

Course	Agricultural Science II
Unit	Agricultural Mechanics II
Subunit	Painting and Finishing
Lesson	Spray Painting and Finishing
Estimated Time	Three 50-minute blocks
Student Outcome	

Identify the safety procedures for spray painting and finishing.
 Demonstrate the procedures for spray painting and finishing.
 Maintain spray painting and finishing equipment.

Learning Objectives

1. Explain the safety procedures which should be followed when spray painting.
2. Describe what types of spray equipment are available.
3. Identify the major parts of a typical air spray gun.
4. Explain how surfaces are prepared for painting.
5. Describe primer and paint and some considerations for choosing them.
6. Explain the general procedures that should be followed when using spray equipment.
7. Identify some common problems that occur when spray painting.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
 - ☐ PPt 1 – Types of Spray Systems
 - ☐ PPt 2 – Parts of a Spray Gun
 - ☐ PPt 3 – Spray Patterns
 - ☐ PPt 4 – Positioning the Spray Gun
 - ☐ PPt 5 – Spray-Painting Technique
 - ☐ PPt 6 – Spray Painting a Panel
 - ☐ PPt 7 – Special Spray-Painting Techniques
2. Activity Sheets
 - ☐ AS 1 – Spray Painting (Instructor)
 - ☐ AS 1 – Spray Painting (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 VII – Painting and Finishing."* University of Missouri-Columbia: Instructional Materials Laboratory, 2004.

Supplies & Equipment

- ☐ See AS 1 for materials and equipment needed to complete the Activity Sheet.

Supplemental Information

1. Internet Sites

- ❑ Spray Operation Standards. Occupational Safety and Health Administration. U. S. Department of Labor. Accessed October 26, 2007, from <http://www.osha.gov/SLTC/sprayoperations/standards.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.
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Interest Approach

Safety with paints and solvents was covered in *Agricultural Mechanics Unit for Agricultural Science I*, Unit VII Lesson 1. Safety with compressed air was discussed in Unit 1, Lessons 1 and 2 of this curriculum. As a review of this material, ask students what safety procedures should be followed when working with paint and compressed air.

Communicate the Learning Objectives

1. Explain the safety procedures which should be followed when spray painting.
2. Describe what types of spray equipment are available.
3. Identify the major parts of a typical air spray gun.
4. Explain how surfaces are prepared for painting.
5. Describe primer and paint and some considerations for choosing them.
6. Explain the general procedures that should be followed when using spray equipment.
7. Identify some common problems that occur when spray painting.

Instructor Directions	Content Outline
Objective 1 <i>Introduce the lesson by discussing safety procedures that should be observed when working with spray equipment and finishes. Much of this information is a review of material presented in Agricultural Mechanics Unit for Agricultural Science I, Unit VII Lesson 1.</i>	Explain the safety procedures which should be followed when spray painting. Wear appropriate protective clothing and gear. <ol style="list-style-type: none">1. Safety glasses or goggles to protect the eyes from splattered paints and solvents2. Approved respirator for all spray painting procedures and for surface preparation that produces dust or toxic fumes3. Rubber gloves for handling bleaches, solvents, or other caustic materials Work in a well-ventilated area. Supplement natural ventilation with forced ventilation if needed. Keep sparks, flames, and devices that can produce them out of the work area. Have an approved fire extinguisher readily available. Follow safety procedures for all equipment and materials used in preparation or for painting. This includes equipment such as steam cleaners, sanders, and ladders, as well as spray equipment, paints, and solvents. Do not point a spray gun, particularly an airless spray gun, at any part of the body or at anyone else. <ol style="list-style-type: none">1. Liquid is propelled from the airless spray gun with

