

Course	Agricultural Science II
Unit	Agricultural Mechanics II
Subunit	Common Power Tools
Lesson	Safe Use and Maintenance of Power Tools for Metalworking
Estimated Time	Three 50-minute blocks

Student Outcome

Analyze the uses and safety procedures of common power tools used in metalworking.


Learning Objectives

1. Identify basic procedures for shop safety.
2. Identify common sources of power for metalworking tools.
3. Identify some safeguards for the use of power tools.
4. List the uses and safeguards for a portable drill.
5. List the uses and safeguards for a portable power nibbler.
6. List the uses and safeguards for a cold circular cutoff saw.
7. List the uses and safeguards for a portable grinder.
8. List the uses and safeguards for a bench grinder.
9. List the uses and safeguards for a sheet metal brake.
10. List the uses and safeguards for a drill press.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
 - ☐ PPt 1 – Basic Procedures for Shop Safety
 - ☐ PPt 2 – Portable Drill
 - ☐ PPt 3 – Using a Nibbler to Make an Interior Cut
 - ☐ PPt 4 – Cold Circular Cutoff Saw
 - ☐ PPt 5 – Portable Grinder
 - ☐ PPt 6 – Bench Grinder
 - ☐ PPt 7 – Sheet Metal Brake
 - ☐ PPt 8 – Drill Press
2. Activity Sheet
 -  AS 1 – Safety and Maintenance Procedures for Power Tools for Metalworking
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 I – Common Power Tools."* University of Missouri-Columbia: Instructional Materials Laboratory, 2004.

Supplemental Information

1. Internet Sites

- ❑ Drill Presses. OSH Answers. Canadian Centre for Occupational Health and Safety. Accessed October 1, 2007, from http://www.ccohs.ca/oshanswers/safety_haz/metalworking/drillpresses.html.
- ❑ Fabricating and Metalworking. Accessed September 12, 2007, from <http://www.fandmmag.com/>.
- ❑ Hand and Power Tools. Occupational Safety and Health Administration. U. S. Department of Labor. Accessed September 12, 2007, from <http://www.osha.gov/SLTC/handpowertools/index.html>.
- ❑ Safety Information. Power Tool Institute, Inc. Accessed September 12, 2007, from <http://www.powertoolinstitute.com/safety.html>.

2. Print

- ❑ Burkybile, C., D. Johnson, J. Lee, and C. Shelhamer. *Agricultural Power and Technology*. Danville, IL: Interstate Publishers, 2005.
- ❑ 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.

3. Electronic Media


- ❑ Smartflix offers a line of videos related to metalworking that can be rented from their Web site. Accessed September 12, 2007, from <http://smartflix.com/store/category/115/Metalworking>.
 - ❑ The Power Tool Institute offers a line of free videos on safety that can be found at <http://www.powertoolinstitute.com/education.html>. Accessed September 12, 2007.
-

Interest Approach

1. Have students discuss the advantages of using power tools for metalworking. What tools would be used for certain jobs and why? What are the reasons for choosing a specific tool for a particular job?
2. Have students discuss safety measures for the use of power tools and why safety precautions are important. What could be the consequences of unsafe use of power tools?

Communicate the Learning Objectives

1. Identify basic procedures for shop safety.
2. Identify common sources of power for metalworking tools.
3. Identify some safeguards for the use of power tools.
4. List the uses and safeguards for a portable drill.
5. List the uses and safeguards for a portable power nibbler.
6. List the uses and safeguards for a cold circular cutoff saw.
7. List the uses and safeguards for a portable grinder.
8. List the uses and safeguards for a bench grinder.
9. List the uses and safeguards for a sheet metal brake.
10. List the uses and safeguards for a drill press.

