Dead center 2. Cutting lips 3. Heels <p>On a properly sharpened twist drill, dead center is at the exact center of the drill, and each cutting lip is at a 59-degree angle to the centerline of the drill.</p> <p>From dead center to the heel, the cutting lips drop slightly to give the bit clearance and provide support so the cutting lips do not break. On a properly sharpened bit, the angle formed between dead center and the heel is 12 degrees for each cutting lip.</p> <p>Use a tool gauge to check the twist drill.</p> <ol style="list-style-type: none"> 1. The correct angle for the cutting lip is 118 degrees. This angle is formed by the cutting lip and the outside edge of the drill. 2. Clearance can be checked by turning the drill slightly and measuring the gap made by the drop to the heel. For a 1-in. drill, there should be approximately a 1/8-in. gap between the drill and the corner of the tool gauge. <p>Proper clearance can also be checked by looking at the drill end on. With the cutting lip held horizontally, the lines of the cutting lip and dead center should make an angle of about 135 degrees. An angle greater than 135 degrees indicates too much clearance; an angle less than 135 degrees indicates that there is not enough clearance.</p>
<p>Objective 5</p> <p><i>Discuss the correct procedure for sharpening a lawn mower blade. General information is listed below; supplement with more detailed information as needed. Refer to PPt 6.</i></p>	<p>Explain some considerations for sharpening a lawn mower blade.</p> <p>Sharpen mower blades frequently. A sharp blade needs less power, produces better looking results, and does less damage to plants.</p> <p>Follow basic safety guidelines.</p>

Instructor Directions	Content Outline
<p>☐ PPt 6 – Filing a Lawn Mower Blade</p>	<ol style="list-style-type: none"> 1. Before making any adjustments or repairs to the mower, disconnect the spark plug wire and secure it away from the spark plug. Disconnect electric mowers from their power source. 2. Wear gloves when removing or installing the blade to protect hands from scrapes and cuts. 3. Follow all assigned safety and use procedures if using a grinding wheel to sharpen the blade. Wear safety goggles or face shield and any other protective clothing recommended by the instructor. 4. Wear safety goggles and leather gloves for any filing work. 5. Follow the manufacturer's and instructor's guidelines for correct sharpening procedure. <p>Sharpen the blade back to its original angle. If the angle is not known, sharpen the blade to a 45-degree angle.</p> <p>Keep one side of the mower blade flat and the other side ground to a cutting edge.</p> <p>Keep the mower blade in balance.</p> <ol style="list-style-type: none"> 1. A blade that is out of balance will cause the mower to vibrate, which can damage the shaft, bearing, and body of the mower. 2. Take an equal amount of metal off both ends of the blade to keep the blade in balance. Even if only one end of the blade is nicked, both ends should still be sharpened the same amount until the nick is removed. 3. Check the balance of the blade by using a blade balancer or by centering the blade hole over a thin horizontal edge. The blade should sit perfectly level.
<p>Objective 6</p> <p><i>Discuss the correct procedure for maintaining a chain saw chain. General information is listed below; supplement with more detailed information as needed. When discussion of these study questions is completed, AS 1-4</i></p>	<p>Explain some considerations for maintaining a chain saw chain.</p> <p>A properly sharpened chain has numerous advantages.</p> <ol style="list-style-type: none"> 1. Cuts more wood faster than a dull chain 2. Reduces operator fatigue 3. Increases work site safety 4. Reduces wear on the chain and saw