Instructor Directions	Content Outline
	<p>enough pressure to penetrate the skin. If this happens, get medical attention immediately.</p> <ol style="list-style-type: none"> 2. Even when the pump is shut off, an airless spray system remains under pressure until the pressure is discharged through the spray gun. <p>Observe safe cleanup procedures.</p> <ol style="list-style-type: none"> 1. Clean spills as they happen. 2. Use the appropriate solvent or cleaning solution. 3. Store chemicals in approved containers and flammable finishes and solutions in a fireproof cabinet. 4. Dispose of cleanup rags properly. 5. Wash hands after working with chemicals that are toxic or could harm skin.
<p>Objective 2</p> <p><i>Discuss different types of spray equipment. This discussion can be used to give students an overview of some of the systems available and also as an introduction to the type of equipment they will be using in the shop. Shop equipment can be used as a reference point for comparing and contrasting the various systems, if desired. Refer to PPT 1.</i></p> <p>☐ PPT 1 – Types of Spray Systems</p>	<p>Describe what types of spray equipment are available.</p> <p>Two basic types of spray equipment: air spray and airless</p> <ol style="list-style-type: none"> 1. Air spray <ol style="list-style-type: none"> a. Compressed air and finish are mixed and propelled from the spray gun as a fine mist. b. Air spraying produces a high-quality finish and can be used with most finishes, including stain, sealer, and topcoat. c. Because of the large quantities of air mixed with the finish, the air spray system is not as efficient at transferring the finish as the airless spray system is. More paint can be lost to overspray and by bouncing off the surface being painted. 2. Airless spray <ol style="list-style-type: none"> a. A high-pressure fluid pump is used to deliver finish to the nozzle of the spray gun, where it is broken into small droplets. b. Airless spray is generally more efficient than air spraying, and finish can be applied faster and in heavier coats. c. The airless sprayer does not break up the coating material as finely as the air sprayer does, which means it may produce a lower quality finish.


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<p>Objective 3</p> <p>☐ PPt 2 – Parts of a Spray Gun</p>	<p>Identify the major parts of a typical air spray gun.</p> <p>Trigger – controls the flow of finish or air and finish through the spray gun</p> <p>Air valve – controlled by the trigger</p> <ol style="list-style-type: none"> 1. By pulling the trigger halfway, air flows through the spray gun. 2. The trigger is pulled back the rest of the way to begin applying finish. <p>Fluid adjustment screw – controls the amount of the finish flowing through the spray gun</p> <p>Spreader adjustment valve – used to set the spray pattern by controlling airflow through the wing ports</p> <p>Air cap – directs compressed air into the stream of finish to break it up into the desired spray pattern; done by three sets of holes, or ports, in the cap</p> <p>Wing ports – holes in the wings of the air cap; amount of air flowing through the wing ports determines the pattern of the spray</p> <p>Fluid tube – carries finish from the cup to the body of the spray gun</p> <p>Fluid tube screen – keeps any lumps or foreign material from entering the spray gun</p>
<p>Objective 4</p> <p><i>Surfaces must be properly prepared before finishes are applied. Discuss surface preparation of metal and wood.</i></p>	<p>Explain how surfaces are prepared for painting.</p> <p>Metal</p> <ol style="list-style-type: none"> 1. Clean any welds by using a chipping hammer and wire brush. 2. Remove surface dirt and grease with a steam cleaner, high-pressure washer, or approved cleaning solution. Do not use gasoline. 3. Remove loose paint and rust and smooth any pitted areas by wire brushing, hand or power sanding, or a combination of techniques. 4. Strip off the old finish if a smooth surface is desired. If the finish is not badly damaged, feather the edges