Instructor Directions	Content Outline
<p>Objective 1</p> <p><i>The list of basic shop safety procedures that appears in the previous lesson is repeated here in case the lessons are not presented in sequence. Refer to PPT 1.</i></p> <p> PPT 1 – Basic Procedures for Shop Safety</p>	<p>Identify basic procedures for shop safety.</p> <p>Adhere to instructions from the following sources.</p> <ol style="list-style-type: none">1. Labels and warnings on containers and tools2. The manufacturer's recommendations for use and maintenance of specific power tools3. Signs posted in the work area4. Directions given by the instructor <p>Wear safety glasses in the shop at all times.</p> <p>Wear protective gear such as gloves, earplugs, and safety shoes if appropriate.</p> <p>Do not wear loose-fitting clothing that could get caught in a moving part.</p> <p>Secure long hair to avoid getting it caught.</p> <p>Keep work areas clean and free of clutter.</p>


Instructor Directions	Content Outline
	<p>Check each tool before using it to make sure it is working properly.</p> <p>Tell the instructor about any damaged tool.</p> <p>Do not use a tool that does not function properly.</p> <p>Return each tool to its proper storage place.</p>
<p>Objective 2</p> <p><i>Electricity and compressed air are common power sources for metalworking tools. In addition to the general safety precautions listed above, there are safety considerations specific to electric and air-driven (pneumatic) tools. These are discussed below.</i></p>	<p>Identify common sources of power for metalworking tools.</p> <ol style="list-style-type: none"> 1. Electricity, including battery packs 2. Compressed air (pneumatic tools)
<p>Objective 3</p>	<p>Identify some safeguards for the use of power tools.</p> <p>Safety precautions for electric tools and battery-powered tools</p> <ol style="list-style-type: none"> 1. Always unplug a tool or disconnect it from its battery before inspecting it and making adjustments. 2. Only use a tool that is double insulated or has a grounded plug. 3. Always plug a tool into a power source with a ground-fault circuit interrupter (GFCI or GFI), which will shut off the electricity if a short occurs. If GFCIs are not installed, portable GFCIs can be plugged into grounded outlets. 4. Do not stand on wet ground or a wet surface while operating an electric tool. 5. Make sure stationary power tools are securely anchored to the floor. 6. Make sure all guards and shields are in place and vents are free of debris before operating an electric tool. 7. Do not bend the power cord sharply or use the cord to pull the plug from the outlet or carry the tool. Such actions could break the cord, and a broken cord is an electrical hazard.


Instructor Directions	Content Outline
	<ol style="list-style-type: none"> 8. Use only the battery specified by the manufacturer for the tool being used. 9. Use only the type of recharger designed for the batteries being used. 10. Always store battery packs safely so that no metal can come in contact with the terminals. This can short-circuit the battery and cause sparks, fire, or burns. <p>Safety precautions for pneumatic tools</p> <ol style="list-style-type: none"> 1. Disconnect pneumatic tools for all inspections and adjustments. 2. Do not join or separate quick-disconnect couplings on high-pressure lines when bystanders are nearby. 3. Do not use compressed air for cleanup if the air pressure is 30 lb per sq in. (psi) or greater. 4. Do not point an air stream at anyone. High-pressure air can drive dust into the eyes, damage eardrums, and cause other types of injury. 5. Inspect couplings and air lines regularly for evidence of wear or damage. 6. Make sure air tanks and air lines are free of moisture and appropriate filters are in place. 7. Follow the manufacturer's recommendations for hose size and maximum air pressure. 8. Oil pneumatic tools regularly according to manufacturer recommendations.
<p>Objective 4</p> <p><i>Refer to PPt 2 or display the actual tool when explaining the main parts and features. Discuss safety and maintenance considerations.</i></p> <p><input type="checkbox"/> PPt 2 – Portable Drill</p>	<p>List the uses and safeguards for a portable drill.</p> <p>Main parts</p> <ol style="list-style-type: none"> 1. On/off switch 2. Power cord 3. Handle 4. Chuck 5. Chuck key <p>Uses</p> <ol style="list-style-type: none"> 1. Drilling and boring 2. Driving and removing screws 3. Sanding 4. Polishing 5. Powering hole saws



