

Lesson 1.1 Equipment Systems

Preface

Agricultural technicians use a combination of technical reading, mechanical skills, and technology to maintain and repair agricultural equipment for planting, harvesting, storing, and processing agricultural goods. Employers expect technicians to recognize the importance of safety and apply employability to skills. By practicing safety and employability skills in the classroom, a student should improve their skills before moving into the workforce.

A technician must be familiar with the equipment used in their local area, as they vary across the United States because of the diverse production of agricultural commodities. Although agricultural equipment varies in size and purpose, they have similar drivetrains and safety equipment. Most equipment contains a driveshaft connected to power-take-off (PTO) via a universal joint (U-joint). The driveshaft powers a series of gears, chains, and belts found in the equipment. Technicians need to be aware of the powertrain's actions and motions to reduce the chance of injury.

Students begin the course by researching types of equipment used in agriculture. Next, students make their first entry in a *Logbook*. Then they practice using their logbook by assembling and disassembling a universal joint. Next, students identify the powertrain components in a combine. Students complete the lesson by identifying safety hazards found on agricultural equipment.

Concepts	Performance Objectives
<p><i>Students will know and understand</i></p> <ol style="list-style-type: none"> 1. Agricultural equipment relates to local agricultural activities. 2. Technicians document plans and processes when servicing equipment. 3. Power take-off (PTO) systems transfer power to agricultural implements. 4. Powertrain systems contain belts, chains, and gears to deliver power for work. 5. Guarding and shielding on agricultural equipment prevent injury to an operator. 	<p><i>Students will learn concepts by doing</i></p> <ul style="list-style-type: none"> • Identify and describe the equipment used in the area to harvest local crops. (Activity 1.1.1) • Organize notebooks to record coursework and projects. (Activity 1.1.2) • Practice recording assembly and disassembly procedures in a logbook. (Activity 1.1.2) • Disassemble and identify the components of a universal joint that connects to a power take-off. (Activity 1.1.3) • Identify types of belts, chains, and gears on a piece of equipment. (Activity 1.1.4) • Identify the safety hazards found in the internal motions of equipment. (Project 1.1.5)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
<p>2. Apply appropriate academic and technical skills.</p> <ul style="list-style-type: none"> • CRP.02.02: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.
<p>4. Communicate clearly, effectively and with reason.</p> <ul style="list-style-type: none"> • CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.

Agriculture, Food, and Natural Resources Career Cluster

3. Examine and summarize importance of health, safety, and environmental management systems in AFNR organizations.

- AG 3.1: Examine health risks associated with a particular skill to better form personnel safety guidelines.
- AG 3.6: Demonstrate methods to correct common hazards.
- AG.3.7: Demonstrate application of personal and group health and safety practices.

Power, Structural and Technical (AG-PST)

1. Apply physical science principles and engineering applications related to mechanical equipment, structures, and biological systems to solve problems and improve performance in AFNR power, structural, and technical systems.

- AG-PST 1.3: Investigate solutions to AFNR power, structural, and technical systems.

2. Operate and maintain mechanical equipment related to AFNR power, structural, and technical systems.

- AG-PST 2.3: Operate machinery and equipment while observing all safety precautions.

Next Generation Science Standards Alignment

Crosscutting Concepts

Cause and Effect: Mechanism and Prediction	Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
	<ul style="list-style-type: none"> • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. • Systems can be designed to cause a desired effect. • Changes in systems may have various causes that may not have equal effects.
Systems and System Models	A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.
	<ul style="list-style-type: none"> • Systems can be designed to do specific tasks. • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 11-12

Key Ideas and Details	<ul style="list-style-type: none"> • RST.11-12.3 – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Craft and Structure	<ul style="list-style-type: none"> • RST.11-12.4 – Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
Integration of Knowledge and Ideas	<ul style="list-style-type: none"> • RST.11-12.7 – Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. • RST.11-12.9 – Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Range of Reading and Level of Text Complexity	<ul style="list-style-type: none"> • RST.11-12.10 – By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 11-12