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	<p>of chipped areas using sandpaper. (Feathering means tapering the uneven areas of a surface until no roughness or edges can be felt.)</p> <ol style="list-style-type: none"> 5. Clean surfaces with a preparatory solvent. 6. Use masking tape to cover any areas that should not be painted. 7. Apply an appropriate primer coat. <p>Wood</p> <ol style="list-style-type: none"> 1. Remove surface dirt and grease using approved cleaning solutions. 2. Apply a sealer to new stock to keep out moisture, which can warp or rot the wood. 3. Remove or repair surface marks, such as mill marks and dents. 4. Remove old paint using paint stripper, a wire brush, or sandpaper. 5. Repair defects and fill holes with caulk or wood filler, as needed. Seal areas requiring filler before filler is applied. Dry wood can pull moisture from the filler, which will cause it to shrink, become loose, and crack the paint. 6. Remove excess glue from surfaces to be painted, if glue has been used for repairs. 7. Sand using fine-grit sandpaper if a smooth finish is desired. 8. Clean surfaces with a tack rag. (A tack rag is a cloth that has been chemically treated so that it will pick up dust and grit.) 9. Use masking tape to cover any areas that should not be painted. 10. Apply an appropriate primer coat.
<p>Objective 5</p> <p><i>Discuss the factors below that influence the choice of a particular primer and finish. The discussion could be expanded by asking students what factors they would consider when choosing a finish or by giving examples of common</i></p>	<p>Describe primer and paint and some considerations for choosing them.</p> <p>Definitions of primer and paint</p> <ol style="list-style-type: none"> 1. Primer – undercoating that prepares the surface for painting <ol style="list-style-type: none"> a. Less surface absorption of paint b. Improves the surface’s ability to hold paint c. Improves the paint’s ability to adhere to the surface

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<p><i>painting jobs and asking students what paint they would use for the job and why.</i></p>	<p>2. Paint – finish that is made up of a vehicle (usually oil- or water-based) that carries a pigment (the substance that adds color to the paint)</p> <p>Considerations for selecting a primer and paint</p> <ol style="list-style-type: none"> 1. Intended use <ol style="list-style-type: none"> a. Indoor or outdoor use b. Need for resistance to water, acids, solvents, or other agents 2. Compatibility <ol style="list-style-type: none"> a. Paint and primer should be designed to work together. b. Both should be appropriate for the surface being finished. 3. Drying time <ol style="list-style-type: none"> a. Time needed between applying a primer and a finish coat or between coats of finish varies greatly, depending on the formulation of the individual coating. b. Other factors, such as temperature, can also affect drying time. 4. Type of finish desired <ol style="list-style-type: none"> a. Flat b. Satin c. Semigloss d. High gloss
<p>Objective 6</p> <p><i>Discuss the basic techniques for spray painting. Supplement with more detailed procedural information as needed. Refer to PPTs 3-7.</i></p> <p><input type="checkbox"/> PPT 3 – Spray Patterns</p> <p><input type="checkbox"/> PPT 4 – Positioning the Spray Gun</p> <p><input type="checkbox"/> PPT 5 – Spray-Painting Technique</p>	<p>Explain the general procedures that should be followed when using spray equipment.</p> <p>Protect against overspray.</p> <ol style="list-style-type: none"> 1. Droplets of paint can float for long distances, settle where they are not wanted, and ruin good finishes. 2. Items that could be damaged by overspray should be removed from the work area. <p>Prepare the finish.</p> <ol style="list-style-type: none"> 1. Mix the finish thoroughly. 2. If multiple cans of the same color are to be used, mix them all together to ensure that the color will be uniform when it is applied. 3. Thin the finish, if needed, using an appropriate thinner.

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<p>☐ PPt 6 – Spray Painting a Panel</p> <p>☐ PPt 7 – Special Spray-Painting Techniques</p>	<ol style="list-style-type: none"> a. Finish must have the correct viscosity (tendency to flow) for work being done. b. Follow the manufacturer's instructions for the correct ratio of finish to thinner; results can be checked using a viscosimeter. <p>4. Strain the finish. This is done to remove any lumps or debris in the finish.</p> <p>Adjust the spray gun.</p> <ol style="list-style-type: none"> 1. Set up the equipment. Follow all assigned procedures for safe and correct use of the equipment. 2. Test the spray pattern. <ol style="list-style-type: none"> a. Hold the spray gun the correct distance from a piece of paper, cardboard, or scrap material and briefly press the trigger. b. For air spray systems, the correct distance is approximately 8 in. 3. Make any corrections to the spray pattern, if needed. <ol style="list-style-type: none"> a. Normal spray pattern - If the pattern is normal, the equipment is ready for use. b. Split spray pattern <ul style="list-style-type: none"> - This pattern is usually caused by the air pressure being too high or by trying to get too wide a spray with thin material. - To correct, reduce the air pressure or open the fluid adjustment screw slightly and close the spreader adjustment valve slightly. - Recheck the spray pattern and adjust until the correct pattern is reached. c. Fan spray pattern <ul style="list-style-type: none"> - A top- or bottom-heavy pattern is generally caused by dried material around the nozzle blocking airflow. - To correct, remove the air nozzle and clean the fluid tip using a rag and appropriate thinner. - This pattern can also be caused by a loose air nozzle or a bent fluid nozzle or needle tip. - To correct, tighten the air nozzle or replace the fluid nozzle or needle tip, if needed. d. Crescent spray pattern <ul style="list-style-type: none"> - A pattern that is heavy on one side is caused by dried material blocking airflow through a wing port.