Instructor Directions	Content Outline
	<p>Additional features</p> <ol style="list-style-type: none"> 1. Available in different sizes 2. Size of drill determined by the chuck capacity (e.g., a 1/4-in. drill holds a drill bit with a shank no larger than 1/4 in.) 3. Single or variable speed 4. Reversible 5. Different kinds of drill bits for different types of jobs 6. Drill bits commonly made of carbon steel, high-speed steel, and cemented carbide <ol style="list-style-type: none"> a. Carbon steel - not as strong as high-speed steel and cemented carbide b. High-speed steel - stronger than carbon steel; withstands higher speeds and lasts for a longer period c. Cemented carbide - outlasts carbon steel and high-speed steel and withstands higher speeds <p>Safety considerations</p> <ol style="list-style-type: none"> 1. Choose the right bit for the job. 2. Make sure the bit is tightly seated in the chuck, securing it by turning the chuck key in each hole. Remove the key before starting the drill. 3. Make sure the work is held securely in place. Use a clamp or vise to hold small work. 4. Use a center punch to mark the location of the hole. The indentation made with the center punch helps guide the bit. 5. Hold the drill perpendicular to the metal to avoid binding the bit. 6. Remove the bit from the drill when the work is completed. <p>Maintenance considerations</p> <ol style="list-style-type: none"> 1. Follow the manufacturer's instructions for regular lubrication of parts. 2. Sharpen or replace dulled bits.
<p>Objective 5</p> <p><i>Refer to PPt 3 or display the actual tool when explaining the main parts and features. Discuss</i></p>	<p>List the uses and safeguards for a portable power nibbler.</p> <p>Main parts</p> <ol style="list-style-type: none"> 1. On/off switch 2. Gear cover


Instructor Directions	Content Outline
<p><i>safety and maintenance considerations.</i></p> <p>☐ PPT 3 – Using a Nibbler to Make an Interior Cut</p>	<ol style="list-style-type: none"> 3. Punch 4. Die 5. Die holder <p>Uses</p> <ol style="list-style-type: none"> 1. Straight cuts 2. Curved cuts 3. Interior cuts 4. Cuts on thin metal that is bent or formed <p>Additional features</p> <ol style="list-style-type: none"> 1. Nibblers do similar work to hand shears or snips 2. Designed so cuttings are ejected down and away from operator <p>Safety considerations</p> <ol style="list-style-type: none"> 1. Wear eye protection. 2. Wear gloves when handling metal with sharp, cut edges. 3. Do not use compressed air or the hands to remove metal chips and cuttings. <p>Maintenance considerations</p> <ol style="list-style-type: none"> 1. Make sure chip-ejection hole is clear of debris. 2. Follow the manufacturer's recommendations for regular service.
<p>Objective 6</p> <p><i>Refer to PPT 4 or display the actual tool when explaining the main parts and features. Discuss safety and maintenance considerations.</i></p> <p>☐ PPT 4 – Cold Circular Cutoff Saw</p>	<p>List the uses and safeguards for a cold circular cutoff saw.</p> <p>Main parts</p> <ol style="list-style-type: none"> 1. On/off switch 2. Table 3. Blade 4. Guard 5. Handle 6. Motor 7. Fence <p>Uses</p> <ol style="list-style-type: none"> 1. Straight cuts 2. Miter cuts