Production and Distribution of Writing	<ul style="list-style-type: none">• WHST.11-12.4 – Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.• WHST.11-12.6 – Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	<ul style="list-style-type: none">• WHST.11-12.7 – Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.• WHST.11-12.8 – Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.• WHST.11-12.9 – Draw evidence from informational texts to support analysis, reflection, and research.
Range of Writing	<ul style="list-style-type: none">• WHST.11-12.10 – Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. Which types of agricultural equipment do you find in your local area?
2. Which agricultural products are grown in your area?
3. What types of equipment do local producers use for growing their crops?
4. What is the purpose of a logbook?
5. How does a logbook keep a technician organized?
6. What information do you record in a logbook?
7. How is power transferred from a tractor to an implement?
8. What are the advantages and disadvantages of a universal joint?
9. How is power transferred within an implement?
10. Where are belts, chains, gears, and pulleys found?
11. What are the advantages and disadvantages of belts, chains, gears, and pulleys?
12. What are the essential components of all machines and equipment?
13. Where is the risk of injury greatest when working on equipment?
14. How is equipment designed to reduce the risk of injury?

Key Terms

Bearing

Bevel gear

Cross shaft

Drive pulley

Driven pulley

Bearing cup

Cam gear

Dial caliper

Driveshaft

Drivetrain

Bending

Combine

Drive gear

Driven gear

Flat-head screwdriver

Forage harvester	Gear	Guard
Grease seal	Grease zerk	Hay baler
Implement	In-running nip points	Logbook
Mower	Nonsynchronous drive	Operating controls
Planter	Point of operation	Power-take-off
Punching	Race	Retaining ring
Rotating	RPM	Shearing
Synchronous drive	Technician	Tillage
Timing belt	Torque	Torque wrench
Tractor	Transversing	Universal join(U-join)
V- belt	Yoke	

Day-to-Day Plans

Time: 10 days

Refer to the *Teacher Resources* section for specific information on teaching this lesson, in particular [Lesson 1.1 Teacher Notes](#), [Lesson 1.1 Glossary](#), [Lesson 1.1 Materials](#), and other support documents.

Day 1:

- Present [Concepts](#), [Performance Objectives](#), [Essential Questions](#), and [Key Terms](#) to provide a lesson overview.
- Provide students with a copy of [Activity 1.1.1 Local Equipment](#).
- Students complete *Activity 1.1.1 Local Equipment*.

Day 2:

- Provide students [Presentation Notes](#) pages to use throughout the presentation to record notes and reflections. Students add these pages to their *Agriscience Notebook*.
- Provide students with a copy of [Activity 1.1.2 Technical Records](#), [Agriscience Notebook Cover Page](#), [Agriscience Notebook Spine Template](#), [Agriscience Notebook Table of Contents](#), [SAE for All Checklist](#), [Logbook Guidelines](#), and the [Logbook Evaluation Rubric](#).
- Students complete Part Two of *Activity 1.1.2 Technical Records*.
- Provide students *Presentation Notes* pages to use throughout the presentation to record notes and reflections. Students add these pages to their *Agriscience Notebook*.
- Present PowerPoint® [Measurement Tools](#).

Day 4:

- Students work in pairs to complete *Activity 1.1.2 Technical Records*.
- Students read pages 610–615 of *Heavy Equipment Power Trains and Systems*.

Day 5:

- Provide students with a copy of [Activity 1.1.3 Universal Connections](#).
- Students work individually to complete Part One of *Activity 1.1.3 Universal Connections* by recording work in their logbook.

Day 6:

- Students work in pairs to complete *Activity 1.1.3 Universal Connections*.

Day 7:

- Present the PowerPoint® **Powertrain Components**.
- Provide students with a copy of **Activity 1.1.4 Combining Chains and Belts**.

Day 8:

- Students complete *Activity 1.1.4 Combining Chains and Belts*.

Day 9:

- Provide students with a copy of **Project 1.1.5 Safety Precautions, Equipment Safety Checklist, Project 1.1.5 Evaluation Rubric**.
- Students work individually to complete Part One of *Project 1.1.5 Safety Precautions*.
- Students work in pairs to start Part Two of *Project 1.1.5 Safety Precautions*.

Day 10:

- Students work in pairs to complete Part Two and Part Three of *Project 1.1.5 Safety Precautions*.

Day 11:

- Students work in pairs to present *Project 1.1.5 Safety Precautions*.
- Evaluate presentations using *Project 1.1.5 Evaluation Rubric*.

Day 12:

- Distribute **Lesson 1.1 Check for Understanding**.
- Students complete *Lesson 1.1 Check for Understanding* and submit for evaluation.
- Use **Lesson 1.1 Check for Understanding Key** to evaluate student assessments.