Instructor Directions	Content Outline
	<p data-bbox="781 218 1474 296">- To correct, clean the port using thinner. Do not use metal tools to clean nozzle openings.</p> <p data-bbox="662 338 902 369">Paint the surface.</p> <ol data-bbox="662 380 1481 1797" style="list-style-type: none"> 1. Hold the spray gun the correct distance from the work at a 90-degree angle. 2. Tipping the spray gun up or down results in an uneven finish. 3. Move the spray gun parallel to the surface being painted. Moving the gun in an arcing motion results in thin spots at the points where the gun is far away from the work and thick spots where it is close to it. 4. Paint edges and corners first. 5. For flat areas, use the following techniques. <ol data-bbox="716 772 1481 1440" style="list-style-type: none"> a. Make the first pass at the top of the panel, moving left to right. b. Aim the spray gun so that the middle of the spray pattern is at the top edge of the panel. c. Start each pass at a point 2 to 3 in. outside the panel. d. While the gun is in motion, pull the trigger and move across the panel at a constant rate of speed. e. Release the trigger while the gun is still moving. Starting and stopping the paint flow while the gun is in motion prevents an excessive buildup of paint where passes overlap. f. Move down and make the second pass, moving from right to left. This pass should overlap the previous one by 50%. g. Continue painting, alternating left and right passes, until the panel is completed. 6. Special techniques for some surfaces <ol data-bbox="716 1486 1481 1797" style="list-style-type: none"> a. Use a vertical spray pattern for thin vertical pieces. b. Paint inside corners as though they were two flat surfaces. c. Use a banding technique to paint narrow edges. d. Use a horizontal spray pattern to paint outside corners. Aim the gun so that the middle of the spray pattern is at the edge of the corner. <p data-bbox="662 1839 951 1871">Clean the spray gun.</p> <ol data-bbox="662 1881 1352 1913" style="list-style-type: none"> 1. Empty the paint cup. Store the material in an

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	<p>appropriate, labeled, sealed container, or dispose of it properly.</p> <ol style="list-style-type: none"> Follow the manufacturer's recommendations and instructor's directions for correct cleaning procedure for the equipment used. Use the appropriate cleaning solution for the material that was sprayed. Use cleaning solution to clean any dried material from the air cap. Do not use wires or other metal objects to clean orifices on the paint gun. Dry all parts and reassemble the spray gun. If the sprayer has been used to spray water-based material, such as latex paint, run mineral spirits through the gun to remove any moisture and keep the gun from rusting. Dispose of all clean-up materials safely and properly. Return all materials and equipment to their proper places.
<p>Objective 7</p> <p><i>If painters are able to recognize common finishing problems, they can avoid making the same mistakes and better protect their buildings and equipment. Some common finishing problems are discussed below. Examples of these or other finishing problems can be shown to students to illustrate or expand on this question. When discussion of these study questions is completed, AS 1 should be used. The student version of this activity should be assigned to evaluate student competency.</i></p> <p> AS 1 – Spray Painting</p>	<p>Identify some common problems that occur when spray painting.</p> <p>Runs and sags</p> <ol style="list-style-type: none"> Possible causes <ol style="list-style-type: none"> Finish applied too heavy Gun operated too close to surface Finish mixed too thin Fluid pressure too high Speed of operation too slow Corrective actions <ol style="list-style-type: none"> Learn to calculate depth of wet finish. Operate spray gun farther from work. Add enough finish to produce the correct viscosity. Use fluid control knob to reduce fluid pressure. Increase speed of operation. <p>Streaks</p> <ol style="list-style-type: none"> Possible causes <ol style="list-style-type: none"> Gun operated too far from surface Passes not overlapped properly Air pressure too high Speed of operation too fast