Instructor Directions	Content Outline
	<p>Additional features</p> <ol style="list-style-type: none"> 1. Features similar to a circular saw or table saw used in woodworking 2. Used for making accurate cuts on soft or unhardened metals <p>Safety considerations</p> <ol style="list-style-type: none"> 1. Wear eye protection. 2. Wear heavy gloves to protect the hands from cuts. 3. Do not use compressed air or your hand to remove metal chips and cuttings. <p>Maintenance considerations</p> <ol style="list-style-type: none"> 1. Follow the manufacturer's recommendations for regular service. 2. Clean, sharpen, or replace blades when they become dull.
<p>Objective 7</p> <p><i>Refer to PPT 5 or display actual tool when explaining the main parts and features. Discuss safety and maintenance considerations.</i></p> <p><input type="checkbox"/> PPT 5 – Portable Grinder</p>	<p>List the uses and safeguards for a portable grinder.</p> <p>Main parts</p> <ol style="list-style-type: none"> 1. On/off switch 2. Grinding wheel 3. Safety guard 4. Handle 5. Power cord <p>Uses</p> <ol style="list-style-type: none"> 1. Grinding 2. Shaping 3. Cleaning 4. Sanding (some models) <p>Additional features</p> <ol style="list-style-type: none"> 1. Lightweight 2. Grinding wheels available in different abrasives and different grits (coarseness) for different jobs 3. Flexible sanding discs can be used with some grinders for sanding wood and metal 4. Can be used with a wire brush for removing rust <p>Safety considerations</p> <ol style="list-style-type: none"> 1. Wear appropriate eye and face protection.

Instructor Directions	Content Outline
	<ol style="list-style-type: none"> 2. Wear additional protective clothing, such as a dust mask or respirator, if needed. 3. Choose the right wheel or disc for the job. It should be rated to turn at speeds higher than the machine will produce. 4. Secure small pieces in a clamp or vise. 5. Examine the work area to identify areas where sparks might fall and make sure there is no fire hazard. Do not grind metal near combustibles. <p>Maintenance considerations</p> <ol style="list-style-type: none"> 1. Inspect grinding wheels regularly. Do not use wheels that are damaged or out of round. 2. Do not use wheels that are less than half of their original diameter. 3. Remove the wheel or disc after use. 4. Store the grinder and accessories in their proper place.
<p>Objective 8</p> <p><i>Refer to PPt 6 or display actual tool when explaining the main parts and features. Discuss safety and maintenance considerations.</i></p> <p> PPt 6 – Bench Grinder</p>	<p>List the uses and safeguards for a bench grinder.</p> <p>Main parts</p> <ol style="list-style-type: none"> 1. On/off switch 2. Grinding wheels 3. Safety shields 4. Adjustable tool rest <p>Uses</p> <ol style="list-style-type: none"> 1. Sharpening and reconditioning tools 2. Shaping metal 3. Cleaning metal surfaces <p>Additional features</p> <ol style="list-style-type: none"> 1. Stationary, mounted on a bench; pedestal grinder is similar to bench grinder but is larger and mounted on the floor 2. Double-shafted motor, allowing a wheel to be mounted on each side 3. One wheel usually coarser, for removing material quickly; other wheel usually finer, for finishing work <p>Safety considerations</p> <ol style="list-style-type: none"> 1. Wear appropriate face and eye protection.

Instructor Directions	Content Outline
	<ol style="list-style-type: none"> 2. Wear additional protective clothing, such as a leather apron or an appropriate filter or respirator, if needed. 3. Adjust the tool rest. 4. Stand to the side of the wheel when starting the grinder and let the wheel run for a short period before using it. Wheels that are going to break generally do so within the first minute of use. 5. Move the work slowly back and forth across the face of the wheel to avoid overheating the metal. 6. Do not force work into the grinding wheel. Allow the speed and grit of the wheel to do the work. <p>Maintenance considerations</p> <ol style="list-style-type: none"> 1. Do not use the wheel to grind soft metals, such as copper and aluminum. They quickly clog the grinding wheel. For soft metals, use an abrasive belt grinder instead. 2. Inspect wheels frequently. Replace wheels that have been damaged or dropped or are too worn to be reconditioned. 3. Wheels should be reconditioned to restore their abrasive work surface and bring them back into round. This is called dressing. Receive proper instruction and permission before dressing a wheel.
<p>Objective 9</p> <p><i>Refer to PPt 7 or display the actual tool to explain the main parts and features of a sheet metal brake. Discuss safety and maintenance considerations.</i></p> <p> PPt 7 – Sheet Metal Brake</p>	<p>List the uses and safeguards for a sheet metal brake.</p> <p>Main parts</p> <ol style="list-style-type: none"> 1. Radius adjustment bolts 2. Bending lever 3. Elevation levers 4. Shoes <p>Uses</p> <ol style="list-style-type: none"> 1. Angle bends 2. Radius bends 3. Seaming 4. Flattening 5. Punching