Instructor Directions	Content Outline
<p><i>can be used. The student versions of these activities can be assigned to evaluate student competency. Refer to PPTs 7-9.</i></p> <ul style="list-style-type: none">  PPT 7 – Parts of a Cutter  PPT 8 – Using the Depth Gauge Tool  PPT 9 – Proper Chain Tension  AS 1 – Dressing a Grinding Wheel  AS 2 – Sharpening a Twist Drill  AS 3 – Sharpening a Lawn Mower Blade  AS 4 – Maintaining a Chain Saw Chain 	<p>The saw will give indications when the chain needs sharpening.</p> <ol style="list-style-type: none"> 1. Chain tends to “walk” sideways while cutting 2. Cut produces fine powdery shavings instead of chips 3. Cuts take longer to make and require pressing on the saw 4. Wood gives off a burning smell during cutting <p>Parts of a chain saw cutter</p> <ol style="list-style-type: none"> 1. Top plate 2. Side plate 3. Cutting edge 4. Gullet 5. Depth gauge 6. Rivet hole 7. Toe 8. Heel <p>Follow basic safety guidelines when making any repairs or adjustments.</p> <ol style="list-style-type: none"> 1. Before making any adjustments or repairs to the saw, disconnect the spark plug wire and secure it away from the spark plug. Disconnect an electric chain saw from its power source. 2. Wear leather gloves when working with the blade to protect hands from the cutters. 3. Wear goggles and leather gloves when filing. 4. Follow manufacturer’s and instructor’s guidelines for correct work procedure. <p>Use the correct equipment.</p> <ol style="list-style-type: none"> 1. The basic tools for sharpening a chain saw chain are a round file and a file guide. 2. Chains differ in the design of their teeth and depth gauges. Be sure to use only manufacturer-recommended sharpening equipment in order to maintain the correct angles, shape, and proportions of the cutters. <p>Adjust depth gauges as needed.</p> <ol style="list-style-type: none"> 1. The depth gauges control the thickness of the chips the cutters make.

Instructor Directions	Content Outline
	<ol style="list-style-type: none"> 2. Depth gauges should be checked every three or four sharpenings. Do this by using the depth gauge tool recommended by the manufacturer. 3. If the tops of the depth gauges extend above the gauge tool, the part above the tool should be filed off using a flat file. 4. The original shape of the depth gauges should be maintained. <p>Check chain tension frequently and adjust as needed.</p> <ol style="list-style-type: none"> 1. A chain that is too loose or too tight can cause increased wear or damage to the saw. 2. Improper chain tension can be a safety hazard. <ol style="list-style-type: none"> a. A chain that is too tight has a tendency to bind, which can lead to an accident. b. A chain that is too loose has a tendency to kick back or come off the bar. <ul style="list-style-type: none"> - Tension the chain when it is cold. - Follow manufacturer's and instructor's guidelines for correct procedure. - A properly adjusted chain moves freely but does not hang loose from the bar.
<p>Application:</p> <ul style="list-style-type: none">  AS 1 – Dressing a Grinding Wheel  AS 2 – Sharpening a Twist Drill  AS 3 – Sharpening a Lawn Mower Blade  AS 4 – Maintaining a Chain Saw Chain 	<p>AS 1 – AS 4 Results will vary.</p>
<p>Closure/Summary</p>	<p>As with all cutting tools, twist drill bits, lawn more blades, and saw chains work best when sharp and in good condition. Use a well-conditioned bench grinder to sharpen drill bits. A twist drill should be straight or it should be discarded. Use a portable grinder or file to</p>

Instructor Directions	Content Outline
	<p>sharpen a lawn mower blade. Lawn mower blades should be sharpened frequently. Sharpen the blade to its original angle, keeping one side flat, and ensure blade is balanced. When sharpening saw chains, use the manufacture-recommended file and file guide. Adjust depth gauges as needed and check chain tension frequently. Employ proper safety guidelines when executing these procedures.</p>
<p>Evaluation: Quiz</p>	<p>Answers:</p> <ol style="list-style-type: none"> 1. a 2. c 3. c 4. b 5. d 6. a 7. c 8. b 9. d 10. a 11. The purpose of dressing is to restore the effectiveness of a wheel that is out of round, loaded, or glazed. 12. Students should list three of the following: <ol style="list-style-type: none"> a. Abrasive material – type of natural or synthetic abrasive material b. Grit – small abrasive cutting particles in the material c. Grade – system of rating the hardness of grinding wheels d. Bond – way the abrasive particles are held together e. Dimensions – outside diameter and width of wheel 13. Students should list the following: <ol style="list-style-type: none"> a. Dead center b. Cutting lips c. Heels 14. Gloves are recommended to help prevent cuts and scrapes. 15. An improperly balanced lawn mower blade will cause the mower to vibrate and in turn damage the shaft, bearing, and body of the mower.

Instructor Directions	Content Outline
	<ol style="list-style-type: none"> 16. Students should list three of the following: <ol style="list-style-type: none"> a. The chain tends to walk sideways while cutting. b. The cut produces fine powdery shavings instead of chips. c. The cut takes longer to make. d. More pressure is required to make the cut. e. The cut produces a smell of burned wood. 17. A loose chain saw chain has a tendency to kick back or jump off the bar, which can endanger the operator. A loose chain can also cause increased wear on parts of the saw.