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	<p>2. Corrective actions</p> <ol style="list-style-type: none"> Operate gun closer to surface. Follow previous pass more accurately. Reduce air pressure. Decrease speed of operation. <p>Orange peel</p> <ol style="list-style-type: none"> Possible causes <ol style="list-style-type: none"> Finish not properly thinned Overspray striking tacky finish Pressure too high or too low Corrective actions <ol style="list-style-type: none"> Add enough thinner to produce correct viscosity. Adjust spraying sequence or procedure. Adjust pressure as needed. <p>Rust</p> <ol style="list-style-type: none"> Possible cause – poor surface preparation Corrective action – remove finish and rust, treat with an appropriate primer coat, and refinish.
<p>Application:</p> <p> AS 1 – Spray Painting</p>	<p>AS 1 Results will vary.</p> <p>Other activities</p> <ol style="list-style-type: none"> Ask an auto collision repair specialist or other professional spray painter to give a presentation to the class about spray painting. Areas that could be covered include safety procedures, setting up equipment, preparing surfaces and finishing materials, techniques for applying spray paint, and methods for avoiding common painting defects. Have students prepare questions for the presenter before the visit.
<p>Closure/Summary</p>	<p>Proper surface preparation is critical for good painting results, whether working with metal or wood surfaces. Selecting the appropriate primer (an undercoat) and paint (a finish made up of a vehicle and a pigment) depends on such factors as intended use, compatibility, drying time, and desired finish. Steps in the spray-painting process include protecting against overspray, preparing the</p>

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	<p>finish, adjusting the spray gun, painting the surface, and cleaning the spray gun. Recognize and avoid common problems such as runs and sags, streaks, orange peel, and rust. Apply spray paint safely by wearing protective clothing, working in a well-ventilated area, avoiding sparks and flames, and following all safety procedures recommended by the manufacturer and instructor.</p>
<p>Evaluation: Quiz</p>	<p>Answers:</p> <ol style="list-style-type: none"> 1. c 2. d 3. a 4. d 5. c 6. b 7. a 8. c 9. d 10. b 11. a. Air spray equipment – uses compressed air b. Airless spray equipment – uses high pressure created by fluid pump 12. a. Trigger b. Air valve c. Fluid adjustment screw d. Spreader adjustment valve e. Air cap f. Wing ports g. Fluid tube h. Fluid tube screen 13. Student should list two of the following. a. Treats surface so less paint is absorbed b. Improves surface's ability to hold paint c. Improves paint's ability to adhere to the surface 14. Student should list two of the following. a. Intended use (e.g., inside or outdoors) b. Compatibility of primer and paint with each other and surface to be painted c. Drying time for primer and paint d. Type of finish desired (e.g., flat, satin, semigloss, and high gloss) 15. Student should list two of the following. a. Split spray pattern – This problem can be corrected by reducing the air pressure or opening

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	<p>the fluid adjustment screw slightly and closing the spreader adjustment valve slightly.</p> <ul style="list-style-type: none"> b. Fan spray pattern – This problem can be corrected by cleaning the nozzle and fluid tip with thinner, tightening the air nozzle, or replacing the fluid nozzle or needle tip. c. Crescent spray pattern – This problem can be corrected by cleaning the port with thinner. <p>16. Finishing material can dry in the equipment causing it to be inoperable.</p>