Instructor Directions	Content Outline
	<p>Additional features</p> <ol style="list-style-type: none"> 1. Hand-operated brakes available in different sizes, from small bench-mounted models to industrial-size machines 2. Brake can exert thousands of pounds of pressure <p>Safety considerations</p> <ol style="list-style-type: none"> 1. Keep fingers clear of the working mechanism. 2. Leave bending machines closed when not in use. <p>Maintenance considerations</p> <ol style="list-style-type: none"> 1. Follow the manufacturer's recommendations for regular service.
<p>Objective 10</p> <p><i>Refer to PPt 8 or display actual tool when explaining main parts and features. Discuss safety and maintenance considerations. Have students complete AS 1 to answer questions about safety and maintenance in the shop.</i></p> <p> PPt 8 - Drill Press</p> <p> AS 1 - Safety and Maintenance Procedures for Power Tools for Metalworking</p>	<p>List the uses and safeguards for a drill press.</p> <p>Main parts</p> <ol style="list-style-type: none"> 1. On/off switch 2. Column 3. Table clamp 4. Hand-feed lever 5. Chuck 6. Table 7. Base <p>Uses</p> <ol style="list-style-type: none"> 1. Drilling 2. Boring 3. Countersinking <p>Additional features</p> <ol style="list-style-type: none"> 1. Performs functions similar to portable drill but capable of heavier work; useful when more precision is needed 2. Size determined by doubling the distance from front edge of the column to the center of the drill bit 3. Available in bench and floor models <p>Safety considerations</p> <ol style="list-style-type: none"> 1. Secure stock before beginning to drill. Clamp piece on the left side of the table to keep it from rotating. 2. Use a center punch to mark and start the hole when drilling in metal.

Instructor Directions	Content Outline
	<ol style="list-style-type: none"> 3. Choose the right bit for the material and the drill - straight-shank bits should be used with geared chucks and taper-shank bits with taper chucks. 4. Make sure the table is properly aligned before turning on the drill press to avoid drilling into the table. 5. Reduce pressure as drill breaks through the work. <p>Maintenance considerations</p> <ol style="list-style-type: none"> 1. Inspect bits regularly. Sharp bits cut better and are less likely to break. 2. Follow the manufacturer's recommendations for regular care. Light grease on the spindle spline provides lubrication and reduces noise.
<p>Application:</p> <p> AS 1 – Safety and Maintenance Procedures for Power Tools for Metalworking</p>	<p>Answers to AS 1 Answers will vary.</p> <p>Other activities</p> <ol style="list-style-type: none"> 1. Show students a video on shop safety. Topics could include general shop safety or particular safety considerations for the equipment in the shop. 2. Accompany or follow the lesson with instructor demonstrations of each tool students will be using and procedures they will be expected to perform. Discuss any specific safety features relevant to the tools and machines in the shop that were not covered in the lesson outline above, and supplement the lesson with discussion of any equipment not covered. Begin or end demonstrations by having students review major parts of the tool and basic use and safety considerations.
<p>Closure/Summary</p>	<p>Power tools can shorten the time it takes to complete metalworking jobs, but they must be used safely to prevent injuries. Using these tools safely requires choosing the right tool for the job, knowing how the tool works, and making the correct tool adjustments. Safe use also requires regular maintenance to be sure the tool is working properly.</p>

Instructor Directions	Content Outline
Evaluation: Quiz	Answers: 1. c 2. b 3. a 4. c 5. c 6. b 7. c 8. a 9. d 10. b