Instructional Resources

PowerPoint® Presentations

Measurement Tools

Powertrain Components

Student Support Documents

Lesson 1.1 Glossary

Presentation Notes

Activity 1.1.1 Local Equipment

Activity 1.1.2 Technical Records

Activity 1.1.3 Universal Connections

Activity 1.1.4 Combining Belts and Chains

Project 1.1.5 Safety Precautions

Teacher Resources

Lesson 1.1 Teacher Notes

Lesson 1.1 Materials

Lesson 1.1 Check for Understanding

Answer Keys and Assessment Rubrics

Lesson 1.1 Check for Understanding Answer Key

Project 1.1.5 Safety Precautions

Student Project Development Template

Equipment Safety Checklist

Reference Sources

- Belle, G., Felinski, D., Howe, S., Jordan, T., Norton, J., Sutton, M., Whitney, S. (n.d.). *Machine guarding etool*. Retrieved from www.osha.gov/SLTC/etools/machineguarding/intro.html
- Dell, Timothy W. (2019). *Heavy equipment power trains and system, 1st edition*. Tinely Park, IL: The Goodheart-Willcox Company, Inc.
- Herren, R. (2006). *Agricultural mechanics fundamentals and applications*. (5th ed.). Clifton Park, NY: Thomson Delmar Learning.
- Koel, L., & Mazur, G. A. (2013). *Agricultural technical systems and mechanics*. Orland Park, IL: American Technical Publishers.

FFA CONNECTIONS

Participation in the FFA provides students additional relevance and real-life experiences to apply the knowledge and skills learned in the classroom. FFA provides many opportunities for students to be engaged in leadership building activities.

Students can develop their Supervised Agricultural Experience (SAE) projects for proficiency awards related to specific course topics. The National FFA Organization suggests related proficiency award areas throughout the course.

Another FFA opportunity for students is the Agriscience Fair, where students propose, plan, conduct, and report research related to course topics. The lessons contain suggestions for potential research projects throughout the course.

The competitive activities offered with the following list of **Career Development Events** (CDEs) allow students to apply knowledge and skill while providing many opportunities for students to be active participants in exploring potential agricultural careers. Specific CDE connections are suggested throughout the course.

- Agricultural Sales
- Employment Skills
- Extemporaneous Public Speaking
- Marketing Plan
- Prepared Public Speaking

This lesson provides conceptual and procedural knowledge required for participation in the following FFA activities:

- Agricultural Proficiency
 -
- Agriscience Fair
 -
- Career Development Events
 -

For more information, visit the [National FFA Organization](http://www.ffa.org) website.

SAE for All

Supervised Agricultural Experience (SAE) activities are essential components of an effective agricultural education program. It is essential to understand how to assist students with developing and maintaining an SAE program.

Every lesson in *Technical Application in Agriculture* will provide students with examples of SAE Connections to enhance student opportunities for experiential learning beyond the classroom walls. SAE opportunities are essential for students to be involved with for several reasons. However, most importantly, an SAE project adds relevance to coursework.

Foundational SAE

All students in an agricultural education program are expected to have a Foundational SAE. Students completing the APP and extensions listed below will meet the Foundational SAE qualification for the Advanced (Grades 10-12) level. Students should record APP and extensions in their *Foundational SAE Log* and place all documented evidence in the *FFA/SAE* section of their *Agriscience Notebook* along with the *SAE for All Foundational Checklist*. Access teacher guides and student activities at the [SAE for All Educator Resources](#) site. Some extensions below may be assigned during this lesson but completed later during the course.

- Career Exploration and Planning
 -
- Employability Skills for College and Career Readiness
 -
- Personal Financial Management and Planning
 -
- Workplace Safety
 -
- Agricultural Literacy
 -

Immersion SAE

Students interested in this lesson's topics should explore the following related Immersion SAEs. An immersion SAE is optional and replaces the agricultural literacy component of the Foundational SAE.

- Ownership/Entrepreneurship
 -
- Placement/Internship
 -
- Research
 -
- Service Learning
 -
- School Based Enterprise
 -

For more information on the guiding principles for implementing SAE programs, visit the [SAE for All: Evolving Essentials](#) site.

Critical Thinking and Application Extensions

Explanation

1.

Interpretation

2.

Application

3.

Perspective

4.

Empathy

5.

Self-Knowledge

6.